

**Course Structure  
for Degree Programme  
B. Tech. in Civil Engineering**

**with effect from AY 2018-19**



**Dr. Babasaheb Ambedkar Technological University  
Lonere 402 103, Dist- Raigad, Maharashtra, INDIA**

## Program Objectives

Goal of the Civil engineering with a specialization in Structural Engineering (SE) at Dr. Babasaheb Ambedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

- a) **Preparation:** To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;
- b) **Core Competence:** To provide students with a solid foundation in mathematical, scientific fundamentals required to solve Structural problems;
- c) **Breadth:** To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;
- d) **Professionalism:** To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;
- e) **Learning Environment:** To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

In addition to above DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design structural system that is safe, economical and efficient;
3. Capable of using modern tools efficiently in all aspects of professional practices;
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge;
5. Shall be engage in continuous research, development and exchange of knowledge for professional development;
6. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
7. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
8. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
9. Continue their professional development throughout their careers and provide opportunities for the professional development;

**Course Structure**  
**Evaluation Scheme**

Sr. No	Particulars of Evaluation	MSE	CA		ESE		Total
			CA <sub>1</sub>	CA <sub>2</sub>	Internal	External	
01	Theory courses	20	10	10	---	60	100
02	Audit courses	---	50	50	---	---	100
03	Studio Courses (Product Design Engg)	---	30	30	40	---	100
03	Laboratory (Practical) courses	---	15	15	10	10	50
04	Seminar / Min Project/ Project Stage 1	---	30		20	---	50
05	Field Training	---	---	---	50	---	50
06	Project Stage II	---	---	---	50	50	100

**Semester- III**

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTBSC301	Mathematics – III	3	1	-	4
02	BTCVC302	Mechanics of Solids	3	1	✓	4
03	BTCVC303	Hydraulics I	2	1	✓	3
04	BTCVC304	Surveying I	2	1	✓	3
05	BTCVC305	Building Construction	2	-	✓	2
06	BTCVC306	Engineering Geology	2	-	✓	2
07	BTHM303	Soft Skills Development	2	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL307	Hydraulics Laboratory I	-	-	2	1
09	BTCVL308	Surveying Laboratory I	-	-	2	1
10	BTCVL309	Building Construction - Drawings Laboratory	-	-	2	1
11	BTCVL310	Engineering Geology Lab	-	-	2	1
12	BTCVS311	Seminar on Topic of Field Visit to Foundation Work	-	-	1	AU
13	BTCVF312	Field Training / Internship/Industrial Training Evaluation (from semester II)	-	-	-	1
Sub-Total			16	4	09	
<b>Total</b>			<b>29</b>			<b>23</b>

**Semester- IV**

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTCVC401	Hydraulics II	2	1	✓	3
02	BTCVC402	Surveying – II	2	1	✓	3
03	BTCVC403	Structural Mechanics-I	3	1	-	4

04	BTID405	Product Design Engineering	1	2	-	3
05	CV E1	<b>Elective I</b>	3	-	-	3
06	BTCVC406	Engineering Management	1	-	-	AU
07	BTHM3401	Basic Human Rights	2	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL407	Hydraulics Laboratory II	-	-	2	1
09	BTCVL408	Surveying Laboratory II	-	-	4	2
10	BTCVL409	Mechanics of Solids Laboratory	-	-	2	1
11	BTCVM410	Mini Project	-	-	2	1
12	BTCVF411	Seminar on Topic of Field Visit to works involving Superstructure Construction	-	-	1	1
Sub-Total			<b>14</b>	<b>5</b>	11	
<b>Total</b>			<b>31</b>			<b>22</b>
<b>Elective I</b>						
	BTCVE404A BTCVE404B BTCVE404C	Numerical Methods in Engineering Planning for Sustainable Development Instrumentation & Sensor Technologies for Civil Engineering Applications	3	-	-	3

### Semester- V

Sr. No	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTCVC 501	Design of Steel Structures	2	2	-	4
02	BTCVC 502	Structural Mechanics-II	2	1	-	3
03	BTCVC 503	Soil Mechanics	3	1	✓	4
04	BTCVC 504	Environmental Engineering	2	-	✓	2
05	BTCVC 505	Transportation Engineering	2	-	✓	2
06	CV E2	<b>Elective II</b>	3	-	-	3
07	BTHM507	Essence of Indian Traditional Knowledge	1	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL508	Soil Mechanics Laboratory	-	-	2	1
09	BTCVL509	Environmental Engineering Laboratory	-	-	2	1
10	BTCVL510	Transportation Engineering Laboratory	-	-	2	1
11	BTCVS511	Seminar on Topic of Field Visit to works related to Building Services	-	-	1	AU
Sub-Total			<b>15</b>	<b>4</b>	<b>7</b>	
<b>Total</b>			<b>26</b>			<b>21</b>
<b>Elective II</b>						
	BTCVE506A BTCVE506B BTCVE506C BTCVE506D	Materials, Testing & Evaluation Computer Aided Drawing Development Engineering Business Communication & Presentation Skills	3	-	-	3

## Semester- VI

\$:Students should register for the CVF 705 in Semester VI to undergo training during vacation after semester VI and appear at examination in Semester VII. Result shall appear in Grade-sheet of Semester VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC601	Design of Concrete Structures I	3	1	-	3
02	BTCVC602	Foundation Engineering	2	1	-	3
03	BTCVC603	Concrete Technology	2	-	✓	2
04	BTCVC604	Project Management	2	1	-	2
05	CVE3	<b>Elective III</b>	3	-	-	3
06	BTCVC606	Building Planning and Design	2	-	✓	2
<b>Practical / Drawing and/or Design</b>						
07	BTCVL607	Concrete Technology Laboratory	-	-	2	1
08	BTCVL608	Building Planning, Design and Drawing Laboratory	-	-	4	2
09	BTCVM609	Community Project (Mini Project)	-	-	2	1
10	BTCVS610	Seminar on Topic of Field Visit Road Construction	-	-	1	AU
11	BTCVF611	Industrial Training <sup>s</sup>	-	-	2	--
Sub-Total			<b>14</b>	<b>3</b>	<b>11</b>	
<b>Total</b>			<b>28</b>			<b>19</b>
<b>Elective III</b>						
	BTCVE605A	Air Pollution Control				
	BTCVE605B	Operations Research				
	BTCVE605C	Geographic Data Analysis and Applications				
	BTCVE605D	Advanced Engineering Geology				
	BTCVE605E	Advanced Soil Mechanics				
	BTCVE605F	Design of Masonry and Timber Structures				

## Semester – VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 701	Design of Concrete Structures II	2	1	-	3
02	BTCVC 702	Infrastructure Engineering	3	-	-	3
03	BTCVC 703	Water Resources Engineering	2	1	-	3
04	BTCVC 704	Professional Practices	2	1	✓	3
05	CVE4	<b>Elective IV</b>	3	-	-	3
06	CVE5	<b>Elective V</b>	3	-	-	3
<b>Practical / Drawing and/or Design</b>						
07	BTCVL707	Professional Practices Laboratory	-	-	2	1
08	BTCVL708	Design & Drawing of Steel Structures	-	-	4	2
09	BTCVP709	Project Stage-I	-	-	2	1
10	BTCVF710	Industrial Training	-	-	-	AU
Sub-Total			<b>15</b>	<b>3</b>	<b>08</b>	
<b>Total</b>			<b>26</b>			<b>22</b>
<b>Elective IV</b>						
	BTCVE705A	Plastic Analysis and Design	-	-	-	
	BTCVE705B	Machine Foundations	-	-	-	

	BTCVE705C BTCVE705D BTCVE705E	Modern Surveying Techniques Engineering Economics Ground Improvement Techniques			
<b>Elective V</b>					
	BTCVE706A BTCVE706B BTCVE706C BTCVE706D BTCVE706F BTCVE706F	Advanced Structural Mechanics Town and Urban Planning Construction Economics & Finance Intelligent Transportation Systems Waste Water Treatment Tunneling and Underground Excavations	-	-	--

### Semester – VIII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 801	Introduction to Earthquake Engineering	2	1		3
02	CVE6	<b>Elective VI</b>	3	-		3
03	CVE7	<b>Elective VII</b>	3	-		3
04	CVE8	<b>Elective VIII</b>	3	-		3
<b>Practical / Drawing and/or Design</b>						
05	BTCVL805	Earthquake Engineering Laboratory	-	-	2	1
06	BTCVL806	Design and Drawing of RC Structures	-	-	4	2
07	BTCVF807	Self-Study Report based on field visit to Infrastructure Project Works	-	-	2	1
08	BTCVP808	Project Stage-II	-	-	8	4
		Sub-Total	<b>11</b>	<b>1</b>	<b>16</b>	
		<b>Total</b>	<b>28</b>			<b>20</b>
<b>Elective VI</b>						
	BTCVE802A BTCVE802B BTCVE802C BTCVE802D BTCVE802E	Limit State Design of Steel Structures Construction Techniques Pavement Management System Composite Materials Disaster Preparedness & Planning Management	-	-		-
<b>Elective VII</b>						
	BTCVE803A BTCVE803B BTCVE803C BTCVE803D	Bridge Engineering Structural Audit Design of Hydraulic Structures Environmental Impact Assessment and Life Cycle Analyses	-	-		-
<b>Elective VIII</b>						
	BTCVE804A BTCVE804B BTCVE804C BTCVE804D BTCVE804E	Rock Mechanics Water Power Engineering Water Resources Economics Planning and Management Finite Element Method Repair & Rehabilitation of Structures	-	-		-
<b>Overall Total</b>			<b>50+168 = 218</b>			<b>127</b>

# Detailed Syllabus

## Semester III

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTBSC301	Mathematics – III	3	1	-	4
02	BTCVC302	Mechanics of Solids	3	1	✓	4
03	BTCVC303	Hydraulics I	2	1	✓	3
04	BTCVC304	Surveying I	2	1	✓	3
05	BTCVC305	Building Construction	2	-	✓	2
06	BTCVC306	Engineering Geology	2	-	✓	2
07	BTHM303	Soft Skills Development	2	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL307	Hydraulics Laboratory I	-	-	2	1
09	BTCVL308	Surveying Laboratory I	-	-	2	1
10	BTCVL309	Building Construction - Drawings Laboratory	-	-	2	1
11	BTCVL310	Engineering Geology Lab	-	-	2	1
12	BTCVS311	Seminar on Topic of Field Visit to Foundation Work	-	-	1	AU
13	BTCVF312	Field Training / Internship/Industrial Training Evaluation (from semester II)	-	-	-	1
		Sub-Total	16	4	09	
		<b>Total</b>		<b>29</b>		<b>23</b>

## BTBSC301 Mathematics – III

Teaching Scheme:(3 Lectures +1 Tutorial) hours/week

### Course Contents

#### Module 1: Laplace Transform (Lectures 08)

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by  $tn$ , scale change property, transforms of functions divided by  $t$ , transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

#### Module 2: Inverse Laplace Transform (Lectures 08)

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

#### Module 3: Fourier Transform (Lectures 05)

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.

