

**PUNJAB TECHNICAL UNIVERSITY
KAPURTHALA**

**Scheme and Syllabus
of
B. Tech. Civil Engineering (CE)**

Batch 2011

**By
Board of Studies Civil Engineering**

Third Semester**Contact Hours: 33 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTAM-301	Engineering Mathematics-III*	4	1	-	40	60	100	5
BTCE-301	Fluid Mechanics-I	3	1	-	40	60	100	4
BTCE-302	Rock Mechanics & Engg .Geology	3	1	-	40	60	100	4
BTCE-303	Strength of Materials	3	2	-	40	60	100	5
BTCE-304	Surveying	3	1	-	40	60	100	4
BTCE-305	Building Materials & Construction	4	0	-	40	60	100	4
BTCE-306	Fluid Mechanics-I Lab	-	-	2	30	20	50	1
BTCE-307	Strength of Materials Lab	-	-	2	30	20	50	1
BTCE-308	Surveying Lab	-	-	3	30	20	50	2
BTCE-309	Workshop Training of 4 weeks duration after 2 nd semester Carpentry, Electrical, Plumbing, Masonry, CAD				30	20	50	1
Total		20	06	07	360	440	800	31

* This subject shall be taught by the faculty of Applied Science Department

Fourth Semester**Contact Hours: 30 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-401	Geomatics Engineering	3	1	-	40	60	100	4
BTCE-402	Construction Machinery & Works Management	3	1	-	40	60	100	4
BTCE-403	Design of Concrete Structures-I	4	1	-	40	60	100	5
BTCE-404	Fluid Mechanics-II	3	1	-	40	60	100	4
BTCE-405	Irrigation Engineering-I	3	1	-	40	60	100	4
BTCE-406	Structural Analysis-I	3	2	-	40	60	100	5
BTCE-407	Concrete Technology Lab	-	-	2	30	20	50	1
BTCE-408	Structural Analysis Lab	-	-	2	30	20	50	1
BTCE-409	General Fitness				100	-	100	
Total		19	07	04	400	400	800	28

Fifth Semester**Contact Hours: 30 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-501	Design of Steel Structures-I	4	1	-	40	60	100	5
BTCE-502	Geotechnical Engineering	4	1	-	40	60	100	5
BTCE-503	Structural Analysis-II	3	2	-	40	60	100	5
BTCE-504	Transportation Engineering-I	3	1	-	40	60	100	4
BTCE-505	Environmental Engineering –I	3	1	-	40	60	100	4
BTCE-506	Transportation Engineering Lab	-	-	2	30	20	50	1
BTCE-507	Geotechnical Engineering Lab	-	-	2	30	20	50	1
BTCE-508	Computer Aided Structural Drawing I	-	-	3	30	20	50	2
BTCE-509	Survey Camp of 04 weeks duration after 4 th Semester				100	50	150	2
Total		17	06	07	390	410	800	29

Sixth Semester

Contact Hours: 34 Hrs

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-601	Design of Concrete Structures-II	4	1	-	40	60	100	5
BTCE-602	Elements of Earthquake Engineering	3	2	-	40	60	100	5
BTCE-603	Foundation Engineering	4	1	-	40	60	100	5
BTCE-604	Numerical Methods in Civil Engineering	4	1	-	40	60	100	5
BTCE-605	Professional Practice	3	2	-	40	60	100	5
BTCE-606	Environment Engineering –II	3	1	-	40	60	100	4
BTCE-607	Environmental Engineering Lab	-	-	2	30	20	50	1
BTCE-608	Computer Aided Structural Drawing II	-	-	3	30	20	50	2
BTCE-609	General Fitness				100	-	100	
Total		21	08	5	400	400	800	32

Seventh / Eighth Semester

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-701	(a) Software Training*	-	-	-	150	100	250	10
	(a) Industrial Training				300	200	500	20
Total					450	300	750	30

***List of Software for Training to be learnt during Training Period**

Any software that enhances professional capability in civil engineering practice a partial indicative list is mentioned below:

1. GT STRUDAL
2. PRIMA VERA
3. GEOTECH
4. ARCVIEW GIS
5. GEO 5
6. GEO STUDIO PROF 2004
7. AUTOCAD CIVIL 3D
8. MX ROAD
9. GEOMATIC
10. STAAD PRO
11. HDM-4
12. PLAXIS
- 13 Any other relevant software

Seventh / Eighth Semester

Contact Hours: 31 Hrs

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCE-801	Design of Steel Structures-II	4	1	-	40	60	100	5
BTCE-802	Disaster Management	4	0	-	40	60	100	4
BTCE-803	Irrigation Engineering-II	3	1	-	40	60	100	4
BTCE-804	Transportation Engineering-II	3	1	-	40	60	100	4
BTCE-XXX	Elective –I *	3	1	-	40	60	100	4
BTCE-YYY	Elective –II *	3	1	-	40	60	100	4
BTCE-805	Project	-	-	6	100	50	150	3
General Fitness					100	-	100	
Total		20	05	06	440	410	850	28

* Elective I and Elective II should not be from the same group

List of Electives:

- **Structural Engineering**

- BTCE- 806 Dynamics of Structures
- BTCE- 807 Finite Element Methods
- BTCE- 808 Advanced Reinforced Concrete Design
- BTCE- 809 Pre-stressed Concrete

- **Geotechnical Engineering**

- BTCE- 810 Ground Improvement Techniques
- BTCE- 811 Soil Dynamics and Machine Foundation
- BTCE- 812 Earth and earth Retaining Structures
- BTCE- 813 Reinforced Earth and Geotextiles.

- **Environmental/ Irrigation Engineering**

- BTCE- 814 Environmental Impact Assessment
- BTCE- 815 Advanced Environmental Engineering
- BTCE- 816 Flood Control and River Engg.
- BTCE- 817 Hydrology and Dams

- **Infrastructure / Transportation Engineering**

- BTCE- 818 Pavement Design
- BTCE- 819 Traffic Engineering
- BTCE- 820 Bridge Engineering
- BTCE- 821 Infrastructure Development and Management

Third Semester

BTAM301 Engineering Mathematics-III

Unit I Fourier Series: Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.

Unit II Laplace Transforms: Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

Unit III Special Functions: Power series solution of differential equations, Frobenius method, Legendre's equation, Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, equations reducible to Bessel's equation.

Unit IV Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients.

Unit V Applications of PDEs: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation in Cartesian Coordinates, solution by the method of separation of variables.

Unit VI Functions of Complex Variable: Limits, continuity and derivative of the function of complex variable, Analytic function, Cauchy-Riemann equations, conjugate functions, harmonic functions; Conformal Mapping: Definition, standard transformations, translation, rotation, inversion, bilinear. Complex Integration: Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions (without proofs), singular points, poles, residue, Integration of function of complex variables using the method of residues.

Suggested Readings/ Books:

- Kreyszing, E., Advanced Engineering Mathematics, Eighth edition, John Wiley, New Delhi.
 - Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.
 - Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore, 1957.
 - Peter. V. O'Nil, Advanced Engineering Mathematics, Wadsworth Publishing Company.
 - Taneja, H. C., Engineering Mathematics, Volume-I & Volume-II, I. K. Publisher.
 - Babu Ram, Advance Engineering Mathematics, Pearson Education.
 - Bindra, J. S., Applied Mathematics, Volume-III, Kataria Publications.
 - Advanced Engineering Mathematics, O'Neil, Cengage Learning.
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BTCE301 Fluid Mechanics-I

Fluid and their properties : Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; Continuum concept of fluid: density, specific weight and relative density; viscosity and its dependence on temperature; surface tension and capillarity, vapor pressure and cavitation, compressibility and bulk modulus; Newtonian and non-Newtonian fluids.

Fluid Statics : Concept of pressure, Pascal's law and its engineering hydrostatic paradox. Action of fluid pressure on plane (horizontal, vertical and inclined) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure. Buoyancy and flotation, stability of floating and submerged bodies, Metacenter height and its determination.

Fluid Kinematics: Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal & tangential acceleration streamline, pathline and streakline, flow rate and discharge mean velocity continuity equation in Cartesian co-ordinates. Rotational flows- Rotational velocity and circulation, stream & velocity potential functions.

Fluid Dynamics :- Euler's equation, Bernoulli's equation and steady flow energy equation; representation of energy changes in fluid system, impulse momentum equation, kinetic energy and momentum correction factors, flow along a curved streamline, free and forced vortex motions.

Dimensional Analysis and Similitude: Fundamental and derived units and dimensions, dimensional homogeneity, Rayleigh's and Buckingham's Pi method for dimensional analysis, dimensionless number and their significance, geometric, kinematic and dynamic similarity, model studies.

Flow Past immersed bodies: Drag and lift deformation Drag and pressure drag. Drag on a sphere, cylinder and Airfoil: lift-Magnus Effect and circulation, lift on a circular cylinder.

Flow Measurement:- Manometers, Pitot tubes, venturimeter and orifice meters, orifices, mouth pieces, notches (**Rectangular and V-notches**) and weirs (**Sharp crested Weirs**).