#### Module 4: Partial Differential Equations and Their Applications (Lectures 05)

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to

find solutions of one dimensional heat flow equation  $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$ , and two dimensional heat flow equation (i.e. Laplace equation :  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ )

#### **Module5: Functions of Complex Variables (Differential calculus)(Lectures 05)**

Limit and continuity of  $f(z)$ ; Derivative of  $f(z)$ ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection, bilinear transformation; Conformal mapping.

#### **Module6: Functions of Complex Variables (Integral calculus)(Lectures 07)**

Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

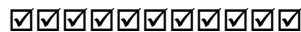
#### **Text Books**

- 1) Grewal B. S., "Higher Engineering Mathematics" Khanna Publishers, New Delhi.
- 2) Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.
- 3) Das H. K. and Er. VermaRajnish, "Higher Engineering Mathematics", S. Chand & Co. Pvt. Ltd., New Delhi.
- 4) Dr. Singh B. B., "A course in Engineering Mathematics (Vol III)", Synergy Knowledgeware, Mumbai.
- 5) Wartikar J.N. and Wartikar P.N., "Engineering Mathematics Vol. I & II", Pune VidyarthiGrihaPrakashan, Pune, 1992
- 6) Ramana B. V., "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.

#### **Reference Books**

- 1) Peter O' Neil, "A Text Book of Engineering Mathematics" Thomson Asia Pte Ltd., Singapore.
- 2) Wylie C. R. & Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill Publishing Co. Ltd., N. Delhi.
- 3) Dr. Singh B. B., "Integral Transforms and their Engineering Applications", Synergy Knowledgeware, Mumbai.
- 4) Sneddon I. N., "Integral Transforms", Tata McGraw-Hill, New York.

**Course Outcomes:** On completion of the course, student will be able to formulate and solve mathematical model of civil engineering phenomena in field of structures, survey, fluid mechanics and soil mechanics.



## **BTCVC302Mechanics of Solids**

**Teaching Scheme:**(3 Lectures +1 Tutorial) hours/week

### **Course Contents**

#### **Module 1: Stress and Strain**

**Simple stress** -Analysis of internal forces, simple stress, shearing stress, bearing stress, diaphragm or skin stresses in thin walled vessels, statically indeterminate members and thermal stresses

**Simple strains** -Stress strain diagram for different engineering materials and its importance for elastic and plastic analysis, Hooke's law: axial and shearing deformations, Poisson's ratio: biaxial and tri-axial deformations, variation of stress with inclination of element, relationship between modulus of rigidity and modulus of elasticity, variation of stress at a point: analytical derivation, introduction to strain measurement devices, Sensors: working principle

#### **Module 2: Axial Force, Shear Force and Moment in Beams**

Axial force, shear force and moment in beams – concept of unbalanced forces at a transverse section, axial forces, shear forces and moment – interaction of these, relations among load shear and moment, introduction to moving loads

**Module 3: Stresses in beams:**Theory of cylindrical bending,Relationship between intensity of loading, shear force and bending moment over elemental length, Derivation of flexural formula, economic sections, analysis of flexural action, derivation of formula for shearing stress, concept of shear flow, shear lag and shear center

**Torsion** -Assumptions, derivation of torsion formulae, torsion of circular shafts, power transmission, stresses and deformation in determinate solid/hollow homogeneous shafts

#### **Module 4: Columns and Struts**



Concept of short and long columns, formulae by Euler and Rankin, Euler's Crippling load for different end conditions, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members, Kern of a section; load applied off the axes of symmetry, introduction to combined axial and flexural loads,

#### Module 5: Combined Stresses

State of simple shear, Analytical and graphical representation of state of combined stress at a point, absolute maximum shearing stress, application of Mohr's circle to combined loading, principal stresses and strains

**Module 6: Theories of Failure:** Concept of failure in strength and failure in deformation, statement and application of maximum principal stress theory, maximum principal strain theory, maximum strain energy theory, maximum shear stress theory, maximum shear strain theory

#### Text Books

- Singer F.L. and Pytle, "Strength of Materials", Harper Collins Publishers, Fourth Edition
- Junnarkar S.B. (2014), "Mechanics of Structures", Charotor Publishers, Anand, 31st edition,
- Khurmi R.S., "Strength of Material", S. Chand and Co., Edition revised 1968, New Delhi
- Sadhu Singh, "Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-048-7
- Prasad I.B., "A text book of Strength of Materials", Khanna Publishers, N. Dehli, ISBN NO:978-81-7409-069-X
- Timoshenko S.P. and Young D.H., "Elements of Strength of Materials", East West Press, 4th edition 1962, New Delhi
- Prasad I.B., "A text book of Strength of Materials", ISBN: 978-81-7409-069-X
- Dr. Sadhu Singh, "Strength of Materials", ISBN: 978-81-7409-048-7
- Ramamrutham S., "Strength of Materials", Dhanpatrai and Sons, Delhi

#### Reference Books

- Beer F P., Jhonston E. R., John. T. D E wolf, "Mechanics of Materials" TMH, 7th edition
- Popov E.P., "Introduction to Mechanics of Solids", Prentice-Hall, Second Edition 2005
- Crandall S.H., Dahl N.C., & Lardner T.J., "An Introduction to Mechanics of Solids", Tata McGraw Hill, 2<sup>nd</sup> Edi, 1978
- Nash W., "Strength of Materials Schaum's outline series", McGraw Hill, fourth edition
- Punmia B. C., "Mechanics of Materials" Laxmi Publications, revised edition, 2016
- Subramanian R., "Strength of Materials" Oxford University Press, 2nd edition, New Delhi
- Dr. Sadhu Singh, "Theory and Solved Problems in Adv. Strength of Materials", ISBN: 978-81-7409-212-7

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Perform the stress-strain analysis.

CO2: Draw force distribution diagrams for members and determinate beams.

CO3: Find deflections in determinant beams.

CO4: Visualize force deformation behavior of bodies.



## BTCVC303 Hydraulics I

**Teaching Scheme:** (2 Lectures + 1 Tutorial) hours/week

### Course Contents

#### Module 1: Fundamental Concepts

(Lectures 06)

Definition of fluids, fluid properties-density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure, types of fluids - Newtonian and non-Newtonian fluid, continuum, fluid pressure

#### Module 2: Fluid Statics

(Lectures 06)

Forces on fluid elements, fundamental equation, manometers, hydrostatic thrust on submerged surfaces, buoyancy, stability of unconstrained bodies, fluids in rigid body motion

**Module 3: Fluid Kinematics**

**(Lectures 06)**

Types of flow, continuity equation, derivation and applications of momentum equation, Euler's equation, Bernoulli's equation, velocity potential and stream function, concept of flow net

**Module 4: Laminar Flow**

**(Lectures 06)**

Fully developed laminar flow between infinite parallel plates, both plates stationary, upper plate moving with constant speed, fully developed laminar flow in pipe.

**Turbulent flow:** Shear stress distribution and turbulent velocity profiles in fully developed pipe flow, velocity distribution and shear stresses in turbulent flow, Prandtl mixing length theory, Nikuradse's experiment, Introduction to Boundary Layer Theory

**Module 5: Dimensional Analysis and Similitude**

**(Lectures 06)**

Nature of dimensional analysis, Rayleigh's Method, Buckingham pi theorem, dimensionless groups and their physical significance, flow similarity and model studies, Scale Effects, Distorted and Undistorted Models

**Module 6: Flow Measurement**

**(Lectures 06)**

Direct methods, restriction flow meters, linear flow meters, traversing methods, measurements in open channel flow

**Flow Through Pipes:** Loss of energy in pipes, pipe discharging from a reservoir, pipe connecting two reservoirs in series and parallel, siphon, transmission of power through nozzle, water hammer in pipes- rigid and elastic water column theory, surge tanks - function, calculation of head loss, introduction to Moody's chart, nomograms and other pipe diagrams

**Text Books**

- Fox. R. W. and Mc-Donald. A. T., "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
- Modi and Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition, 1991
- Kumar K. L., "Fluid Mechanics"
- Bansal R. K., "Fluid Mechanics"
- Jain A.K., "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7

**Reference Books**

- Streeter V. L., Bedford K. W. and Wylie E. B., "Fluid Dynamics", New York, McGraw-Hill, Ninth Edition, 1998
- Som S. K. & Biswas G., "Introduction to Fluid Mechanics & Fluid Machines", Tata McGraw-Hill, 2<sup>nd</sup> Edi., 2003

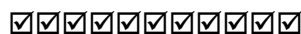
**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Calibrate the various flow measuring devices.

CO2: Determine the properties of fluid and pressure and their measurement.

CO3: Understand fundamentals of pipe flow, losses in pipe and analysis of pipe network.

CO4: Visualize fluid flow phenomena observed in Civil Engineering systems.



## BTCVC304 Surveying – I

**Teaching Scheme:** (2 Lectures +1 Tutorial) hours/week

### Course Contents

**Module 1: Chain Surveying**

**(Lectures 08)**

Definition, principles, classification, fields and office work, scales, conventional signs, survey instruments, their care and adjustment, ranging and chaining, reciprocal ranging, setting perpendiculars, well-conditioned triangles, traversing, plotting, enlarging and reducing figures

**Module 2: Compass Surveying**

**(Lectures 08)**

Prismatic compass, surveyor's compass, bearing systems and conversions, local attraction, magnetic declination, dip traversing, adjustment of errors

**Module 3: Plane Table Surveying****(Lectures 05)**

Plane table instruments and accessories, merits and demerits, methods: radiation, intersection, resection, traversing

**Module 4: Leveling and Applications****(Lectures 08)**

Level line - Horizontal line - Levels and Staves, Spirit level – Sensitiveness, Bench marks - Temporary and permanent adjustments, Fly and Check leveling, Booking, reduction, Curvature and Refraction – reciprocal leveling - Longitudinal and cross sections - Plotting - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs. Planimeter-Types, Theory, concept of zero circle, Study of Digital Planimeter, Computation of Areas and Volumes

**Module 5: Theodolite Surveying****(Lectures 05)**

Theodolite - Vernier and micro-optic - Description and uses - temporary and permanent adjustments of vernier transit – Angles: Horizontal - Vertical - Heights and Distances - Traversing - Closing error and distribution - Gales's table - Omitted measurements

**Module 6: Engineering Surveys****(Lectures 05)**

Reconnaissance, Preliminary and location surveys for engineering projects, Layout, Setting out works, Route Surveys for highways, railways and waterways, introduction to curve ranging, Mine Surveying - Instruments – Tunnels: correlation of underground and surface surveys, shafts

**Text Books**

- Kanetkar T.P. and Kulkarni S. V., "Surveying and Leveling", Vols. I, II and III, VidyarathiGruhPrakashan, Pune
- Punmia B.C., "Surveying", Vols. I, II and III, Laxmi Publications, 16th edition, 2016

**Reference Books**

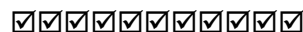
- Clark D., "Plane and Geodetic Surveying", Vol. I & II, C.B.S. Pub. &Distri., N. Delhi, 6th edi.
- Anderson J. M. and Mikhail E. M., "Introduction to Surveying", McGraw Hill Book Company
- Bannister A. and Raymond S., "Surveying", ELBS, Sixth Edition, 1992
- KahmenHeribert and Faig Wolfgang, "Surveying", Walter de Gruyter, 1995

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Perform measurements in linear/angular methods.