Suggested Readings / Books:

- Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
 - Hydraulic and Fluid Mechanic by P.N.Modi & S.M.Seth
 - Engineering Fluid Mechanics by R.J.Garde & A.G.Mirajgaoker
 - Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman
 - Fluid Mechanics : Streetes VL & Wylie EB; Mcgraw Hill book company.
 - Fluid Mechanics by White
 - Introduction to Fluid Mechanics by Robert W.Fox & Alan T.McDonald
 - Fluid Mechanics by Potter, Cengage Learning
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BTCE302 Rock Mechanics & Engineering Geology

General Geology : Importance of Engg. Geology applied to Civil Engg. Practices. Weathering, definition, types and effect. Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition.

Rocks & Minerals : Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes. Rock quality designation (RQD).

Structural Geology: Brief idea about stratification, apparent dip, true dip, strike and in conformities. Folds, faults & joints : definition, classification relation to engineering operations.

Engineering Geology: Geological considerations in the Engg. Projects like tunnels, highways, foundation, dams, reservoirs. Earthquake : Definition, terminology, earthquake waves, intensity, recording of earthquake.

Engineering properties of rocks and laboratory measurement : Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature

In-situ determination of Engg. Properties of Rock masses : Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in situ stresses, bore hole test

Improvement in properties of Rock masses : Pressure grouting for dams and tunnels, rock reinforcement rock bolting.

Suggested Readings / Books:

- Introduction to Rock Mechanics : Richard E. Goodman.
 - Engg. Behaviour of rocks : Farmar, I.W.
 - Rock Mechanics and Engg. : Jaager C.
 - Fundamentals of Rock Mechanics : Jaager and Cook
 - Engineering Geology : D.S.Arora
 - Engineering Geology : Parbin Singh
 - Rock Mechanics for Engineering : B.P. Verma.
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BTCE 303 Strength of Material

Concept of Equilibrium: Load, reaction; General equilibrium equations; Equilibrium of a point in space; Equilibrium of a member; Concept of free body diagrams; Displacements; Concept of displacement-constraints/ supports; Statical-determinacy of a problem.

Simple Stress and Strains: Introduction; Concept of stress and strain; Stress-strain curves for ductile, brittle materials; Generalized Hooke's law, Stress-strain diagram of ductile and brittle material, statically determinate and indeterminate problems, compound and composite bars, thermal stresses. Elastic constants, relations between various elastic constants and its use;

Lateral strain, volumetric strain, Poisson's ratio; Stress and strains in thin cylinders, spherical shells; Thin vessels subjected to internal pressures.

Complex stress and strains: Introduction; Normal stress, tangential stress; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress; Concept of principal stress and its computation; Mohr circle; Principal strains, computation of principal stresses from the principal strains.

Shear force and Bending moment diagrams: Introduction to the concept of reaction diagrams—shear force and bending moment; Role of sign conventions; Types of load, beams, supports; Shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load, and moment; Relationship between load, shear force and bending moment; Different methods for plotting a bending moment and shear force diagrams.

Bending and Shear Stresses: Introduction; Assumptions and derivation of flexural formula for straight beams; Centroid of simple and built up section, second moment of area; Bending stress calculation for beams of simple and built up section, composite sections (flitched sections); Shear stress; Variation of bending and shear stress along the depth of section.

Columns and Struts: Stability of Columns; Buckling load of an axially loaded column with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.

Torsion of Circular shafts: Torsion, basic assumptions, derivation of torsion equation; Power transmitted by shafts; analysis and design of solid and Hollow shafts based on strength and stiffness; Sections under combined bending and torsion, equivalent bending and torsion.

Failure theories: Maximum principal stress theory, Maximum shear stress theory, Distortion Energy theory, Strain Energy theory, Constant

Suggested Readings / Books:

- Strength of Material by S. Ramamrutham
 - Mechanics of Material : E .Popov
 - Strength of Material : Rajput
 - Strength of Materials : Sadhu Singh
 - Strength of Materials by Gere, Cengage Learning
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BTCE304 Surveying

Introduction: Definition, principles of surveying, different types of surveys, topographical map, scale of map.

Chain and Compass Surveying: Measurement of distances with chain and tape, direct & indirect ranging, offsets, bearing and its measurement with prismatic compass, calculation of angles from bearings.

Plane Table Surveying: Setting up the plane table and methods of plane tabling.

Levelling & Contouring: Setting up a dumpy level, booking and reducing the levels by rise & fall method and height of instrument method, correction due to curvature and refraction, characteristics of contours, methods of contouring, uses of contour maps.

Theodolite Traversing: Temporary and permanent adjustments, measurement of horizontal and vertical angles, adjustment of closing error by Bowditch & Transit rules.

Tachometry: Definition, determination of tachometer constants and reduced level from tachometric observations.

Triangulation: Selection of stations and base line, corrections for base line, satellite station and reduction to centre.

Curves: Elements of a simple curve, different methods of setting out of simple circular curve.

Suggested Readings / Books:

- Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill (2006)
 - Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I and II, Laxmi Publications (2005)
 - Agor, R., Surveying, Khanna Publishers (1982)
 - Bhavikatti, S.S. Surveying & Levelling Volume I&II (2009)
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BTCE305 Building Material & Construction

Building Stones & Bricks: General, 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.

Cement: Composition of cement, Raw Materials, Manufacturing process, Varieties of cement, Hydration of cement, Properties, testing of cement.

Concrete : Introduction, Constituents of concrete, Batching of materials, Manufacturing process of cement concrete, workability and factors affecting it, Methods to determine workability, segregation and bleeding of concrete, Strength of concrete and factors affecting it.

Timber: Structure of a tree, classification of trees, Defects in timber, Qualities of good a timber, Seasoning of timber, Decay of timber, Preservation of timber

Miscellaneous materials: Paints, Distempering, Glass, Plastics.

Foundation and Walls : Definition, types of foundations, causes of failures of foundation and remedial measures, Types of walls and thickness considerations.

Brick and stone masonry: Terms used, Types of bonds & their merits and demerits, rubble and ashlar joints in stone masonry, cement concrete hollow blocks and their advantages and disadvantage.

Damp Proofing: Sources, causes and bad effects of dampness, preventive measures for dampness in buildings.

Roofs: Terms used, Classification of roofs and roof trusses, Different roof covering materials.

Plastering and pointing: Objects ,Methods of plastering , Materials and types, Defects in plastering, Special material for plastered surface, Distempering white washing and colour washing.

Floors: General ,Types of floors used in building & and their suitability, factors for selecting suitable floor for building.

Miscellaneous topics: Building Services – Plumbing service, Electrical services, Air conditioning, Accoustics and sound insulation, Fire protection measures, Lift

Suggested Readings / Books:

- Rangwala – Building materials
 - Bindra SP, Arora KR Building construction
 - Shetty MS , Concrete Technology
 - Punmia BC, Building construction
 - Singh, Parbin , Building materials
 - Sushil Kumar , Building Construction
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BTCE306 Fluid Mechanics Lab-I

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 pipe line flow with a pitot static probe.

Suggested Readings / Books:

- Practical Fluid Mechanics for Engineering Applications (Mechanical Engineering (Marcell Dekker) By John J. Bloomer
 - Fluid Mechanics Practical Manual by S.Sarabjit Singh.
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BTCE-307 Strength of Material Lab

List of experiments:

1. Draw Stress Strain curve for Ductile and Brittle material in tension.
2. Draw Stress Strain curve for Ductile and Brittle material in compression.
3. Draw shear stress, shear strain curve for ductile and brittle material in torsion strength testing
4. 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.
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BTCE-305 Surveying Lab

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.
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BTCE-309 Workshop Training

This will be held after 2nd Semester during Summer in the Institute Workshop for four weeks daily for 4 hrs. The students will be trained in the area of Carpentry, Electrical, Plumbing, Masonry and CAD work.

BTCE-401 Geomatics Engineering

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

3 1 0

1. Photogrammetry

Introduction, Basic Principles, Photo-Theodolite, Elevation of a Point by Photographic Measurement, Aerial Camera, Vertical Photograph, Tilted Photograph, Scale, Crab and Drift, Flight Planning for Aerial Photography, Ground Control for Photogrammetry, Photomaps and Mosaics, Stereoscopic Vision, Stereoscopic parallax, Stereoscopic Plotting Instruments, Applications.

2. Electromagnetic Distance Measurement (EDM)

Electromagnetic Waves, Carrier Waves, Black body radiation, Laws of radiation Modulation, Types of EDM Instruments, Electro-optical, Infrared, and Microwave EDM Instruments, Effect of Atmospheric Conditions, The Geodimeter, The Tellurometer, Wild Distomats, Electronic Total Station.

3. Remote Sensing

Introduction, Basic Principles, Electromagnetic (EM) Energy Spectrum, EM Radiations and the Atmosphere, Interaction of EM radiations with Earth's Surface, Types of remote sensing systems, Remote Sensing Observation Platforms, Satellites and their characteristics – Geostationary and sun-synchronous, Earth Resources Satellites, Meteorological satellites, Sensors, Types and their characteristics, Across track and Along track scanning, Applications of Remote Sensing.

4. Geographical Information System (GIS)

Definition, GIS Objectives, Hardware and software requirements for GIS, Components of GIS, Coordinate System and Projections in GIS, Data structure and formats, Spatial data models – Raster and Vector, Data inputting in GIS, Data base design - editing and topology creation in GIS, Linkage between spatial and non spatial data, Spatial data analysis – significance and type, Attribute Query, Spatial Query, Vector based spatial data analysis, Raster based spatial data analysis, Errors in GIS, Integration of RS and GIS data, Digital Elevation Model, Network Analysis in GIS, GIS Software Packages.

5. Global Positioning System (GPS)

Introduction, Fundamental concepts, GPS system elements and signals, GPS measurements and accuracy of GPS, Satellite Movement, GPS Satellites, Co-ordinate systems - Geoids, Ellipsoid and Datum, Spheroid, Customised Local Reference Ellipsoids, National Reference Systems, Worldwide Reference Ellipsoid, WGS 84, Differential-GPS, Classification of GPS receivers, GPS Applications.

Books Recommended:

1. Arora, K.R., 2007: Surveying Vol-III, Standard Book House.
2. Campbell, J.B.2002: Introduction to Remote Sensing. Taylor Publications.
3. Chang.T.K. 2002: Geographic Information Systems, Tata McGrawHill.
4. Heywood.I, Cornelius S, CrverSteve. 2003: An Introduction to Geographical Information Systems, Pearson Education.
5. Joseph George, 2003: Fundamentals of Remote Sensing. Universities Press.
6. Punmia, B.C., Jain A.K., 2005: Higher Surveying, Luxmi Publications
7. Sabbins, F.F., 1985: Remote Sensing Principles and Interpretation. W.H.Freeman and company.
8. Kaplan, E.D., Understanding GPS : Principles and Application; Artec House; 2 Edition

BTCE-402 CONSTRUCTION MACHINERY & WORKS MANAGEMENT

Internal Marks: 40

L T P

External Marks: 60

3 1 0

Total Marks: 100

1. INTRODUCTION :Need for project planning & management, time, activity & event, bar chart, Milestone chart, uses & draw backs.

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.

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.

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.

5. CONSTRUCTION EQUIPMENT AND MACHINERY :Tractors, bull dozers, rippers, scrappers, power shovels, 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: Hosts, Winches, Cranes, Belt conveyors, Ropeways, trucks & Wagons.

6. :Plants for grading, batching, mixing, types of mixers, concrete pumps, bitumen plants.

BOOKS RECOMMENDED:

Construction Planning and Equipment - R.L.Peurifoy - Tata McGraw Hill, New Delhi

PERT and CPM - L.S.Srinath, East West Press

Management Guide to PERT & CPM - Wiest & levy; Prentice Hall

Construction Equipment & Planning and Application. - Mahesh Verma Artec Publication.

Construction Planning and Management by U. K. Shrivastava; Galgotia Publications Pvt. Ltd.

BTCE-403 DESIGN OF CONCRETE STRUCTURES-I

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

4 1 0

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

Part A: CONCRETE TECHNOLOGY

1. **CEMENTS & ADMIXTURES:** Portland cement – chemical composition – Hydration, Setting of cement – Structure of hydrate cement – Test on physical properties – Different grades of cement – Admixtures – Mineral and chemical admixtures.
2. **AGGREGATES:** Classification of aggregate – Particle shape & texture – Bond, strength & other mechanical properties of aggregate – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand – Deleterious substance in aggregate – Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded aggregate – Maximum aggregate size.
3. **Properties of Concrete:** Workability – Factors affecting workability – Measurement of workability by different tests – Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete – Steps in manufacture of concrete – Quality of mixing water, Abram's Law, Factors affecting strength; Characteristics strength of concrete, Target strength, Modulus of elasticity, Modulus of rupture
4. **MIX DESIGN :** Factors in the choice of mix proportions – Durability of concrete – Quality Control of concrete – Statistical methods – Acceptance criteria – Proportioning of concrete mixes by various methods – BIS method of mix design.

Part B: DESIGN OF REINFORCED CONCRETE ELEMENTS

1. Objectives and Methods of Analysis and Design
2. Properties of Concrete and Steel
3. Design Philosophies of Working Stress Method and Limit State Method
4. Limit State of Collapse - Flexure
5. Computation of Parameters of Governing Equations
6. Determination of Neutral Axis Depth and Computation of Moment of Resistance
7. Numerical Problems on Singly Reinforced Rectangular Beams
8. Doubly Reinforced Beams – Theory and Problems
9. Flanged Beams – Theory and Numerical Problems
10. Shear, Bond, Anchorage, Development Length and Torsion
11. Reinforced Concrete Slabs: One and Two way Slabs

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- 404 Fluid Mechanics-II

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

L T P
3 1 0

1. Laminar Flow: Navier-stokes equations in Cartesian coordinates (no derivation), meaning of terms, Flow through circular section pipe, flow between parallel plates, stokes law. Flow through porous media,. Transition from laminar to turbulent, Critical velocity and critical Reynolds Number

2. Turbulent Flow: Turbulent flows and flow losses in pipes, Darcy equation minor head losses in pipe fittings, hydraulic and energy gradient lines. Definition of turbulence, scale and intensity, Effects of turbulent flow in pipes. Equation for velocity distribution in smooth and rough pipes (no derivation). Resistance diagram.

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.

4. Uniform flow in open Channels: Flow classifications, basic resistance Equation for open channel flow. Chezy, Manning, Bazin and Kutter formulae. Variation of roughness coefficient, conveyance and normal depth. Velocity Distribution. Most efficient flow sections; rectangular, trapezoidal and circular.

5. Energy and Momentum principles and critical flow: Energy and specific Energy in an open channel;critical depth for rectangular and trapezoidal channels. Alternate depths, applications of specific energy to transitions and Broads crested weirs. Momentum and specific force in open channel flow, sequent depths.

6. Gradually varied Flow: Different Equation of water surface profile; limitation, properties and classification of water and surface profiles with examples, computation of water surface profile by graphical, numerical and analytical approaches.

7. Hydraulic Jump and Surges: Theory of Jump, Elements of jump in a rectangular Channel, length and height of jump, location of jump, Energy dissipation and other uses, Positive and negative surges

Books:

5. Hydraulics & Fluid Mechanics by P.N.Modi and S.M.Seth; Standard Publication
6. Flow in Open Channels by S.Subraminayam; Tata MacGraw Hill
7. Introduction to Fluid Mechanics by Robert N.Fox & Alan T.Macnold
8. Fluid Mechanics : Dr. R.K. Bansal; Laxmi Publications
9. Fluid Mechanics : Dr. Jagdish Lal; Metropolitan Book Co. (p) Ltd.

BTCE-405 IRRIGATION ENGINEERING –I

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

3 1 0

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.

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. **CANAL IRRIGATION:**Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Silt theories-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.

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.

5. **LOSSES IN CANALS, WATER LOGGING AND DRAINAGE:**Losses in canals-Evaporation and seepage, water logging, causes and ill effects of water logging anti wter logging measures. Drainage of land, classification of drains - surface and subsurface drains, Design considerations for surface drains, Advantages and maintenance of tile drains.

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, planing of an irrigation project, Economics & financing of irrigation works. Documentation of project report.

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 tubewells, optimum capacity, Duty and delta of a tube well. Rehabilitation of tubewell.

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.

Books:-

Principles & practice of Irrigation Engg. S.K.Sharma; S. Chand, Limited.

Irrigation & Water Power Engg. B.C. Punmia, Pande B.B.Lal; Laxmi Publications (p) Ltd

Fundamentals of Irrigation Engg. Dr. Bharat Singh; Nem Chand & Bros

Irrigation Engg. & Hydraulic Structure S.R.Sahasrabudhe; S. K. Kataria & Sons

Irrigation Engg. & Hydraulic Structure Varshney, Gupta & Gupta; Nem Chand and Brothers

Irrigation Engg. & Hydraulic Structure Santosh Kumar Garg; Khanna Publishers

BTCE- 406 STRUCTURAL ANALYSIS- I

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

3 2 0

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

10. Geometric Methods: Double integration; Macaulay's method; Moment area method; Conjugate beam method.
11. 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.

Determinate Structures: Concept of determinacy; Analysis of determinate structural elements—truss, arch, beam, frame, cables; Internal forces in determinate structures; Reaction diagram-- Bending moment, shear force, radial shear, normal thrust diagrams for the determinant structures.

12. Analysis of plane trusses, compound and complex trusses using method of joints, method of joints, tension coefficients.
13. Analysis of three-hinged arch of various shapes under different loading conditions.
14. Analysis of simple portal frame, cables under different loading conditions.
15. Analysis of cables under point load and UDL with ends at same or different levels.

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 beams, girders with floor beams and frames; 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.

Analysis of Cables and Suspension Bridges: General cable theorem, shape, elastic stretch of cable, maximum tension in cable and back-stays, pressure on supporting towers, suspension bridges, three hinged stiffening girders.

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.

Book Recommended

- 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-407 CONCRETE TECHNOLOGY LAB

Internal Marks: 30
External Marks: 20
Total Marks: 50

L T P
0 0 2

List of experiments:

1. To Determine the Specific Gravity of 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 by Cube and Cylinder.
7. To carry out the Split Tensile and Flexural strength of Concrete.
8. Compressive strength of Brick and Tile as 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-408 Structural Analysis Lab

Internal Marks: 30

External Marks: 20

Total Marks: 50

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0 0 2

List of Experiments

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.

References:

A Laboratory Manual on Structural Mechanics by Dr. Harwinder Singh; New Academic Publishing Comp. Ltd.

Fifth Semester

BTCE 501 Design of Steel Structures – I

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

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3 2 0

Note: Relevant Indian Codes of Practice are permitted in Examination.