CO2: Perform plane table surveying in general terrain.

CO3: Know the basics of leveling and theodolite survey in elevation and angular measurements.



## BTCVC305 Building Construction

**Teaching Scheme:** (2 Lectures) hours/week

### Course Contents

**Module 1: Masonry Construction****(Lectures 06)**

Stone masonry: Random rubble, un-coursed rubble, coursed rubble &amp; ashlar brickwork &amp; brick bonds - english, flemish, principles to be observed during construction composite masonry, various partition walls, brick, aluminum &amp; timber, solid concrete blocks, hollow concrete blocks and light weight blocks (aerated autoclaved), soil stabilized blocks, fly ash blocks, cement concrete walls

**Module 2: Concrete for Construction****(Lectures 06)**

Introduction and properties of ingredients, importance of admixture materials such as pozzolona, fly ash, specific purpose chemical admixtures, Properties of fresh and hardened concrete

**Module 3: Arches and Lintels****(Lectures 06)**

Arches and their stability, technical terms in arches, types of arches, methods of construction; Lintel: Necessity, materials: wood, stone, brick, steel, R.C.C. and reinforced brick lintels, beams: types according to material, layout such as primary and secondary, continuous beams, formwork for RCC elements: function, requirements

**Module 4: Means of Lateral Communication**

**(Lectures 08)**

**Doors and windows**

Doors - classification based on parameters such as material, geometry, fixtures and fastening

Windows - classification based on parameters such as material, geometry, fixtures and fastening

Use of composite materials for doors and window frames and shutters, laying out of passages

**Stairs:**Terminology, requirements of a good stair, various types, uses and limitations

**Ramps:**Requirements and types, planning aspects for physically handicapped persons

**Elevators:**Types and their Use

**Module 5: Flooring Roofs and Types**

**(Lectures 06)**

**Flooring:**Types, factors for selections of floorings, flooring in ground and upper floors, various types of tiled flooring: natural, composite, synthetic, and special purpose flooring, concrete flooring for industrial purpose: tremix flooring

**Roof coverings:**Terms used, roof and their selection, pitched roofs and their types, roof coverings and their selection. Natural, composite, synthetic, and special purpose roof coverings, timber trusses (King Post and Queen Post), steel trusses types and their suitability

**Module 6: Precast and Pre-engineered Buildings**

**(Lectures 05)**

Principles- advantages and disadvantages, types of prefabricate, standardization, basic, nominal and actual dimensions, tolerances, joints production, transportation and erection

**Text Books**

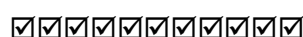
- Punmia B.C., Jain A. K., "Building Construction", Laxmi Pub. Pvt. Ltd., 10th Edi, N. Delhi
- Arora S. P. and Bindra S. P., "Text Book of Building Construction", DhanpatRai Publications
- Kumar Sushil, "Building Construction" Standard Publishers, 20th Edition, 2010.
- P. Purushothama Raj, "Building Construction Materials and Techniques", Pearson Education
- Jain V.K., "Automation Systems in Smart and Green Buildings" ISBN NO: 978-81-7409-237-3

**Reference Books**

- NBC 2005, National Building Code of India, Parts III, IV, VII and IX, B.I.S. New Delhi
- Chudley R., "Construction Technology", Vol.1, 2, 3 and 4 ELBS Publisher
- SP 7- National Building Code Group 1 to 5, B.I.S. New Delhi
- I.S. 962 - 1989 Code for Practice for Architectural and Building Drawings, B.I.S. New Delhi
- Sikka V. B., "A Course in Civil Engineering Drawing", S. K. Kataria and Sons
- Catalogues. Information Brochures, Trade Literature by material or product manufacturers
- Mehta, Scarborough, Arm Priest, "Building Construction", Pearson Education
- Macay W.B, "Building Construction", Vol. I, II, III, IV, Pearson Education
- Jain V.K., "Handbook of Designing and Installation of Services in High Rise Building Complexes" ISBN : 978-81-7409-245-8

**Course Outcomes:**On completion of the course, students will be able to:

- CO1: Understand types of masonry structures.
- CO2: Understand composition of concrete and effect of various parameters affecting strength.
- CO3: Comprehend components of building and there purposes.
- CO4: Comprehend the precast and pre-engineered building construction techniques.



# BTCVC306 Engineering Geology

Teaching Scheme:(2 Lectures) hours/week

## Course Contents

### Module 1: Introduction and Physical Geology

(Lectures 06)

Definition, Scope and subdivisions, applications of Geology in Civil Engineering, Major features of the Earth's structure, internal structure of earth, and Geological work of river: features of erosion, deposition and transportation, Civil Engineering Significance, Geological work of wind: Processes and features of erosion, deposition and transportation, Civil Engineering Significance. Volcano: Central and Fissure types, Products of volcano, Mountain: Origin and formation, types, examples

### Module 2: Mineralogy and Petrology

(Lectures 07)

Mineralogy: Physical properties of mineral, Classification of minerals, Petrology: Definition, rock cycle, Igneous rocks: Origin, Textures and Structures, Classification, Concordant and Dis-concordant Intrusions, Civil Engineering significance, Secondary rocks: Formation, Classification, Residual deposits: Soil, Laterite and Bauxite and their importance, Sedimentary deposits: Formation, Textures, Classification and Structures, Civil Engineering significance, Chemical and organic deposits, Metamorphic rocks: Agents and Types of Metamorphism, Stress and anti-stress Minerals, Structures, Products of metamorphism

### Module 3: Structural Geology

(Lectures 05)

Outcrop, Strike and Dip, Unconformity-Types, Outliers and Inliers, Overlap Fold and Fault: Parameters, Classification, Causes, Civil Engineering significance Joint: Types, Civil engineering considerations

### Module 4: Building Stones

(Lectures 05)

Properties of rocks, Requirement of good building stone, Building stones of India

**Groundwater:**Sources of groundwater, water table, Zones of groundwater, Porosity and permeability

### Module 5: Geology of Dams and Reservoirs, Tunnels and Bridges

(Lectures 08)

Preliminary geological survey, Influence of geological conditions on location, alignment, Design and Type of a dam, geological considerations in site selection for dams, Site improvement techniques, dams on carbonate rocks, sedimentary rocks, folded strata and Deccan traps, favorable and unfavorable geological conditions for reservoir site

**Tunnels and Bridges:**Influence of geological conditions on tunneling, difficulties during tunneling, tunnel lining, tunneling in folded strata, sedimentary rocks and Deccan traps, dependence of types of bridges on geological conditions

### Module 6: Preliminary Geological Investigations

(Lectures 06)

Steps in geological investigations, consideration of structural features exploratory drilling: Observations, Preservation of cores, Core logging, Core recovery, Graphical representation of core log, Limitation of exploratory drilling method

### Text Books

- Singh Prabin, "Engineering and General Geology", S. K. Katariya and sons, Delhi
- Mukerjee P. K., "A Text Book of Geology", World Press Pvt. Ltd., Calcutta
- Gokhale K.V.G.K. and Rao D. M., "Experiments in Engineering Geology", TMN, New-Delhi
- Gupte R. B., "A Text Book of Engineering Geology", Pune VidyarthiGrihaPrakashan, Pune
- SubinoyGangopadhyay, "Engineering Geology ",oxford university

### Reference Books

- G. W. Tyrrell, "Principles of Petrology", B. I. Publication Pvt. Ltd., New Delhi
- A. Holmes, "Principles of Physical Geology", ELBS Chapman & Hall, London
- Billings M. P., "Structural Geology", Prentice Hall of India Private Ltd., New Delhi
- Legget R. F., "Geology Hand book in Civil Engineering", McGraw-Hill, New York
- Krynine D. P. & Judd W. R., "Principles of Engineering Geology & Geo-technics", CBS Publishers &Distri., New Delhi
- Reddy Dr. D. V., "Engineering Geology for Civil Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

- Read H. H., “Rulley’s Elements of Mineralogy”, CBS Publishers & Distributors, Delhi

**Course Outcomes:** On completion of the course, the students will be able to:

- CO1: Recognize the different land forms which are formed by various geological agents.
- CO2: Identify the origin, texture and structure of various rocks and physical properties of mineral.
- CO3: Emphasize distinct geological structures which have influence on the civil engineering structure.
- CO4: Understand how the various geological conditions affect the design parameters of structures.



## **BTHM303 Soft Skills Development**

**Teaching Scheme:** (2 Lectures) hours/week

**Program Educational Objectives:**

- 1) To build the skills like team building so that they can work efficiently in groups.
- 2) To provide knowledge of conflict management while working in large organizations.
- 3) To develop management skills required in routine work environment.
- 4) To polish the personality of the learners in order to make them good leaders and employees.
- 5) To imbibe qualities like manners & etiquettes co-ordination, mutual understanding while working in a group.