- 1. Introduction:** Properties of structural steel, I.S. rolled sections, I.S. specifications.
- 2. Connections:** Riveted, bolted and welded connections for axial and eccentric loads.
- 3. Tension members:** Design of members subjected to axial tension.
- 4. Compression members:** Design of axially loaded members, built-up columns, laced and battened columns including the design of lacing and battens.
- 5. Flexural members:** Design of laterally restrained and un-restrained rolled and built-up sections, encased beams.
- 6. Column bases:** Design of slab base, gusseted base and grillage foundation.
- 7. Roof truss:** Design loads, combination of loads, design of members (including purlins) and joints, detailed working drawings.

BOOKS & CODES RECOMMENDED:

- 1) Limit state design of steel structures: S K Duggal, Mc Graw Hill
- 2) Design of steel structures: N Subramanian Oxford Higher Education
- 3) Design of steel structures (Vol. 1): Ram Chandra Standard Book House - Rajsons
- 4) Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti / K International Publishing House
- 5) IS 800: 2007 (General construction in steel-Code of practice)*
- 6) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

* permitted in Examination

BTCE-502 Geotechnical Engineering

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

L T P
3 2 0

- 1. Basic Concepts:** Definition of soil and soil mechanics, common soil mechanics problems in Civil Engineering. Principal types of soils. Important properties of very fine soil. Characteristics of main Clay mineral groups. Weight volume relationship and determination of specific gravity from pycnometer test. Field density from sand replacement method and other methods.
- 2. Index Properties:** Grain size analysis. Stokes's law and Hydrometer analysis. Consistency and sensitivity of Clay, Atterberg Limits, Flow Index and Toughness Index. Underlying theory of shrinkage limit determination. Classification of coarse and fine grained soils as per Indian Standard.
- 3. Compaction:** Definition and object of compaction and concept of O.M.C. and zero Air Void Line. Modified proctor Test. Factors affecting compaction Effect of compaction on soil properties and their discussion. Field compaction methods- their comparison of performance and relative suitability. Field compactive effort, Field control of compaction by proctor.
- 4. Consolidation:** Definition and object of consolidation, Difference between compaction and consolidation. Concept of various consolidation characteristics i.e. a_v , m_v and c_v , primary and secondary consolidation. Terzaghi's Differential equation and its derivation. Boundary conditions for Terzaghi's solution for one dimensional consolidation concept of c_v , t_v & U . consolidation test determination of c_v from curve fitting methods, consolidation pressure determination. Normally consolidated and over consolidated clays. Causes of over-consolidation. Effect of disturbance on e - $\log \sigma$ curves of normally consolidated clays, importance of consolidation settlement in the design of structures.
- 5. Permeability and Seepage:** Concept of effective stress principal, seepage pressure, critical hydraulic gradient and quick sand condition. Capillary phenomenon in soil. Darcy's Law and its validity, seepage velocity, co-efficient of permeability (k) and its determination in the laboratory. Average permeability of stratified soil mass, factors affecting 'k' and brief discussion.
- 6. Shear Strength:** Stress analysis of a two dimensional stress system by Mohr circle. Concept of pole. Coulomb's law of shear strength coulomb - Mohr strength theory. Relation between principal stresses at failure. Direct, triaxial and unconfined shear strength tests. Triaxial shear tests based on drainage conditions typical strength envelopes for clay obtained from these tests. Derivation of skempton's pore pressure parameters. Stress strain and volume change characteristics of sands.
- 7. Stability of Slopes:** slope failure, base failure and toe failure - Swedish circle method - $\phi=0$ analysis and $c=0$ analysis - friction circle method - Taylor's stability number - stability charts - sliding block analysis

Books:-

1. Soil Mech. & Foundation Engg, by K.R.Arora Standard *Publishers* Distributors
2. Geotechnical Engineering, by P. Purshotama Raj *Tata Mcgraw Hill*
3. Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS *Publishers* & Distributors.
4. Principle of Geotechnical Engineering by B.M.Das Cengage Publisher
5. Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao New Age International Publishers
6. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
7. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers.

BTCE-503 Structural Analysis-II

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

L T P
3 2 0

Pre-requisite: 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; Solution of simultaneous algebraic equations.

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.

Influence Line Diagrams: Concept and application in the analysis of statically indeterminate structures; Influence line for bar forces in the statically indeterminate trusses, beams and frames.

RECOMMENDED 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
5. Structural Analysis, Devdas Menon, Narosa Publishers.

BTCE-504 Transportation Engineering – I

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

L T P
3 1 0

Highway Engineering

1. **Introduction:** Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport.
2. **Highway Development & Planning:** Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys.
3. **Highway Alignment:** Requirements, Alignment of Hill Roads, Engineering Surveys.
4. **Highway Geometric Design:** Cross Section Elements, Carriageway, Camber, Sight Distances, Horizontal Curves, Extra-widening, Super-elevation, Vertical Curves.
5. **Highway Materials:** Properties of Sub-grade and Pavement Component Materials, Tests on Sub-grade Soil, Aggregates and Bituminous Materials.
6. **Highway Construction:** Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements.
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.
8. **Highway Economics & Financing:** Total Transportation Cost, Economic Analysis, Sources of Highway Financing.

Traffic Engineering

9. **Traffic Characteristics:** Road User Characteristics, Driver Characteristics, Vehicular Characteristics.
10. **Traffic Studies:** Volume Studies, Speed Studies, O-D Survey, Parking Study.
11. **Traffic Safety and Control Measures:** Traffic Signs, Markings, Islands, Signals, Cause and Type of Accidents, Use of Intelligent Transport System.
12. **Traffic Environment Interaction:** Noise Pollution, Vehicular Emission, Pollution Mitigation Measures.

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-505 Environmental Engineering - I

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

L T P
3 1 0

- 1. Introduction:** Beneficial uses of water, water demand, per capita demand, variations in demand, water demand for fire fighting, population forecasting and water demand estimation.
- 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.
- 3. Pumps and pumping stations:** Types of pumps and their characteristics and efficiencies; Pump operating curves and selection of pumps; pumping stations.
- 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. 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 defluoridation, and water desalination and demineralization, taste and odour removal.
- 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.
- 7. Rural water supply:** Principles, selection of source, rain water harvesting, quantitative requirements, low cost treatment techniques.

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-506 Transportation Engineering Lab

Internal Marks: 30
External Marks: 20
Total Marks: 50

L T P
0 0 2

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

Books/Manuals Recommended :

1. Khanna S.K., and Justo, C.E.G. "Highway Material & Pavement Testing", Nem Chand and Brothers, Roorkee.

BTCE-507 Geotechnical Engineering Lab

Internal Marks: 30

External Marks: 20

Total Marks: 50

L T P

0 0 2

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 pycnometer method.
4. Grain size analysis of sand and determination of uniformity coefficient (C_u) and coefficient of curvature (C_c).
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. Triaxial Test
12. Swell Pressure Test

Books Recommended:-

Soil Testing Engineering, Manual By Shamsheer Prakash and P.K. Jain. Nem Chand & Brothers

BTCE-508 Computer Aided Structural Drawing

Internal Marks: 30

External Marks: 20

Total Marks: 50

L T P

0 0 3

- 1) Structural Drawings of Reinforced Concrete Elements such as Beams, Slabs.
- 2) Structural Drawings of Steel Elements such as Connections, Tension Members, Compression Members, Beams, Column Base, and Roof Trusses.

BTCE-509 Survey Camp

Internal Marks: 100

External Marks: 50

Total Marks: 150

Survey Camp of 4 weeks duration will be held immediately after IVth semester at a Hilly Terrain. The students are required to prepare the Topographical Map of the area by traditional method. Students should also be exposed to modern Survey Equipment and practices, like Total Station, Automatic Level, GPS etc.

Sixth Semester

BTCE-601 DESIGN OF CONCRETE STRUCTURES-II

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

L T P
4 1 0

Note: Relevant Indian Codes of Practice and Design handbooks are permitted (as per note mentioned below) in Examination.

1. Stairs : Types and Design of Stairs
2. Foundations - Theory and Design: Isolated Footing (Square, Rectangular), Combined Footing(Rectangular, Trapezoidal, Strap), Raft Footing
3. Compression Members: Definitions, Classifications, Guidelines and Assumptions, Design of Short Axially Loaded Compression Members, Design of Short Compression Members under Axial Load with Uniaxial and biaxial Bending, Preparation of Design Charts, Design of Slender Columns
4. Design of Continuous beams and curved beam.
5. Design of Domes.
6. Design of Retaining walls: Cantilever type retaining wall, Counterfort type retaining wall.
7. Introduction to water retaining structures. Design of circular and rectangular water tanks resting on ground.

Books:

1. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education
2. Limit state Design of Reinforced Concrete; Varghese P C; Prentice-Hall of India Pvt. Ltd”.
3. Reinforced Cement Concrete, Mallick and Rangasamy; Oxford-IBH.

BIS Codes of practice and Design Handbooks:

1. *IS 456-2000*- Indian Standard. Plain and Reinforced concrete -Code of practice
2. *IS 3370- Code of practice for concrete structures for storage of liquids
3. *Design Aid SP 16
4. Explanatory hand book SP24.
5. Detailing of Reinforcement SP 34

Note: The codes marked with * are permitted in examination.