**Module 1: Development of Proficiency in English (Lectures 02)**

Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups), 5 Ws& 1 H & 7 Cs for effective Communication, Imbibing Etiquettes and manners, Study of different pictorial expressions of non-verbal communication and their analysis

**Module 2: Self-Management (Lectures 02)**

Self-Evaluation, Self-discipline, Self-criticism, Recognition of one’s own limits and deficiencies, dependency, etc., Self-Awareness, Self-Management, Identifying one’s strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride, Leadership & Team Dynamics

**Module 3: Time Management Techniques (Lectures 02)**

Practice by game playing and other learning strategies to achieve the set targets Time Management Concept, Attendance, Discipline & Punctuality, Acting in time, Quality /Productive time

**Module 4: Motivation/ Inspiration (Lectures 02)**

Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation

**Motivation techniques:** Motivation techniques based on needs and field situations

**Module 5: Interpersonal Skills Development (Lectures 02)**

Positive Relationship, Positive Attitudes and Empathies: comprehending others’ opinions, points of views, and face them with understanding Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills

**Module 6: Effective Computing Skills (Lectures 02)**

Designing an effective Presentation, Contents, appearance, themes in a presentation, -Tone and Language in a presentation, Role and Importance of different tools for effective presentation

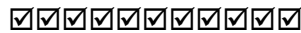
**Reference Books**

- 1) Mitra, Barun, “Personality Development and Soft Skills”, Oxford University Press, 2016

- 2) Ramesh, Gopalswamy, “The Ace of Soft Skills: Attitude, Communication & Etiquette for Success”, Pearson Education, 2013
- 3) Covey, Stephen R., “Seven Habits of Highly Effective People: Powerful Lessons in Personal Change”
- 4) Rosenberg Marshall B., “Nonviolent Communication: A Language of Life”

**Program Educational Outcomes**

- 1) Learners will acquire interpersonal communication skills.
- 2) Learners will develop the ability to work independently.
- 3) Learners will develop the qualities like self-discipline, self-criticism and self-management.
- 4) Learners will have the qualities of time management and discipline.
- 5) Learners would be able to present themselves as an inspiration for others.



## BTCVL307Hydraulic Engineering Laboratory I

**Practical:**2 hours / week

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

- 1) Measurement of Viscosity of various fluids
- 2) Demonstration of working of different types of valves and pipe fittings
- 3) Measurement of pressure Piezometer, manometers, Pressure gauges
- 4) Measurement of discharge - Calibration of measuring tank, Use of hook or point gauge.
- 5) Verification of Bernoulli's Theorem
- 6) Determination of metacentric height.
- 7) Calibration of an orifice / mouthpiece / venturimeter / orifice meter
- 8) Study of factors affecting coefficient of friction for pipe flow (for two different materials and two different diameters)
- 9) Determination of loss of head due to Pipe Fittings

Use of computer programs such as MS Excel is desirable for post-processing of results.

## BTCVL308Surveying Laboratory - I

**Practical:**2 hours / week

Practical Work consists of performances among the list below and detailed reporting in form of field book, journal and drawing sheets. Practical examination shall be based on above practical course.

Essential Practical

- 1) Use of Dumpy Level, Auto Level and Tilting Level.
- 2) Sensitivity of Bubble Tube using Dumpy Level.
- 3) Evaluation of constant of Planimeter, and use of Digital Planimeter for measurement of areas.
- 4) Study of Theodolite.
- 5) Methods of Plane Table Survey
- 6) Study and use of Total Station

Among following any four shall be performed

- 1) Reciprocal Levelling.
- 2) Illustration of Permanent adjustment of Dumpy Level
- 3) Measurement of Horizontal Angle by Various Methods
- 4) Measurement of Magnetic Bearing and Vertical Angle by Theodolite
- 5) Two Point and Three Point Problems

6) Study and use of Minor Instruments

**Course Outcomes:** On completion of the course, the students will be able to:

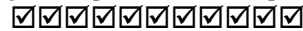
CO1: Use the theodolite along with chain/tape, compass on the field.

CO2: Apply geometric and trigonometric principles of basic surveying calculations.

CO3: Plan a survey, taking accurate measurements, field booking, and adjustment of errors.

CO4: Apply field procedures in basic types of surveys, as part of a surveying team.

CO5: Employ drawing techniques in the development of a topographic map.



## BTCVL309 Building Construction - Drawings Laboratory

**Practical:** 2 hours / week

### List of Drawing Assignments

- 1) Sketch Book consisting of free hand proportional scale sketches for items to be drawn on drawing sheets as mentioned below under (2)
- 2) Drawing to scale on a half imperial drawing sheet covering following aspects.
  - a) Lettering, Symbols, Types of lines and dimensioning as per IS 962.
  - b) Foundations: - Isolated, Combined Footings, Under Reamed Piles, Rafts.
  - c) Types of Stone Masonry: Elevation and Sectional Drawings.
  - d) Types of Brick masonry: Elevation and Sectional Drawings.
  - e) Types of Doors: Elevation and Sectional Drawings.
  - f) Types of Windows: Elevation and Sectional Drawings, Standard Aluminum Sections.
  - g) Types of Stairs: Plan and Sectional Drawings.
  - h) Trusses: Various types, various roof covering materials, sketches for sectional profiles
  - i) Typical plan for a single room and sectional views.
- 3) Site visit: To understand various building materials and their use.

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Draw plan, elevation and section of various structures.

CO2: Apply the principles of planning and by laws used for building planning.

CO3: Prepare detailed working drawing for doors and windows.



## BTCVL310 Engineering Geology Laboratory

**Practical:** 2 hours / Week

### List of Experiments

Practical Work consists of study of relevant rock and mineral samples. Detailed report is expected.

- Megascopic study of Rock forming minerals
- Megascopic study of Ore forming minerals
- Megascopic study of Igneous rocks
- Megascopic study of Secondary rocks
- Megascopic study of Metamorphic rocks
- Cross-section Preparation and interpretation of geological maps
- Study of Structural Geological models
- Preparation of bore log /lithologs
- Interpretation of bore- hole data

Study tour to the places of Engineering Geological importance



A Journal containing record of above practical work shall be examined as Term Work. Practical examination shall be based on above practical course.

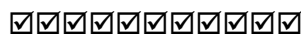
**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Calculate the linear measurement on surface.

CO2: Find out engineering properties of various geological materials.

CO3: Draw subsurface lithologs.

CO4: Identify minerals and rocks by studying physical properties.

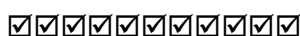


### BTCVS311 Seminar on Topic of Field Visit to Foundation Work

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of foundation execution. It is desirable to collect basic information of geotechnical aspects of foundations, types and components of foundations, tools and plants, construction machinery, etc. Intention is to introduce students to process of collection and presentation of technical information. Report shall be submitted to cover above aspects as studied.

### BTCVF312 Field Training (from semester II)

Student shall undergo field training / industrial training / internship during summer vacation after Semester II. This training is at elementary level expecting exposure to field practices. A brief report shall be submitted. Evaluation shall be based on report and power point presentation.



### Semester- IV

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTCVC401	Hydraulics II	2	1	✓	3
02	BTCVC402	Surveying – II	2	1	✓	3
03	BTCVC403	Structural Mechanics-I	3	1	-	4
04	BTID405	Product Design Engineering	1	2	-	3
05	CV E1	<b>Elective I</b>	3	-	-	3
06	BTCVC406	Engineering Management	1	-	-	AU
07	BTHM3401	Basic Human Rights	2	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL407	Hydraulics Laboratory II	-	-	2	1
09	BTCVL408	Surveying Laboratory II	-	-	4	2
10	BTCVL409	Mechanics of Solids Laboratory	-	-	2	1
11	BTCVM410	Mini Project	-	-	2	1
12	BTCVF411	Seminar on Topic of Field Visit to works involving Superstructure Construction	-	-	1	1
Sub-Total			<b>14</b>	<b>5</b>	<b>11</b>	
<b>Total</b>			<b>31</b>			<b>22</b>
<b>Elective I</b>						
	BTCVE404A BTCVE404B BTCVE404C	Numerical Methods in Engineering Planning for Sustainable Development Instrumentation & Sensor Technologies for Civil Engineering Applications	3	-	-	3

# BTCVC401Hydraulics II

Teaching Scheme:(2 Lectures +1 Tutorial) hours/week

## Course Contents

### Module 1: Uniform Flow in Open Channel

(Lectures 06)

Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot tube, current meter) weir & spillway: sharp, broad & round crested weirs, calibration of weir, time of emptying tank with weir, profile of ogee spillway, flow below gates

### Module 2: Steady & Uniform Flow

(Lecture 05)

Chezy's & Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section- considerations for rectangular, triangular, trapezoidal, circular sections

Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow, specific force, specific discharge derivation of relationships and numerical computations

### Module 3: Varied Flow

(Lectures 07)

**Gradually (G.V.F.):** Definition, classification of channel Slopes, dynamic equation of G.V.F. (Assumption and derivation), classification of G.V.F. profiles-examples, direct step method of computation of G.V.F. profiles

**Rapidly varied flow (R.V.F.):** Definition, examples, hydraulic jump- phenomenon, relation of conjugate depths, parameters, uses, types of hydraulic jump

### Module 4: Impact of Jet

(Lectures 05)

Impulse momentum principle, impact of jet on Vanes-flat, curved (stationary and moving), inlet & outlet velocity triangles under various conditions, Series of flat, curved vanes mounted on wheel

### Module 5: Hydraulic Machines

(Lectures 08)

**Turbines:** Importance of hydro-power, classification of turbines, description, typical dimensions and working principle of Pelton, Francis & Kaplan turbine (detailed design need not to be dealt with), Module quantities, specific speed, performance characteristics, selection of type of turbine, description & function of draft tube, Thomas's cavitation number

**Pumps:** Classification, component parts, working of centrifugal pump, performance characteristics, pump selection, common troubles & remedies, introduction to different types of pumps: reciprocating, multi-stage, jet, air lift, submersible pump

### Module 6: Boundary Layer Theory

(Lectures 06)

Concept, Boundary layer along thin plate- Characteristics, Laminar, Turbulent Boundary Layer, laminar sub layer, Various Thicknesses- Nominal, displacement, Momentum, Energy. Hydraulically smooth and Rough boundaries, Separation of Boundary layer, control of Separation, Introduction to Drag and Lift on submerged bodies (Flat plates, Sphere, Cylinder, aerofoil), Stokes law, Concept of Drag and Lift coefficients

### Text Books

- Modi, Seth, "Fluid Mechanics – Hydraulic & Hydraulic Mechanics" Standard Book House
- Bansal R.K., "Fluid Mechanics", Laxmi Publications, 9th edition 2017
- Garde R. J., "Fluid Mechanics through Problems", New Age Publications, 3rd edition 2011
- Jain A. K., "Fluid Mechanics", Khanna Publications, 8th edition, 2003, Delhi
- Kumar K. L., "Fluid Mechanics", Eurasia Publication House, 11th edition, Delhi
- Rangaraju, "Open Channel flow", Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., "Fluid Mechanics through Problems" Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., "Flow in Open Channel", Edition V, Tata McGraw-Hill Pub. Co., Delhi

### Reference Books

- Streeter, "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Shames, "Mechanics of Fluids", McGraw Hill, 4th edition

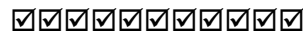
- Chaw V. T., “Flow in Open Channel”, McGraw-Hill International Book Co., Auckland
- Hughes & Brighton, “Fluid Mechanics”, Tata McGraw Hill

**Course Outcomes:**On completion of the course, the students will

CO1: Design open channel sections in a most economical way.

CO2: Know about the non-uniform flows in open channel and the characteristics of hydraulic jump.

CO3: Understand application of momentum principle of impact of jets on plane



## BTCVC402 Surveying – II

**Teaching Scheme:**(2 Lectures +1 Tutorial) hours/week

### Course Contents

**Module 1: Tachometry**

**(Lectures 08)**

Significance and systems, principle, constants, basic formulae and field work stadia method, auto reduction tachometer, tangential system

**Electronic Distance Measurement:**Importance, principles of electronic distance measuring (EDM) instruments, classification of EDM’s based on carrier waves used, study and use of total station

**Module 2: Triangulation**

**(Lectures 06)**

Principle & classification, system, selection of station, base line measurement, correction and use of subtense bar, signals, satellite station, reduction to center, spherical excess, angular observations, tri-iteration

**Triangulation Adjustments:**Theory of errors, laws of weights, concept of most probable value

**Module 3: Field Astronomy**

**(Lectures 06)**

Terms, co-ordinate systems, determination of latitude and true bearing by observation on the sun and pole star

**Module 4: Curves**

**(Lectures 06)**

Horizontal and vertical curves, simple curves, setting with chain and tapes, tangential angles by theodolite, double theodolite, compound and reverse curves, transition curves, functions and requirements, setting out by offsets and angles, vertical curves, sight distance requirements

**Module 5: Photogrammetry**

**(Lectures 06)**

Terms, types, vertical photographs, scale, ground coordinates, relief displacement, flight planning photomaps and mosaics, stereoscopy and photo interpretation

**Module 6: Remote Sensing**

**(Lectures 06)**

Introduction, classification and principles, electromagnetic energy and its interaction with matter, idealized systems, sensors, platforms, and application in civil engineering, G.P.S & G.I.S. as surveying techniques – Overview, uses and applications

**Text Books**

- Bannister A., Raymond S., Wartikar J.N., Wartikar P.N., “Surveying”, ELBS, 6th Editon, 1992
- HeribertKahmen and Wolfgang Faig, “Surveying ”, Walter de Gruyter, 1995
- Kanetkar T.P., "Surveying and Leveling", Vols. I, II and III, VidyarthiGruhPrakashan, Pune
- Punmia B.C., “Surveying”, Vols. I, II and III, Laxmi Publications

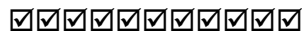
**Reference Books**

- James M. Anderson and Edward M. Mikhail, “Introduction to Surveying”, McGraw Hill Book Company
- Clark D., “Plane and Geodetic Surveying”, Vol. I and II, C.B.S. Publishers and Distributors, New Delhi, Sixth Edition
- Agor, “Advanced Surveying”, Khanna Publications, Delhi
- Arora K. L., “Surveying”, Vol.1 & 2
- Basak, “Surveying and Levelling”Vol 1 & 2, Tata McGraw Hill Publications, New Delhi

- Duggal S. K., “Surveying”, Vol 1 & 2, Tata Mcgraw Hill Publications, New Delhi
- Gopi S., Satikumar R. and Madhu N., “Advanced Surveying”, Pearson Education,
- Chandra A. M., “Higher Surveying”, New Age International Publication

**Course Outcomes:** On completion of the course, the students will be able to:

- CO1: Understand basics different types of curves on roads and their preliminary survey.
- CO2: Perform setting of curves, buildings, culverts and tunnels.
- CO3: Comprehend different geodetic methods of survey such as triangulation, trigonometric leveling.
- CO4: Comprehend modern advanced surveying techniques.



## **BTCVC403 Structural Mechanics – I**

**Teaching Scheme:** (3 Lectures +1 Tutorial) hours/week

### **Course Contents**

**Module 1: Beam Deflections**

**(Lectures 06)**

Calculations of deflection for determinate beams by double integration, Macaulay’s method, moment area method, conjugate beam method, deflection by method of superposition

**Module 2: Energy Principles**

**(Lectures 05)**

Strain energy and strain energy density, strain energy in traction, shear, flexure and torsion - Castiglano's and Engessor's energy theorems, principle of virtual work, application of energy theorems for computing deflections in beams, Maxwell's reciprocal theorem, Williot Mohr diagrams

**Module 3: Method of Consistent Deformation**

**(Lectures 07)**

Different structural systems, concept of analysis, basic assumptions, indeterminacy, choice of unknowns, Castiglano's theorem

**Indeterminate Beams:** Analysis of indeterminate beams: Propped cantilever and fixed beams - fixed end moments and reactions for standard cases of loading – slopes and deflections in fixed beams

**Module 4: Moment Distribution Method**

**(Lectures 06)**

Analysis of continuous beams propped cantilevers, continuous beams - theorem of three moments - analysis of continuous beams settlement effects, thermal effect, Shear Force and Bending Moment diagrams for continuous beams, portal frames with and without sway

**Module 5: Slope Deflection Method**

**(Lectures 06)**

Analysis of continuous beams, analysis of rigid frames, frames without sway and with sway, settlement effects, introduction to difficulties in frames with sloping legs and gabled frames

**Module 6: Thin Cylinders**

**(Lectures 07)**

Thin cylinders subjected to internal fluid pressure, wire wound thin cylinders, thin cylindrical shells, circumferential and hoop stresses, longitudinal stresses, maximum shear stress, concept of stresses in thick cylinders

**Text Books**

- Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill, 3rd edition 2010
- Wang C.K., “Statically Indeterminate Structures”, McGraw Hill
- Vazirani V.N., Ratwani M.M and Duggal S.K., “Analysis of Structures - Vol. I”, ISBN NO: 978-81-7409-140-8
- Khurmi R.S., “Theory of Structures”, S Chand, Delhi
- Punmia B.C., “Structural Analysis”, Laxmi Publications

**Reference Books**

- Timoshenko and Young, “Theory of structures”, McGraw Hill

- Norris C. H. and Wilbur J. B., “Elementary Structural Analysis”, McGraw Hill
- Kinney J. S., “Indeterminate Structural Analysis”, Oxford and IBH
- Hibbler R. C., “Structural Analysis”, Pearson Publications, 9<sup>th</sup> Edition
- Schodek, “Structures”, Pearson Education, 7<sup>th</sup> edition
- Ramamrutham S. and Narayanan R., “Theory of Structures” DhanpatRai Publishers, Delhi

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Describe the concept of structural analysis, degree of indeterminacy.

CO2: Calculate slopes and deflection at various locations for different types of beams.

CO3: Identify determinate and indeterminate trusses and calculate forces in the members of trusses

Perform the distribution of the moments the in continuous beam and frame.



## BTID405 Product Design Engineering

### Course Contents

**Pre Requisites:** Knowledge of Basic Sciences, Mathematics and Engineering Drawing

**Design Studio:** 2 hr / week to develop designs through sketching, practical skills and learning digital tools

**Continuous Assessment:** Documentation of steps in the selected product design

**Final Assessment:** Product Design in Studio with final product specifications

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

1. Create simple design of components or a system as whole
2. Create design documents for knowledge sharing
3. Manage own work to meet design requirements
4. Work effectively in a team

Subject refers to products in civil engineering. Product may an entity such as a building, bridge, road, railway, airport, tunnel, port, harbor, water supply or disposal schemes or components involved in such entities as tiles, doors, windows, walls, structural members, abutment, pier, etc., or even materials produced in industry such as cement, steel, composites, FRP, bricks or blocks etc. It is intended to refer to few of these products which may be chosen by student. Group activity is encouraged.

#### **Module1: Introduction to Engineering Product Design:**

**(Lectures 02)**

Concept of a product, Problem solving approach for Product Design, Trigger for Product/ Process/ System, Disassembling existing Product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, revival of failed products, Public/Society’s perception of products, and its input into product design.

#### **Module 2: Ideation**

**(Lectures 02)**

Generation of ideas, Funnelling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, scale and cost, Initial specifications of products

#### **Module 3: Conceptualization**

**(Lectures 02)**

Computer operation principles and image editing through a graphical Composition; Computer aided 2D drafting and 3D Modeling through simple exercises.

Designing of components, Drawings of parts and synthesis of a product from its component parts, idea of rendering designs for 3-D visualization and to create a photo image, Parametric modelling of product, 3-D Visualization of mechanical products, Detail Engineering drawings of components

#### **Module 4:Detailing**

**(Lectures 02)**

Managing assembling, Product specifications- data Sheet, Simple component designs, Workshop and erection safety and health issues, Create documents for knowledge sharing

#### **Hands-on Activity Charts for Use of Digital Tools using software such as Autodesk Fusion 360 or similar freeware**

Activity 1	Learn the basic vector sketching tools.	2
Activity 2	General understanding of shading for adding depth to objects. Understanding of editing vectors	2
Activity 3	Begin developing a thought process for using digital sketching.	3
Activity 4	Create a basic shape objects sphere, box cylinders	3
Activity 5	Create Automotive wheel concepts	3
Activity 6	Understanding Navigation and Data Panel Interface	2
Activity 7	Solid and Surface modelling, Rendering 3-D models	4
Activity 8	Product market and Product Specification Sheet	3
Activity 9	Documentation for the product	2

#### **Reference Books**

- Model Curriculum for “Product Design Engineer –Mechanical”, NASSCOM (Ref. ID: SSC/Q4201, Ver 1.0, NSQF Level: 7)
- Eppinger, S., & Ulrich, K. (2015), “Product Design and Development”. McGraw-Hill Higher Education.
- Green, W., & Jordan, P. W. (1999), “Human Factors in Product Design: Current Practice and Future Trends”, CRC Press.
- Sanders, M. S., & McCormick, E. J. (1993), “Human Factors in Engineering and Design”, McGraw-Hill Book Company
- Roozenburg, N. F., & Eekels, J. (1995), “Product Design: Fundamentals and Methods (Vol. 2)”, John Wiley & Sons Inc.
- Lidwell, W., Holden, K., & Butler, J. (2010), “Universal Principles of Designs: Revised and Updated: 125 ways to Enhance Usability, Influence Perception, Increase Appeal, make Better Design Decisions and Teach through Design”, Rockport Pub.

## **BTCVE404A Numerical Methods in Engineering**

**Teaching Scheme:**(3 Lectures) hours/week

**Pre Requisites:** Mathematics - I and Mathematics – II

### **Course Contents**

#### **Module 1(Lectures 06)**

Basis of Computations, Matrix Operations on Computer, Multiplication and Inversion, Solution of Simultaneous Equations, Gauss Elimination Method, Cholesky Decomposition method, Gauss Jordan and Gauss Seidal Methods

#### **Module 2**

**(Lectures 06)**

Roots of Equation, Trial and Error, Bisection, Secant Iteration, Newton Rapson Method, Solution of Ordinary Differential Equation, Euler’s Method, Modified Euler’s Method and RungaKutta Methods.