BTCE-602 ELEMENTS OF EARTHQUAKE ENGINEERING

Internal Marks :	40	L T P
External Marks :	60	3 2 0
Total Marks :	100	

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.
2. Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings.
3. 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. Lateral Force analysis, Floor Diaphragm action, moment resisting frames, shear walls.
5. Concepts of seismic design, Lateral Strength, Stiffness, ductility and structural configuration.
6. Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake.
7. Introduction to provisions of IS 4326.
8. Introduction to provision of IS 13920.

References :

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
7. IS 1893-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures.
8. IS 4326-1993 2002 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
9. IS 13920-1993 2002 Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.

BTCE-603 FOUNDATION ENGINEERING

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

L T P
4 1 0

Soil Investigation: 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.

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, K_a and K_p 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).

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. Skempton's 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 Westerguard 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.

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

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.

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. Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International
6. Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
7. Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education
8. Foundation Engineering by Varghese P.C, PHI Learning.
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publication.
10. Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education

BTCE-604 NUMERICAL METHODS IN CIVIL ENGINEERING

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

L T P
4 1 0

- 1. Equation:** Roots of algebraic transcendental equation, Solution of linear simultaneous equations by different methods using Elimination, Iteration, Inversion, Gauss-Jordan and method. Homogeneous and Eigen Value problem, Nonlinear equations, Interpolation.
- 2. Finite Difference Technique:** Initial and Boundary value problems of ordinary and partial differential equations, Solution of Various types of plates and other civil engineering related problems
- 3. New Marks Methods:** Solution of determinate and indeterminate structures using Newmarks Procedure (Beam)
- 4. Statistical Methods:** Method of correlation and Regression analysis for fitting a polynomial equation by least square
- 5. Initial Value problem:** Galerkin's method of least square, Initial Value problem by collocation points, Rungekutta Method
- 6. New Marks Method:** Implicit and explicit solution, solution for nonlinear problems and convergence criteria

Books:

1. Numerical Mathematical Analysis: James B. Scarborough Oxford and IBH Publishing, 1955.
2. Introductory Methods of Numerical Analysis: S.S. Sastry, PHI Learning (2012).
3. Introduction To Computer Programming and Numerical Methods by Xundong Jia and Shu Liu, Dubuque, Iowa: Kendall/Hunt Publishing Co.
4. Numerical Methods, J.B Dixit , USP (Laxmi publication),

BTCE-605 PROFESSIONAL PRACTICE

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

L T P
3 2 0

1. **Estimates**-Method of building estimates, types, site plan index plan, layout plan, plinth area, floor area, Technical sanction, administrative approval, estimate of buildings, roads, earthwork, R.C.C. works, sloped roof, roof truss, masonry platform, complete set of estimate.
2. **Schedule of Rates, analysis of rates**- For earthwork, concrete work, D.P.C., stone masonry, plastering, pointing, roadwork
3. **Specifications**- For different classes of building and Civil engineering works.
4. Rules and measurements for different types of Civil engineering works.
5. **Types of contracts**- Tenders, tender form, submission and opening of tenders, measurement book, muster roll , piecework agreement and work order
6. **Accounts**-Division of accounts, cash, receipt of money, cash book, temporary advance, imprest, accounting procedure
7. **Arbitration**: Acts and legal decision making process.

Books Recommended

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-606 ENVIRONMENTAL ENGINEERING - II

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

L T P
3 1 0

- 1. Introduction:** Terms & definitions, systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions.
- 2. Sewerage System:** Generation and estimation of community Sewage, flow variations, storm water flow, types of sewers. Design of sewers and storm water sewers, construction & maintenance of sewers, sewer appurtenances, sewage pumping and pumping stations.
- 3. House Drainage:** Principles of house drainage, traps, sanitary fittings, systems of plumbing, drainage lay out for residences.
- 4. Characteristics of Sewage:** Composition of domestic and industrial sewage, sampling, physical, chemical and microbiological analysis of sewage, biological decomposition of sewage, BOD and BOD kinetics, effluent disposal limits.
- 5. Treatment of Sewage:** Introduction to unit operations and processes - Primary treatment; screening (theory), grit chamber (theory and design), floatation units, sedimentation tanks (theory and design), Secondary treatment units; ASP (theory and design), Sequencing batch reactors (theory and design), Trickling filters (theory and design) Anaerobic systems; Anaerobic filters (theory), UASB (theory), Anaerobic lagoons, Sludge Handling and disposal; thickening, stabilization, dewatering, drying and disposal.
- 6. Low Cost Sanitation Systems:** Imhoff tanks (theory and design), septic tank (theory and design), soakage pit/soil absorption systems; stabilization ponds (theory and design); macrophyte ponds; oxidation ponds (theory and design); and constructed wetland systems.
- 7. Wastewater Treatment Plants and Advanced Wastewater Treatment:** Treatment Plants; site selection, plant design, Hydraulic Profiles, operation and maintenance aspects. Advanced wastewater treatment for nutrient removal, disinfection and polishing.

Books:

1. Waste Water Engg. (Environmental Engg.-II) by B.C.Punmia, Ashok 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. "Waste Water Engineering - Treatment and Reuse" by Metcalf & Eddy, TMH, New Delhi.
4. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
5. Environmental Engineering (Vol. II) by S.K. Garg, Khanna Publishers, Delhi.

BTCE -607 ENVIRONMENTAL ENGINEERING LABORATORY

Internal Marks: 30
External Marks: 20
Total Marks: 50

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1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of a given sample of water.
7. Determination of Hardness of a given water sample
8. Determination of total solids, dissolved solids, suspended solids of a given water sample.
9. To determine the concentration of sulphates in water/wastewater sample.
10. To find chlorides in a given sample of water/waste water.
11. To find acidity/alkalinity of a given water sample
12. To determine the COD of a wastewater sample.

Books Recommended:

1. Chemistry for Enviromental Engg. and Science by Sawyer & McCarty, TMH, New Delhi
2. Standard Methods for the examination of water & wastewater, APHA, AWWA, WE

BTCE-608 COMPUTER AIDED STRUCTURAL DRAWING - II

Internal Marks: 30
External Marks: 20
Total Marks: 50

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0 0 3

Structural Drawings of Reinforced Concrete Elements as per BTCE-601

**SEVENTH / EIGHTH
SEMESTER**

BTCE-701 SOFTWARE AND INDUSTRIAL TRAINING

Course	Duration	Internal Marks	External Marks	Total Marks
a) Software Training	Minimum 6 week	150	100	250
b) Industrial Training	Minimum 12 week	300	200	500

***List of Software for Training to be learnt during Training Period**

Any software that enhances professional capability in civil engineering practice a partial indicative list is mentioned below:

1. GT STRUDAL
2. PRIMA VERA
3. GEOTECH
4. ARCVIEW GIS
5. GEO 5
6. GEO STUDIO PROF 2004
7. AUTOCAD CIVIL 3D
8. MX ROAD
9. GEOMATIC
10. STAAD PRO
11. HDM-4
12. PLAXIS
13. Any other relevant software

BTCE 801 Design of Steel Structures – II

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

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4 1 0

Note: Use of relevant Indian Standards is allowed.

- 1) Elements of a plate girder, design of a plate girder, curtailment of flanges, various type of stiffeners.
- 2) Design of steel foot bridge with parallel booms and carrying wooden decking, using welded joints.
- 3) Complete design of an industrial shed including:
 - i) Gantry girder
 - ii) Column bracket
 - iii) Mill bent with constant moment of inertia
 - iv) Lateral and longitudinal bracing for column bent
- 4) Design of single track railway bridge with lattice girders having parallel chords (for B.G.)
 - i) Stringer
 - ii) Cross girder
 - iii) Main girders with welded joints
 - iv) Portal sway bracings
 - v) Bearing rocker and rollers

BOOKS & CODES RECOMMENDED:

- 1) Limit state design of steel structures: **S K Duggal**
- 2) Design of steel structures: **N Subramanian**
- 3) Design of steel structures (Vol. 2): **Ram Chandra**
- 4) Design of steel structures: **L S Negi**
- 5) Design of steel structures (by limit state method as per IS: 800-2007): **S S Bhavikatti**
- 6) IS 800: 2007 (General construction in steel-Code of practice)*
- 7) SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

* permitted in Examination

BTCE 802 DISASTER MANAGEMENT

Internal marks: 40
External marks: 60
Total marks: 100

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4 0 0

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.

Disaster Mitigation and Preparedness: *Natural Hazards:* causes, distribution pattern, consequences and mitigation measures for earth quake, tsunami, cyclone, flood, landslide drought etc. *Man-made hazards:* causes, consequences mitigation measures for various industrial hazards/disasters, Preparedness for natural disasters in urban areas.

Hazard and Risk Assessment: Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems.

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

Capacity Building: Gender sensitive disaster management approach and inculcate new skills and sharpen existing skills of government officials, voluntary activists, development of professional and elected representative for effective disaster management, role of media in effective disaster management, overview of disaster management in India, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines..

Application of Geoinformatics 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.

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.

Case Studies: Lessons and experiences from various important disasters with specific reference to Civil Engineering.

Books/References:

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. [www.http//ndma.gov.in](http://ndma.gov.in)
6. Disaster Management –Future Challenges & Opportunities by Jagbir Singh, I.K. International Publishing House.