#### **Module 3**

**(Lectures 06)**

Interpolation with Newton's Divided Differences, Lagrange's Polynomial, Finite Difference Method, Central, Forward and Backward Differences, Least Square Polynomial Approximations Application in Deflection of Determinate Beams, Buckling Load of Long Columns

#### **Module 4**

**(Lectures 04)**

Numerical Integration: Trapezoidal Rule, Simpon’s Rules, Gauss Quadrature Rules

**Module 5****(Lectures 04)**

Statistical Analysis of Experimental Data, Mean, Median, Mode, Deviation, Measures of Dispersion, Least Square Method, Regression Analysis: Linear, Parabolic, Curve Fitting

**Module 6****(Lectures 04)**

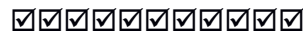
Implementation of above methods by algorithm development leading to programming in Spreadsheets / Fortran / C / C++

**Text Books**

- Balaguruswami E., “Numerical Methods”, Tata Mc-Graw Hill
- Scheid F, “Numerical Analysis (Schaum’s series)”, Tata Mc-Graw Hill
- Chapra. S. C. and Canale R. P., “Numerical Methods for Engineers”, by, Tata Mc-Graw Hill
- Shantha Kumar M , “Computer Based Numerical Analysis”, Khanna Publication
- Grewal B.S. and Grewal J.S., “Numerical Methods in Engineering and Science”, Khanna Publication, N. Delhi
- Sastry, S.S., "Introductory Methods of Numerical Analysis", Printice Hall of India, New Delhi

**Reference Books**

- Jain, Aryengon, “Numerical Methods for Scientific and Engineering Applications”, Wiley Eastern Publication
- Numerical Recipe , Oxford Publishing
- Manuals for the Commercial Computer Programmes



## BTCVE404B Planning for Sustainable Development

**Teaching Scheme:**(3 Lectures) hours/week

### Course Contents

**Module 1:****(Lectures 06)**

Sustainable Development-explains and critically evaluates the concept of sustainable development, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability,

**Module 2:****(Lectures 06)**

Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

**Module 3:****(Lectures 04)**

Innovation for sustainable development- Environmental management and innovation strategies.

**Module 4:****(Lectures 04)**

Societal transformations. Institutional theory.

**Module 5:****(Lectures 04)**

Governance for sustainable development. Policy responses to environmental degradation.

**Module 6:****(Lectures 04)**

Capacity development for innovation. Research methods.

**Text/Reference Books:**

- Harris, J.M. (2004) Basic Principles for Sustainable Development, Global Development and Environment
- Institute, working paper 00-04, available at:  
[http://ase.tufts.edu/gdae/publications/Working\\_Papers/Sustainable%20Development.PDF](http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF)
- Robinson, J. (2004), “Squaring the circle? Some thoughts on idea of sustainable Development” Ecological Economics 48(4): 369-384.
- Hjorth, P. & A. Bagheri (2006), “Navigating towards Sustainable Development: A System Dynamics Approach”, Futures 38: 74-92.

- Mog, J.M. (2004) „Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs“, World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)
- Arundel, A., R. Kemp, and S. Parto (2004) Indicators for Environmental Innovation: What and How to Measure, forthcoming in International Handbook on Environment and Technology Management (ETM), edited by D. Annandale, J. Phillimore and D. Marinova, Cheltenham, Edward Elgar.
- Douthwaite, B. (2002) Enabling Innovation. A practical guide to understanding & fostering innovation, London, Zed Books.



## **BTCVC406 Engineering Management**

**Teaching Scheme:**(1 Lecture) hours/week

### **Course Contents**

**Module 1: Evolution of Management Thought**

**(Lectures 02)**

Scientific, human behavior, system approach, introduction to elements of systems – input, output, process restriction, feedback, contingency approach, contributions by Taylor, Frank and Lillion, Gilbreth, Henry Fayol, Elton Mayo, McGregor (theory X and theory Y), H. L. Gantt, Maslow

**Module 2: Functions of Management**

**(Lectures 02)**

Planning – nature and purpose of planning, strategies and policies, management by objectives, formal and informal organization, centralization, decentralization, line, line and staff, functional organization, principles of site layout, leading and directing, controlling and coordination (introduction only), communication process, motivation

**Module 3: Decision Making**

**(Lectures 02)**

Importance of decision making, steps in decision making, analysis of decision, decision under certainty, uncertainty and decision under risk, criterion of optimism and regret, sensitivity of criteria and decision under conflict, expected monetary value, decision tree, theory of games (dominance pure and mixed strategy).

**Module 4: Operations Research**

**(Lectures 04)**

Linear programming, simple l-p model, simplex method - duality, sensitivity analysis, application of linear programming in transportation and assignment models

**Module 5: Simulation Studies**

**(Lectures 02)**

Monte-Carlo simulation, queuing or waiting line theory (simple problems), dynamic programming, introduction to emerging optimization techniques

**Module 6: Material Management**

**(Lectures 02)**

Material management – purchasing principles, stores, coding system function, responsibilities, record and accounting. Inventory control – an introduction, inventory cost, EOQ analysis, ABC analysis, safety stocks

**Text Books**

- Deshpande S. H., “Operation Research”
- Deshpande A. S., “A Text book of Management”
- Gopal Krishnan, “Material Management”, Sdushman.
- Taha, “Operation Research”
- Banga and Sharma, “Engineering Management”

**References**

- Stoner, “Engineering Management”
- Davar, “Principles of Management”
- Koontz, Dounell and Weigrick, “Essentials of Management”
- Kast and Rosinweig, “Management and Organization”, Tata McGraw Hill Publication.



- Wagner, “Operation Research”, Wikey Easter Ltd., New Delhi
- Zhamb L.C., “Quantitative Techniques in Management”, Vol. I,
- Miller and Stars, “Executive Decisions & Operation Research”, Prentice Hall of India

**Course Outcomes:**On completion of the course, the students will be able to:

- CO1: Demonstrate the nuances of management functions.
- CO2: Analyze the framework of a business organization.
- CO3: Adopt an empirical approach toward business situations.
- CO4: Apply various Management techniques.



## **BTHM3401 Basic Human Rights**

**Teaching Scheme:**(2 Lectures) hours/week

### **Course Contents**

**Module 1: Basic Concepts** **(Lectures 04)**  
 Individual, group, civil society, state, equality, justice. Human Values, Human rights & Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working & exploited people

**Module 2: Fundamental Rights and Economic Program** **(Lectures 04)**  
 Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

**Module 3: Workers and Human Rights** **(Lectures 04)**  
 Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

**Module 4: NGOs and Human Rights in India** **(Lectures 04)**  
 Land, Water, Forest issues.

**Module 5: Human Rights in Indian Constitution and Law** **(Lectures 04)**  
 i) The Constitution of India: Preamble; ii) Fundamental rights; iii) Directive principles of state policy; iv) Fundamental duties; v) Some other provisions

**Module 6: UDHR and Indian Constitution** **(Lectures 04)**  
 Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

#### **References**

- 1) Shastry, T. S. N., “India and Human Rights: Reflections”, Concept Publishing Company India (P Ltd.), 2005.
- 2) C. J. Nirmal, “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford India.



## **BTCVL407Hydraulic Engineering Laboratory II**

**Practical:**2 hours / week

Practical Work consists of at least three performances from groups listed below and detailed reporting in form of journal. Practical examination shall be based on above.

#### **Group (A)**

- 1) Calibration of V notch / Rectangular notch.
- 2) Calibration of Ogee Weir.
- 3) Study of hydraulic jump

- a) Verification of sequent depths,
  - b) Determination of loss in jump.
  - c) Study of parameters with respect to Fraud Number: i)  $Y_2/Y_1$ ; ii) Length; iii) Energy loss
- 4) Study of flow below gates – Discharge v/s head relation, Equation of flow, Determination of contraction in fluid in downstream of gate.
- 5) Velocity distribution in open channel in transverse direction of flow.

**Group (B)**

- 1) Impact of jet.
- 2) Study of Turbines (Demonstration).
- 3) Tests on Centrifugal Pump.
- 4) Study of Charts for Selection of Pumps

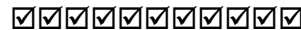
Use of computer programs such as MS Excel is desirable for post-processing of results.

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Understand various properties of fluids and measurement techniques.

CO2: Carry out calibrations of various flow measuring devices.

CO3: Understand mechanism of hydraulic jump, various jets and pumps.



## BTCVL408 Surveying Laboratory - II

**Practical:** 4 hours / week

Practical Work consists of performing field practical from the list below and detailed reporting in form of journal. Practical examination shall be based on above.

1. Tacheometry

- a) Determination of tachometric constants,      b) Determination of grade of a line.

2. Use of subtense bar for distance measurement.

3. Setting out of curves

- a) Simple circular curves,      b) Transition curves

4. Study of topo sheets

5. Study of Aerial Photographs under Stereoscope

6. Traversing by Total Station.

**Projects:** 1) Road Project 2) Radial Contouring. 3) Block Contouring Project 4) Theodolite Traversing

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Determine contour level of field.

CO2: Determine the tachometric constants and grade of a line.

CO3: Use sub tense bar for distance measurement.



## BTCVL409 Solid Mechanics Laboratory

**Practical:** 2 hours / week

Practical Work consists of performance of at least seven experiments from the list below (excluding the eleventh study) experiment: Detailed report is expected.

**List of Experiments**

- 1. Tension test on ferrous and non-ferrous alloys (mild steel / cast iron /aluminum etc.)
- 2. Compression test on mild steel, aluminum, concrete, and wood.

3. Shear test on mild steel and aluminum (single and double shear tests).
4. Torsion test on mild steel and cast iron solid bars and pipes.
5. Flexure test on timber and cast iron beams.
6. Deflection test on mild steel and wooden beam specimens.
7. Graphical solution method for principal stress problems.
8. Impact test on mild steel, brass, Aluminum, and cast iron specimens.
9. Experimental on thermal stresses.
10. Strain measurement involving strain gauges / rosettes.

Assignment involving computer programming for simple problems of stress, strain computations.

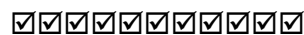
**Course Outcomes:** On completion of the course, the students will be able to:

Evaluate Young Modulus, torsional strength, hardness and tensile strength of given specimens.

Determine the strength of coarse aggregates.

Find the compressive strength of concrete cubes and bricks.

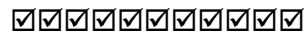
Determine physical properties of given coarse aggregates, fine aggregates and cement samples.



## BTCVM410 Mini Project

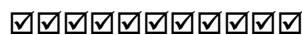
**Practical:** 2 hours / week

Students shall take up work leading to product development. Needs of community around may be of prime concern. Work may target at easing out conventional construction operation by improvement of traditional devices / tools or development of altogether new approach.