BTCE-803 IRRIGATION ENGINEERING-II

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

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3 1 0

1. **Head Works:**Types of head works, Functions and investigations of a diversion head work : component parts of a diversion head work and their design considerations, silt control devices.
2. **Theories of Seepage:** Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, Limitations of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.
3. **Design of Weirs:** Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir.
4. **Energy Dissipation Devices:** Use of hydraulic jump in energy dissipation, Factors affecting design, Types of energy dissipators and their hydraulic design.
5. **Canal Regulators:** Offtake alignment, cross-regulators – their functions and design, Distributory head regulators, their design, canal escape.
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.
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.
8. **Canal Out-lets :** Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of nonmodular, semi-modular and modular outlets.

Books

1. Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers
2. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
3. Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, . Katson Publishing
4. Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
5. P.N. Modi; Irrigation with Resources and with Power Engineering, Standard Book House
6. Irrigation Engg. Vol. I & II by Ivan E. Houk, John Wiley and sons

BTCE-804 Transportation Engineering – II

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

L T P
3 1 0

Railway Engineering

- 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, Loading Gauge, Construction Gauge.
- 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, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.
- 3) **Geometric Design of Railway Track:** Alignment, Gradients, Horizontal Curve, Super-elevation, Equilibrium Cant, Cant Deficiency, Transition Curves.
- 4) **Points and Crossings:** Functions, Working of Turnout, Various types of Track Junctions and their layouts, Level-crossing.
- 5) **Railway Stations & Yards:** Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards
- 6) **Signalling and Interlocking:** Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking.
- 7) **Modernization of Railway Tracks:** High Speed Tracks, Improvement in existing track for high speed, Ballastless Track, MAGLEV, TACV Track.

Airport Engineering

- 8) **Introduction to Airport Engineering:** Air Transport Scenario in India and Stages of Development, National and International Organizations.
- 9) **Airport Planning:** Aircraft Characteristics, Factors for Site Selection, Airport Classification, General Layout of an Airport. Obstructions and Zoning Laws, Imaginary Surfaces, Approach Zones and Turning Zones.
- 10) **Runway Orientation and Design:** Head Wind, Cross Wind, Wind Rose Diagram, Basic Runway Length, Corrections, Geometric Design Elements, Runway Configuration.
- 11) **Taxiway and Aircraft Parking:** Aircraft Parking System. Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.
- 12) **Visual Aids:** Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.

Books Recommended:

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-805 PROJECT

Internal Marks: 100
External Marks: 50
Total Marks: 150

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Students are required to work on project in any of the areas related to Civil Engineering. The students will work 6 hrs per week with his / her supervisor(s).

BTCE-806 DYNAMICS OF STRUCTURES

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

Overview of structural dynamics: Fundamental objective of structural dynamic analysis - types of prescribed loadings - essential characteristics of a dynamic problem - method of discretization: lumped-mass procedure - generalized displacements - the finite-element concept

Single degree of freedom systems: Components of the basic dynamic system formulation of the equations of motion - direct equilibration using D'Alembert's principle - principle of virtual displacements - *generalized SDOF systems* - rigid body assemblage

Free vibration response: Solution of the equation of motion - undamped free vibrations - damped free vibrations - critical damping - underdamped systems - overdamped systems - negative damping

Response to harmonic loading: Undamped system complementary solution - particular solution - general solution - response ratio - damped system - resonant response

Response to periodic loading: Fourier series expression of the loading - response to the fourier series loading - exponential form of fourier series solution

Response to impulsive loads: General nature of impulsive loads - sine-wave impulse - rectangular impulse - triangular impulse - shock load.

Response to general dynamic loading: Duhamel integral for an undamped system - numerical evaluation of the duhamel integral for an undamped system - response of damped systems - response analysis through the frequency domain

Multi degree of freedom systems: Formulation of the MDOF equations of motion - selection of the degrees of freedom - orthogonality conditions - normal co-ordinates - uncoupled equations of motion - undamped & damped - mode superposition procedure

Continuous parameter systems: Vibration analysis by Rayleigh's method - basis of the method - approximate analysis of a general system - selection of the vibration shape - improved Rayleigh method

Practical vibration analysis: Preliminary comments - stodola method - fundamental mode analysis – proof of convergence - analysis of second mode - analysis of third and higher modes – analysis of highest mode - Rayleigh's method in discrete co-ordinate systems.

Books:

1. Clough R.W. & Penzien J., Dynamics of Structures, McGraw Hill
2. Weaver W., Jr. Timoshenko S.P., Young D.H, Vibration Problem in Engineering, John Wiley
3. Meivovitch L., Elements of Vibration Analysis, McGraw Hill
4. Seto W.W., Mechanical Vibrations, Schaum's Outline Series, McGraw Hill
5. Srinivasan P., Mechanical Vibration Analysis, Tata McGraw Hill
6. A K Chopra; Dymanics of Structures; Prentice-Hall
7. Earthquake Resistant Design of Structures; Pankaj Agrawal, Manish Shrikhande; Prentice Hall of India

BTCE-807 FINITE ELEMENT METHODS

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

Introduction: the finite element method - the element characteristic matrix - element assembly and solution for unknowns - summary of finite element history - basic equations of elasticity – strain displacement relations - theory of stress and deformation - stress-strain-temperature relations

The direct stiffness method: structure stiffness equations - properties of $[K]$ - solution of unknowns - element stiffness equations - assembly of elements - node numbering to exploit matrix sparsity - displacement boundary conditions - gauss elimination solution of equations - conservation of computer storage - computational efficiency - stress computation - support reactions - summary of the finite element procedure

Stationary principles, Rayleigh-Ritz and interpolation: principle of stationary potential energy - problems having many d.o.f - potential energy of an elastic body - the Rayleigh-Ritz method - piecewise polynomial field - finite element form of Rayleigh-Ritz method - finite element formulations derived from a functional - interpolation - shape functions for C^0 and C^1 elements - lagrangian interpolation functions for two and three dimensional elements

Displacement based elements for structural mechanics: formulae for element stiffness matrix and load vector - overview of element stiffness matrices - consistent element nodal vector - equilibrium and compatibility in the solution - convergence requirements - patch test - stress calculation - other formulation methods

Straight sided triangles and tetrahedral: natural coordinates for lines - triangles and tetrahedral - interpolation fields for plane triangles - linear and quadratic triangle - quadratic tetrahedron

The isoparametric formulation: introduction - an isoparametric bar element - plane bilinear element - summary of gauss quadrature - quadratic plane elements - direct construction of shape functions for transition elements - hexahedral (solid) isoparametric elements - triangular isoparametric elements - consistent element nodal loads - validity of isoparametric elements - appropriate order of quadrature - element and mesh instabilities - remarks on stress computation

Coordinate transformation: transformation of vectors - transformation of stress, strain and material properties - transformation of stiffness matrices - transformation of flexibility to stiffness - inclined support - joining dissimilar elements to one another- rigid links - rigid elements

Bending flat plates: plate bending theory - finite elements for plates - triangular discrete Kirchoff element - boundary conditions

Introduction to weighted residual method: some weighted residual methods - galerkin finite element method - integration by parts - axially loaded bar - beam - plane elasticity

Reference books

1. Desai C.S., *Elementary Finite Element Method*, Prentice Hall of India
2. Chandrupatla T.R. & Belegundu A.D., *Introduction to Finite Elements in Engineering*, Prentice Hall of India
3. Bathe K.J., *Finite Element Procedures in Engineering Analysis*, Prentice Hall of India

4. Gallagher R.H., *Finite Element Analysis: Fundamentals*, Prentice Hall Inc.
5. Rajasekaran S., *Finite Element Analysis in Engineering Design*, Wheeler Pub.
6. Krishnamoorthy C. S., *Finite Element Analysis - Theory and Programming*, Tata McGraw Hill
7. Zienkiewics O.C. & Taylor R.L., *The Finite Element Method*, Vol I & II, McGraw Hill

BTCE-808 ADVANCED REINFORCED CONCRETE DESIGN

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

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.

Large span concrete roofs – Classification- Behaviour of Flat slabs- Direct design and equivalent frame method- Codal provisions

Forms of Shells and Folded plates- Structural behaviour of cylindrical shell and folded plate- Method of analysis-beam action, arch action and membrane analysis- Codal provisions- Design of simply supported circular cylindrical long shells and folded plates.

Yield line analysis of slabs- virtual work and equilibrium method of analysis- simply supported rectangular slabs with corners held down- uniform and concentrated loads- design of simply supported rectangular and circular slabs

Analysis of deep beams- Design as per IS 456-2000

Analysis of stresses in concrete chimneys- uncracked and cracked sections- Codal provisions- Design of chimney

Retaining walls -Analysis and Design of cantilever and counterfort retaining walls with horizontal and inclined surcharge.

Overhead water tanks- rectangular and circular with flat bottom- spherical and conical tank roofs- staging- Design based on IS 3370

Reference books

1. Reinforced Concrete Structural Elements- Purushothaman. P, Tata Mc Graw Hill
2. Design and Construction of Concrete Shell Roofs- G.S.Ramaswamy
3. Reinforced Concrete – Ashok K Jain, Nem Chand Bros. Roorkee
4. Plain and Reinforced Concrete – Jain & Jaikrishna, Vol. I & II, Nem Chand Bros. Roorkee
5. Reinforced Concrete Chimneys- Taylor C Pere,
6. Yield Line Analysis of Slabs- Jones L L, Thomas and Hudson
7. Design of deep girders, Concrete Association of India
8. Reinforced Concrete, Mallick & Gupta- Oxford & IBH
9. IS 456-2000
10. IS2210-1998- Criteria for design of reinforced concrete shell structures and folded plates
11. IS 4998-1998- Criteria for design of reinforced concrete chimneys
12. IS 3370- 1991- Part 1-4- Code of Practice for concrete structures for the storage of liquids

BTCE – 809 PRESTRESSED CONCRETE

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

Note: IS 1343 is permitted in examination.

Materials for prestressed concrete and prestressing systems

High strength concrete and high tensile steel – tensioning devices – pretensioning systems – post tensioning systems.

Analysis of prestress and bending stresses

Analysis of prestress – resultant stresses at a sector – pressure line or thrust line and internal resisting couple – concept of load balancing – losses of prestress – deflection of beams.

Strength of prestressed concrete sections in flexure, shear and torsion

Types of flexural failure – strain compatibility method – IS:1343 code procedure – design for limit state of shear and torsion.

Design of prestressed concrete beams and slabs

Transfer of prestress in pre tensioned and post tensioned members – design of anchorage zone reinforcement – design of simple beams – cable profiles – design of slabs.

Books

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH
4. R. Rajagopalan, Prestressed Concrete.
5. IS 1343 2012 **Code of Practice for Prestressed Concrete**

BTCE-810 GROUND IMPROVEMENT TECHNIQUES

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

Introduction to soil improvement without the addition of materials - dynamic compaction equipment used - application to granular soils - cohesive soils - depth of improvement - environmental considerations - induced settlements - compaction using vibratory probes - vibro techniques vibro equipment - the vibro compaction and replacement process - control of verification of vibro techniques - vibro systems and liquefaction - soil improvement by thermal treatment - preloading techniques - surface compaction introduction to bio technical stabilization

Introduction to soil improvement with the addition of materials - lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils - settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting - commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting - introduction - application and limitations - plant for preparing grouting materials - jet grouting - jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone columns

Soil improvement using reinforcing elements - introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls

Geotextiles - Behaviour of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls – pavements

Reference books

1. Moseley, *Text Book on Ground Improvement*, Blackie Academic Professional, Chapman & Hall
2. Boweven R., *Text Book on Grouting in Engineering Practice*, Applied Science Publishers Ltd
3. Jewell R.A., *Text Book on Soil Reinforcement with Geotextiles*, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., *Text Book On Soil Improvement Technique & Their Evolution*, Balkema Publishers
5. Donald .H. Gray & Robbin B. Sotir, *Text Book On Bio Technical & Soil Engineering Slope Stabilization*, John Wiley
6. Rao G.V. & Rao G.V.S., *Text Book On Engineering With Geotextiles*, Tata McGraw Hill
7. Korener, *Construction & Geotechnical Methods In Foundation Engineering*, McGraw Hill
8. Shukla, S.K. and Yin, J.H. *Fundamental of Geosynthetic Engineering*, Taylor & Francis
9. Swamisaran, *Reinforced Soil and its Engineering Application*, New Age Publication
10. Gulati, S.K. and Datta, M., *Geotechnical Engineering*, TMH

BTCE-811 SOIL DYNAMICS & MACHINE FOUNDATION

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

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations - theory of vibration: general definitions - properties of harmonic motion - free vibrations of a mass-spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom - special response

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants - methods of determination of soil constants in laboratory and field based on IS code provisions

Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines - design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method)

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations

Note: Use of I.S 2974 Part I and II will be allowed in the university examination

Reference books

1. Shamsher Prakash, *Soil Dynamics*, McGraw Hill
2. Das and Ramana, *Principle of Soil Dynamica*, Cengage Learning
3. Alexander Major, *Dynamics in Soil Engineering*
4. Sreenivasalu & Varadarajan, *Handbook of Machine Foundations*, Tata McGraw Hill
5. IS 2974 - Part I and II, *Design Considerations for Machine Foundations* *
6. IS 5249: *Method of Test for Determination of Dynamic Properties Of Soils*

* IS code marked with * is permitted in examination.

BTCE-812 EARTH AND EARTH RETAINING STRUCTURES

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

Earthen Dam

Introduction to Earthen dams, types of dams, selection of type of dam based on material availability, foundation conditions and topography

Design details – crest, free board, upstream and down stream slopes, upstream and down stream slope protection – central and inclined cores – types and design of filters

Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation

Stability analysis – critical stability conditions – evaluation of stability by Bishop's and sliding wedge methods under critical conditions

Construction techniques – methods of construction – quality control

Instrumentation – measurement of pore pressures

Earth pressure theories – Rankine's and Coulomb's earth pressure theories for cohesionless and cohesive backfills – computation of earth pressures for various cases – inclined – with surcharge – submerged and partly submerged – stratified backfills

Rigid retaining structures – active and passive earth pressures against gravity retaining walls – computation of earth pressures by Trial wedge method – a mathematical approach for completely submerged and partly submerged backfills – Perched water table – importance of capillary tension in earth pressure.

Graphical methods of earth pressure computation – trial wedge method for coulomb's and Rankine's conditions, for regular and irregular ground and wall conditions – Rebhan's construction for active pressure – friction circle method – logarithmic spiral method.

Design of gravity retaining wall – cantilever retaining walls

Flexible retaining structure – type and methods of construction – design strength parameters – safety factor for sheet pile walls – computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – anchored sheet piles – free earth method – fixed earth method – Rowe's moment reduction method – stability of sheet piling

Diaphragm walls and coffer dams – type of diaphragm walls and their construction techniques in various soil types – earth pressure on braced cuts and coffer dams – design of coffer dams

Reference books

1. Huntington, Earth pressure on retaining walls.
2. Bowles, Foundation Analysis and Design.
3. Jones, Earth Reinforcements & Soil structures.
4. Prakash, Ranjan & Sasan, Analysis & Design of Foundation & Retaining Structures.

BTCE-813 REINFORCED EARTH AND GEOTEXTILES

Internal Marks : 40 L T P

External Marks : 60 3 1 0

Total Marks : 100

Reinforced Earth – The mechanisms of the reinforced earth techniques – Design principles – Materials used for construction – Advantages of reinforced earth – Reinforced earth construction with GI sheets and strips

An overview of Geosynthetics, Description of Geotextiles – Geogrids – Geonets – Geomembranes – Geocomposites – Geocells – Designing with Geotextiles – Geotextile properties and test methods – Functions of Geotextile – Design methods for separation – stabilization – filtration – Drainage, Soil anchors.

Designing with Geogrids – Geogrid properties and test methods – Designing with Geonets – Geonet properties and test methods – Designing with Geomembranes – Geomembrane properties and test methods – construction practices with Geotextiles, Geogrids, Geonets, Geomembranes

Design of liquid Contaminant liners – liquid contaminant liners – Covers for reservoirs- Water conveyance (Canal liners)-- solid material liners – underground storage tanks – Design of pavements Geo composites as liquid / Vapour Barriers –Improvement in bearing capacity – Erosion Control for waterways.

Reference books

1. Robert M. Koerner, *Designing with Geosynthetics*, Prentice Hall – 1989
2. G.V Rao & GVS Suryanarayana Raju, *Engineering with Geosynthetics*, Tata Mc Graw Hill Publishing Co. New Delhi
3. Korener, *Construction & Geotechnical Methods In Foundation Engineering*, McGraw Hill
4. Shukla, S.K. and Yin, J.H. *Fundamental of Geosynthetic Engineering*, Taylor & Francis
5. Swamisaran, *Reinforced Soil and its Engineering Application*, New Age Publication
6. Gulati, S.K. and Datta, M., *Geotechnical Engineering*, TMH

BTCE-814 ENVIRONMENTAL IMPACT ASSESSMENT

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

Concepts of environmental impact analysis - key features of the National Environmental Policy Act and its implementation, screening in the EIA process, role of the USEPA, environmental protection and EIA at the national level, utility and scope of the EIA process

Planning and management of environmental impact studies

Environmental impact - factors for consideration in assessing the impacts of water related projects, power projects, waste water treatment facilities etc .

Concepts and terms in the impact assessment process, Socioeconomic impact analysis.

Simple methods for impact identification – matrices, net works and checklists.

Description of the environmental setting

Environmental indices and indicators for describing the affected environment.

Prediction and assessment- Prediction and assessment of the impact on surface water, soil, groundwater, air, water quality, vegetation and wild life and biological environments. Case studies and examples.

Prediction and assessment of visual impacts and impacts on the socio-economic setting, decision methods for evaluation of alternatives, public participation in decision-making

Preparing the EIA document

Environmental monitoring.

Reference books

1. Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc., 1996
2. Betty Bowers Marriot, Environmental Impact Assessment A Practical Guide, McGraw Hill, Inc., 1997.
3. C.J. Barrow, Environmental & Social Impact Assessment – An Introduction, Edward Arnold, 2002.
4. Evan. K. Paleologos and Ian Lerche, Environmental Risk Analysis, McGraw Hill Inc., 2001
5. Peter Morris (ed.) and Riki Therivel (ed.), Methods of Environmental Impact Assessment, Routledge, 2001.

BTCE 815 ADVANCED ENVIRONMENTAL ENGG.

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

INTRODUCTION

Environment, Biosphere, Ecosystems; their interrelationships and pollution.

AIR POLLUTION & CONTROL

Air pollution, Physical & chemical fundamentals, Air pollution standards, Effects of air pollution; climate change, Air pollution meteorology, Atmospheric dispersion of pollutants, Indoor air quality models, Air pollution control of stationary & mobile sources.