## BTCVF411 Seminar on Topic of Field Visit to works involving Superstructure Construction

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of execution of superstructure of buildings or other. It is desirable to collect basic information on components of superstructure, tools and plants, construction machinery, etc. Intention of the work is to introduce the student to the chronological order of execution of works and generate data on vocabulary of terms in field.



## Semester- V

Sr. No	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
<b>Theory</b>						
01	BTCVC 501	Design of Steel Structures	2	2	-	4
02	BTCVC 502	Structural Mechanics-II	2	1	-	3
03	BTCVC 503	Soil Mechanics	3	1	✓	4
04	BTCVC 504	Environmental Engineering	2	-	✓	2
05	BTCVC 505	Transportation Engineering	2	-	✓	2
06	CV E2	<b>Elective II</b>	3	-	-	3
07	BTHM507	Essence of Indian Traditional Knowledge	1	-	-	AU
<b>Practical / Drawing and/or Design</b>						
08	BTCVL508	Soil Mechanics Laboratory	-	-	2	1
09	BTCVL509	Environmental Engineering Laboratory	-	-	2	1
10	BTCVL510	Transportation Engineering Laboratory	-	-	2	1
11	BTCVS511	Seminar on Topic of Field Visit to works related to Building Services	-	-	1	AU
		Sub-Total	<b>15</b>	<b>4</b>	<b>7</b>	
		<b>Total</b>	<b>26</b>			<b>21</b>
		<b>Elective II</b>				
	BTCVE506A	Materials, Testing & Evaluation	3	-		3
	BTCVE506B	Computer Aided Drawing				
	BTCVE506C	Development Engineering				
	BTCVE506D	Business Communication & Presentation Skills				

## BTCVC 501 Design of Steel Structures

**Teaching Scheme:** (2 Lectures + 2 Tutorial) hours/week

### Course Contents

#### Module 1: Introduction and Connections

(8 Lectures)

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

#### Module 2: Axially Loaded Members

(6 Lectures)

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice

Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

#### Module 3: Beams

(6 Lectures)

Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections

#### Module 4: Industrial Roofing

(6 Lectures)

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details

Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

## Module 5: Columns and Column Bases

(8 Lectures)

Simple and built up section, lacing, battening, column subjected to axial force and bending moment, column splices.

Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt

## Module 6: Introduction to Plastic Analysis and Limit State method (4 Lectures)

Introduction to: Plastic Analysis, Hinge Formation, Collapse Mechanism, Recent approaches in Steel Structure design based on Plastic Analysis Method and Limit State Approach, Introduction to Provisions in IS 800-2007

**Note:** Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic design concept and IS 800: 1984. Unit 6 shall be taught with reference to IS 800 2007

Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

### Text Books

- Duggal S. K., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Gambhir, “Fundamentals of Structural Steel Design”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Negi L. S., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Chandra Ram, “Design of Steel Structures”, Vol. I & Vol. II, Standard Book House, New Delhi
- Dayaratnam P., “Design of Steel Structures”, Wheeler Publishing, New Delhi
- Subramanian N., “Steel Structures: Design and Practice” Oxford Univ. Press, Delhi
- Vazirani V.N. and Ratwani M.M., “Design and Analysis of Steel Structures”, ISBN NO: 978-81-7409-295-3
- Sai Ram K. S., “Design of Steel Structures”, Pearson Education, 2<sup>nd</sup> Edition

### Reference Books

- Arya A. S. and Ajamani J.L., “Design of Steel Structures”, Nemchand and Brothers, Roorkee
- Vazirani&Ratwani, “Design of Steel Structures”, Standard Book House, New Delhi
- Duggal S. K., “Limit State Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
- Gaylord E.H. and Gaylord C.N., “Design of Steel Structures” McGraw Hill, New York
- Lothers J.E., “Design in Structural Steel” Vol.-I, Prentice Hall New Jersey
- Salmon and Johnson, “Steel Structures: Design and Behaviour”, Harper and Row, New York
- Steel Designers Manual.

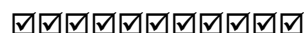
**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.

CO4: Understand provisions in relevant BIS Codes.



## BTCVC 502 Structural Mechanics-II

**Teaching Scheme:** (2 Lectures + 1 Tutorial) hours/week

### Course Contents

Application of All methods shall be restricted to beams, Frames and /or pin jointed frames or trusses of Degree of Indeterminacy up to three

**Module 1: Analysis of trusses****(6 Lectures)**

Analysis of determinate and indeterminate pin jointed trusses by energy method, effects of settlement and pre-strains

**Module 2: Moving Loads and Influence Lines****(6 Lectures)**

Introduction to moving loads, concept of equivalent UDL, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending and deflection of determinate beams, influence line diagram (ILD) for forces in determinate frames and trusses, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, application of Muller Breslau principle for determinate structures to construct ILD

**Module 3: Cables, Suspension Bridges and Arches****(6 Lectures)**

Analysis of forces in cables, suspension bridges with three hinged and two hinged stiffening girders, theory of arches, Eddy's theorem, circular, parabolic and geometric arches, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches, effect of yielding of supports, rib shortening and temperature changes. ILD for 3 hinged arches and suspension bridges

**Module 4: Analysis of Indeterminate Structures by direct Flexibility Method****(6 Lectures)**

Fundamental concepts of flexibility method of analysis, flexibility coefficients and their use in formulation of compatibility equations, application of above methods to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of members, rigid jointed frames.

**Module 5: Analysis of Indeterminate Structures by direct Stiffness Method****(6 Lectures)**

Fundamental concepts of stiffness method of analysis, stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports, pin jointed frames.

**Module 6: Finite Element Method** (Contents to conceptual level)**(6 Lectures)**

Introduction to analysis by discretization such as finite difference method, Finite element method: types of elements-1D, 2D, 3D, Plane Strain and Plane Stress Problem, isoperimetric and axisymmetric, convergence criteria, Pascal's triangle, direct stiffness method, principle of minimum potential energy. Shape functions, concept of local and global stiffness matrix

**Text Books**

- Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill
- Pandit G. S. and Gupta S. P., "Structural Analysis - a Matrix Approach", Tata McGraw Hill, N.Delhi, 1986
- Chandrupatla T. R., Belegundu A. D., "Introduction to Finite Elements in Engineering, Prentice Hall, N. Delhi, 1996
- Thadani B. N. and Desai J. P., "Structural Analysis"
- Punmia B.C., "Structural Analysis", Laxmi Publications
- Wang C.K., "Statically Indeterminate Structures", McGraw Hill
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. II" Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-205-6
- Sadhu Singh, "Theory and Solved Problems in Adv. Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-212-7
- Ramamrutham S. and Narayanan R., "Theory of Structures" Dhanpat Rai Publishers, Delhi

**Reference Books**

- Norris C. H. and Wilbur J. B., "Elementary Structural Analysis", McGraw Hill
- Beaufait, F. W., "Basic Concepts of Structural Analysis", Prentice Hall, N.J.

- Kinney J. S., “Indeterminate Structural Analysis”, Oxford and IBH
- Krishnamurthy, C.S., “Finite Element Analysis – Theory and Programming”, Tata McGraw Hill, N. Delhi 1994
- Hibbler R. C., “Structural Analysis”, Pearson Publications
- Kanchi M. B., “Matrix Methods of Structural Analysis”, Wiley Eastern Ltd., N. Delhi
- Wang C. K., “Matrix Methods of Structural Analysis”, International Text-book, Scranton, Pennsylvania, 1970
- Gere J.M., Weaver W., “Analysis of Framed Structures”, D. Van Nostrand Company, Inc., Princeton, N. Jersey

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Have a basic understanding of matrix method of analysis and will be able to analyze the determinant structure.

CO2: Have a basic understanding of the principles and concepts related to finite difference and finite element methods

CO3: Have a basic understanding of concept of influence line



## BTCVC 503 Soil Mechanics

**Teaching Scheme:** (3 Lectures + 1 Tutorial) hours/week

### Course Contents

**Module 1: Introduction**

**(2 Lectures)**

Definition of soil and soil engineering, Application areas of soil mechanics, Three Phase system, Soil moisture, Soil minerals  
Soil structure, Terzaghi’s effective stress concept, Effective and neutral pressure

**Module 2: Soil Consistency (10 Lectures)**

**Index properties of soil:** Different unit weights of soil, and their determination, unit weight of solids, unit weights of soil mass, method for determination of field density viz. sand replacement and core cutter, Specific Gravity determination methods void ratio and porosity, degree of saturation, Inter relation between weight volume state, density indexes, Atterberg’s limits and their significance, Soil Classification: Soil classification based on particle size and consistency, I.S. classification system

**Module 3: Flow of Water Through Soil: Permeability**

**(6 Lectures)**

Head, gradient and potential, Darcy’s law, Factors affecting permeability, Field and Laboratory methods of determining permeability, Seepage pressure, quick sand condition, Derivation of Laplace equation, Flow net: characteristics & application, construction of flow net, piping phenomenon, Permeability through stratified soil, Discharge and seepage velocity.

**Module 4: Shear Strength**

**(8 Lectures)**

Concept of shear, Coulomb’s theory and failure envelope, Principle stress, stress analysis (Total stress approach and effective stress approach), representation of stresses on Mohr’s circle for different types of soil such as cohesive and cohesionless, saturated and partly saturated soil etc, Application of shear stress parameters in the field, Different types of shear tests: Unconsolidated undrained, Consolidated undrained and consolidated drained choice of the type of test, box shear test, triaxial compression test with pore pressure and volume change measurement, Unconfined compression test, vane shear test

**Module 5: Compressibility of Soils (8 Lectures)**

**Compaction** Theory of compaction, factors influencing compaction, compacted density, Laboratory Standard and modified compaction test, Method and measurement of field compaction, Field compaction control

**Consolidation**

Compressibility: Definition, compressibility of laterally confined soil, compression of sand and clay, e-p and e-log p curve, compression index. Consolidation: Terzaghi’s theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation, degree of consolidation, relevance of one dimensional consolidation to field condition, time factor

**Module 6: Earth Pressure Theories**

**(5 Lectures)**

Earth pressure at rest, active and passive conditions, Elementary idea about Rankin’s and Coulomb’s earth pressure. Graphical methods for active earth pressure.

### Text Books

- Kasamalkar B. J., “Geotechnical Engineering”, Pune Vidyarthi Griha Prakashan Pune
- Murthy V.N.S., “Soil Mechanics & Foundation Engineering”, U.B.S. Publishers and Distributors N. Delhi
- Punmia B.S., “Soil Mechanics & Foundation Engineering”, Laxmi Publications
- Arora K. R., “Soil Mechanics” Standard Publishers, N. Delhi
- Gopal R Rao “Basic Soil Mechanics “

### Reference Books

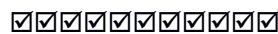
- Alam Singh, “Text book of soil mechanics in theory and practice”, Asian Pub. House, Mumbai
- Taylor D.W., “Fundamentals of Soil mechanics”
- Terzaghi and Peak “Soil mechanics” John Willey and Sons, New-York
- Scott R. F., “Principal of soil mechanics”
- Lambe T.W, “Soil Testing” by Willey Eastern Ltd., New Delhi

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Understand different soil properties and behavior

CO2: Understand stresses in soil and permeability and seepage aspects.