NOISE POLLUTION & CONTROL:

Introduction, Rating Systems, Sources & Criteria, Noise prediction and Control

SOLID WASTE MANAGEMENT:

Perspectives & properties, collection, transfer & transport, Life cycle assessment, Disposal in a landfill, Waste to energy, Composting, Resource conservation & recovery for sustainability

HAZARDOUS WASTE MANAGEMENT:

The hazard, risk, definition & classification RCRA & HSWA, CERCLA & SARA, Hazardous waste management, Treatment technologies,
Land disposal, Groundwater contamination & remediation

BOOKS:

- 1..Davis & Cornwell, Environmental Engineering, Mc Graw Hill Int Ed
- 2..Peavy, H.S, Rowe, D.R, Tchobanoglous, G, Environmental Engineering, Mc Graw Hill
- 3..E.P. Odum, Fundamentals of Ecology, Oxford and IBH Pub.
4. Vesilind, Worrell and Reinhart, Solid Waste Engineering, Cengage Learning India
5. Rao and Rao, Air Pollution, Tata McGraw Hill Pub

BTCE 816 FLOOD CONTROL & RIVER ENGINEERING

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

River Engineering, Flood forecasting, Flood Estimation, Estimating Design flood, Empirical formulate, statistical or Probability methods, Unit hydrograph method

Flood control and Economics of Flood control

River Regime theories, River Modeling, Meandering

River Training, Channel improvements; cut offs, River control structures

Sediment load, Resistance to flow,

Social and environmental impacts.

BOOKS:

- 1.R.J. Garde, K.G. Ranga Raju, 1. Mechanics of Sedement Transportation and Alluvial Stream problems, Wiley Eastern Ltd.
2. V.A. Vanoni , Sedimentation Engg, John Wiley and Sons
3. .A. Raudkivi, Loose Boundary Hydraulics, Pergamon Press, Inc
4. P.N. Modi, Irrigation Water Resources and Water Power Engineering, Standard Book House
5. Manual on rivers, their behaviour and Training, Pub No. 60, CBIP, New Delhi

BTCE - 817 HYDROLOGY AND DAMS

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

- 1) Introduction, Precipitation: Importance of hydrological data in water resources planning. The hydrologic cycle. Mechanics of precipitation, types and causes, measurement by rain gauges, Gauge net-works, hyetograph, averaging depth of precipitation over the basin, mass-rainfall curves, intensity duration frequency curves, depth area-duration curves.
- 2)
 - a) Interception, Evapo-transpiration and Infiltration: Factors affecting interception, evaporation from free water surfaces and from land surfaces, transpiration, Evapo-transpiration.
 - b) Infiltration Factors affecting infiltration, rate, Infiltration capacity and its determination.
- 3) Runoff: Factors affecting runoff, run-off hydrograph, unit hydrograph theory, S-curve hydrograph, Snyder's synthetic unit hydrograph.
- 4) Peak Flows: Estimation of Peak flow-rational formula, use of unit hydrograph, frequency analysis, Gumbel's method, design flood and its hydrograph.
- 5) Gravity Dams-Non Overflow Section: Forces acting, Stability factors, stresses on the faces of dam, Design of profile by the method of zoning, elementary profile of a dam.
- 6) Gravity Dams-Spillways: Creagers profiles neglecting velocity of approach, profile taking velocity of approach into account, Upstream lip and approach ramp, Advantages of gated spillways, Discharge characteristics of spillways.
- 7) Arch and Buttress Dams: Classification of arch dam- constant radius, constant angle and variable radius, Cylinder theory, Expression relating central angle and Cross-Sectional area of arch. Types of buttress dams, Advantages of buttress dams.
- 8) Earth Dams: Components of earth dams and their functions, Phreatic line determination by analytical and graphical methods.

REFERENCE

1. Engineering Hydrology - J.Nemec, Prentice Hall
2. Engineering Hydrology by Stanley Buttlar, John. Wiley
3. Ground Water Hydrology by TODD, John. Wiley
4. Engineering for Dams Vol. II & III by Creager Justin & Hinds. John. Wiley
5. Hydrology by. S.K.Garg, Khanna Pub
6. Hydrology Principles, Analysis and Design by. Raghunath, H M, New Age Int. Pub

BTCE-818 PAVEMENT DESIGN

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

Note: Use of IRC:37-2012 and IRC:58-2011 shall be allowed in the examination.

1. **Introduction:** Types of pavement structure. Functions of pavement components, Factors affecting pavement design, Design wheel load, Strength characteristics of pavement materials. Comparison of flexible and rigid pavements.
2. **Design of Flexible Pavements:** General design considerations, Methods for design of flexible pavements – Group Index Method, Triaxial Test Method, Hveem Stabilometer Method, McLeod's Method, Indian Roads Congress Method.
3. **Design of Bituminous Mixes:** Mix Design Approaches, Marshall Method of Bituminous Mix Design, Superpave
4. **Design of Rigid Pavements:** General design considerations, Westergard's Analysis, Methods for design of rigid pavements - PCA method, AASHTO Method, Indian Roads Congress Method, Types and design of Joints in cement concrete pavements.
5. **Modern Design Concepts:** Reinforced Concrete Pavement, Airport Pavement Design, Bituminous Pavement with Cemented Base, Interlocking Concrete Block Pavement, Full Depth Bituminous Pavement, Ultrathin White Topping, Perpetual Pavement, Pavement Overlays.

Books Recommended:

1. Yoder, E. J., and M. W. Witczak, "Principals of Pavement Design", Wiley Publication.
2. Khanna, S. K., and C. E. G. Justo, "Highway Engineering", Nem Chand & Bros., Roorkee.
3. Sharma, S. K., "Principles, Practice and Design of Highway Engineering", S. Chand & Co.
4. Chakraborty, P. and A. Das, "Principles of Transportation Engineering", Prentice Hall India.
5. Yang H. Huang, "Pavement Analysis and Design", Prentice Hall.

BTCE-819 TRAFFIC ENGINEERING

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

- 1. Introduction:** Elements of Traffic Engineering, Components of traffic system – road users, vehicles, highways and control devices.
- 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. Traffic Stream Characteristics:** Traffic stream parameters, characteristics of interrupted and uninterrupted flows.
- 4. Traffic Studies:** Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, parking studies, accident studies.
- 5. Traffic Regulation and Control:** Signs and markings, Traffic System Management, At-grade intersections, Channelisation, Roundabouts.
- 6. Traffic Signals:** Pre-timed and traffic actuated. Design of signal setting, phase diagrams, timing diagram, Signal co-ordination.
- 7. Grade Separated Intersections:** Geometric elements for divided and access controlled highways and expressways.
- 8. Traffic Safety:** Principles and practices, Road safety audit.
- 9. Intelligent Transportation System:** Applications in Traffic Engineering

Books Recommended:

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-820 BRIDGE ENGINEERING

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

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

Books Recommended:

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-821 INFRASTRUCTURE DEVELOPMENT & MANAGEMENT

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

Introduction: Impact of Infrastructure development on economic development, standard of living and environment. Reasons for rise of public sector and government in infrastructural activities. Changed socio-economic scenario and current problems and related issues.

Policies on Infrastructure Development: A historical review of the Government policies on infrastructure. Current public policies on transportations, power and telecom sectors. Plans for infrastructure development. Legal framework for regulating private participation in roads and highways, Ports & Airports, Power and Telecom.

Construction and Infrastructure: Construction component of various infrastructure sectors. Highway, ports and aviation, oil and gas, power, telecom, railways, irrigation. Current scenario, future needs, investment needed, regulatory framework, government policies and future plans. Technological and methodological demands on construction management in infrastructure development projects.

Infrastructure Management: Importance, scope and role in different sectors of construction.

- **Highway Sector:** Repayment of Funds, Toll Collection Strategy, Shadow tolling, and direct tolls, Maintenance strategy, Review of toll rates & structuring to suit the traffic demand,
- **Irrigation Projects:** Large / Small Dams - Instrumentation, monitoring of water levels, catchments area, rainfall data management, prediction, land irrigation planning & policies, processes Barrages, Canals.
- **Power Projects:** Power scenario in India, Estimated requirement, Generation of Power distribution strategies, national grid, load calculation & factors, Hydropower - day to day operations, management structures, maintenance, Thermal Power, Nuclear Power.
- **Airports:** Requisites of domestic & International airports & cargo & military airports, facilities available, Terminal management, ATC.
- **Railways:** Mass Rapid Transport System MRTS, LRT, Multi-modal Transport System.

Books Recommended:

1. Chandra, Prassanna, "Projects, Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw-Hill, New Delhi, 2006.
2. Raghuram, G. & Jain, R., "Infrastructure Development & Financing Towards a Public-Private Partnership", Macmillan India Ltd., New Delhi, 2002.
3. India Infrastructure Report 2001 & 2002, Oxford University Press, New Delhi, 2001/02.
4. NICMAR, "Construction Business Opportunities in Infrastructure Development in India", NICMAR, Mumbai, 2001.
5. Parikh Kirit S., "India Development Report, 1999-2000", Oxford University Press, New Delhi, 2002.
6. GOI Rakesh Mohan Committee, "The India Infrastructure Report", National Council of Applied Economic Research, New Delhi, 1996.