CO3: Develop ability to take up soil design of various foundations.



## BTCVC 504 Environmental Engineering

**Teaching Scheme:** (2 Lectures) hours/week

### Course Contents

#### Module 1: Introduction

(4 Lectures)

Environment and its components, importance of water, role of environmental engineer, sources of water, water demand: Design flow, design period, design population, factors affecting water consumption, variation in demand, and design capacity for water supply components, quality of water: Physical, chemical, biological characteristics, Indian standard for quality of potable water

#### Module 2: Treatment of Water

(10 Lectures)

Conveyance of raw water: Canals and pipelines, hydraulics of conduits, laying and jointing of pipelines, testing of pipe lines, designing of rising main, type of valves, types of pumps, intake structure, types of intake structures, necessity of water treatment processes

Types of Treatments:

**Aeration:** Necessity, methods, removal of taste and odour, design of aeration fountain

**Sedimentation:** Suspended Solids, settling velocity, types of sedimentation tanks, surface loading, detention time, inlet and outlet arrangements

**Coagulation:** Necessity, coagulant dosage, choice of coagulants, optimum pH

**Rapid Mixing:** Necessity, gravitational, mechanical, pneumatic devices

**Slow Mixing and Flocculation:** Design of flocculation chamber, mean velocity gradient, design of clari-flocculator, plate settler and tube settler

**Filtration:** Theory of filtration, filter materials, types of filters, components, working and cleaning of filters

**Disinfection:** Theory of disinfection, factors affecting, efficiency of disinfection, types of disinfectants, break point chlorination, bleaching powder estimation

Water softening methods: Lime-soda, ion exchange method, demineralization



**Module 3: System of Water Supply****(4 Lectures)**

Continuous and intermittent system, type of distribution systems, layouts, methods of supply: gravity, pumping and combination, hydraulic analysis of distribution system

**Module 4: Treatment of Waste Water****(2 Lectures)**

Sources of wastewater flows, components of wastewater flows, wastewater constituents, characteristic of municipal waste water, necessity of treatment of waste water, sewerage systems, concept of sewage, sullage, storm water, introduction of preliminary treatment, primary treatment, secondary treatment, introduction to tertiary or advanced treatment fundamentals of anaerobic treatment, sewage and industrial waste of common origin, types

**Module 5: Treatment of Solid Waste****(3 Lectures)**

Types, sources, characteristics, ill-effects of improper solid waste management, collection, processing techniques, methods of treatment of solid waste-composting, incineration, pyrolysis and sanitary land filling, biodegradable, non-degradable segregation of solid waste, concept of hazardous waste management, e-waste disposal

**Module 6: Air Pollution****(3 Lectures)**

Definition, sources of air pollution, types air pollutants, atmospheric stability, mixing heights, plume types and meteorological parameters, effects of air pollution, control measures of air pollution

**Text Books**

- Rao and Rao, "Air Pollution ", Tata McGraw Hill Publications, New Delhi, 1990
- Garg S. K., "Water Supply Engineering", Khanna Publishers, New Delhi
- Birdi J. S. and Birdi G. S., "Water Supply & Sanitary Engineering", Dhanpat Rai Pub. Company, 8<sup>th</sup> edition, New Delhi

**Reference Books**

- Peavy and Rowe, "Environmental Engineering", McGraw Hill Publications
- Stern, "Environmental Engineering", Vol. I to IV, McGraw Hill Publications
- Sharma and Kaur, "Environmental Chemistry", Goyal Publisher
- Government Of India Publication, "Water Supply and Treatment Manual"
- Fair and Geyr, "Environmental Engineering", McGraw Hill Publications
- Steel and McGhee, "Environmental Engineering", McGraw Hill Publications
- Viessman & Hammer, "Water Supply & Pollution Control", Harper Collins Collage Publishers
- Publications by reouted organizations such as WHO, NEERI, MERI, MPCB, CWPRS, etc.

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Apply the water treatment concept and methods.

CO2: Prepare basic process designs of water and wastewater treatment plants.

CO3: Apply the wastewater treatment concept and methods.

CO4: Apply the solid waste management concepts.



## BTCVC 505 Transportation Engineering

**Teaching Scheme:** (2 Lectures) hours/week

### Course Contents

**Module 1: Introduction****(4 Lectures)**

Importance of various modes of transportation, Highway Engineering, Road Classification, Developments in Road Construction, Highway Planning, Alignment and Surveys,

**Module 2:** (6 Lectures)  
Geometric Design- Cross section elements, Sight distances, Horizontal alignment, Vertical alignment, Intersections, Construction of Pavements, Construction and Maintenance of Drainage, Road Arboriculture

**Module 3:** (4 Lectures)  
**Highway Materials:** Soil – relevant properties, Various tests, Aggregates – strength, hardness, toughness, soundness, durability, shape, specific gravity, water absorption, Bituminous materials – Bitumen, Tar, and Asphalt – various properties, Design of Bituminous paving mixes-Marshall stability test

**Module 4: Traffic Engineering** (6 Lectures)  
Traffic Characteristics, Speed, Journey Time and Delays, Vehicle Volume Counts, Origin and Destination Studies, Analysis and Interpretation of Survey Data, Traffic Operations, Design of Signals and Rotary intersections, Parking Space Design, Highway Lighting, Planning and Administration, Road Markings, Signs  
**Road Accidents and Safety:** Classification, Causes, Mitigation and Control Measures, Aspects of Safety in Usage of Roads, Type and Design of anti-crash barriers, Introduction to Intelligent Transport Systems (ITS).

**Module 5: Pavement Design** (6 Lectures)  
Basic Principles, Methods for different Types of Pavements, Design of flexible pavement using IRC: 37- 2012, Design of rigid pavement using IRC: 58-2011

**Module 6: Other modes of Transport** (4 Lectures)  
Introduction to Railways, Airways, Waterways, Pipeline Transportation, Classification, Requirements, Comparative Studies

#### Text Books

- Khanna and Justo, “Highway Engineering”, Nemchand& Bros., Roorkee
- Khanna S.K., “Highway Engineering”,
- Arora N. L., “Transportation Engineering”
- Bindra and Arora, “Highway Engineering”, Standard Publishers
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, VolIKhanna Publishers, N. Delhi
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, Vol II Khanna Publishers, N. Delhi ISBN NO: N/A
- Shahani P.B, “Road Techniques” Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-197-1 PRICE 149/-
- Kadiyali L.R, “Traffic Engineering and Transport Planning”, Khanna Publishers, N. Delhi, ISBN NO:978-81-7409-220-X

#### Reference Books

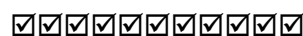
- Garber, N.J. and Hoel, L.A., “Traffic and Highway Engineering”, West Publishing Company, New York
- Jones, J.H., “Geometric Design of Modern Highways’, E & FN SPON Ltd., London.
- Khistry, C.J., “Transportation Engineering – An Introduction’, Prentice Hall of India Ltd.
- Agor R., “Surface Transportation (Railways and Highways)”,Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-273-1

**Course Outcomes:**On completion of the course, the students will be able to:

Comprehend various types of transportation systems and their history of the development

Comprehend to various types of pavements

Design the pavements by considering various aspects associated with traffic safety measures.



## BTHM3507 Essence of Indian Traditional Knowledge

**Teaching Scheme:** 1 Lecture / week

### Course Contents

**Module I** (03 Lectures)  
Ancient Education System in India, History of Indian Knowledge System, Sources of knowledge transmission and

**Module II** (02 Lectures)

Indian Linguistic Tradition (Phonology, morphology, syntax & semantics), Yoga & Holistic Health care

**Module III** (01 Lectures)

Philosophical Traditions in ancient India, Relevance in today's life

**Module IV** (03 Lectures)

Glimpses of ancient Indian science and technology, Ancient structures in India, Traditional materials, Construction styles and Techniques, Developments in construction materials, living styles and habitation, Town Planning, Case Studies

**Module V** (02 Lectures)

Developments in water supply, sanitation, irrigation and agriculture, Case Studies

**Module VI** (01 Lectures)

Developments in transportation and communication, Case Studies

**Text / Reference Books**

- V. Sivaramakrishna, "Cultural Heritage of India", Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edi., 2014
- Swami Jitatanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan
- Fritzof Capra, "Tao of Physics"
- Fritzof Capra, "The wave of Life"
- Jha V. N. (English Trans.), "Tarkasangraha of Annam Bhatta", International Chinmay Foundation, Velliarnad, Arnakulam
- "Yoga Sutra of Patanjali", Ramakrishna Mission, Kolkata
- Jha GN (English Trans.), R N Jha, "Yoga-darshanam with Vyasa Bhashya", Vidyanidhi Prakasham, Delhi, 2016
- Jha RN, "Science of Consciousness Psychotherapy and Yoga Practices", Vidyanidhi Prakasham, Delhi, 2016
- P R Sharma (English translation), "Shodashang Hridayam"
- Indian Journal of Traditional Knowledge:  
<https://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijtk/ijtk0.asp>
- Swayam Course by Prof. D. P. Mishra, IIT Kanpur: [https://swayam.gov.in/nd1\\_noc19\\_ae07/preview](https://swayam.gov.in/nd1_noc19_ae07/preview)



## BTCVL508 Soil Mechanics Laboratory

**Practical:** 2 hours / week

Term work shall consist of performance of at least seven experiments from the following mentioned list of experiments.

- 1) Specific gravity determination of coarse and fine grained soil
- 2) Particle size distribution-Mechanical sieve analysis, wet sieve analysis
- 3) Determination of Attergerg's consistency limit
- 4) Permeability- Determination of coefficient of permeability
- 5) Field density determination
- 6) Direct shear box test
- 7) Procter compaction test
- 8) Tri-axial test
- 9) Unconfined compression test
- 10) One dimensional consolidation test

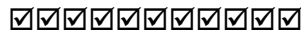
**Course Outcomes:** On completion of the course, the students will able to:

CO1: Determine different engineering properties of soil.

CO2: Identify and classify soils based on standard geotechnical engineering practices.

CO3: Perform Laboratory oratory compaction and in-place density tests.

CO4: Perform and interpret direct shear tests and estimate shear strength parameters.



## BTCVL509 Environmental Engineering Laboratory

**Practical:** 2 hours / Week

Practical Work consists of performance of at least six experiments from the List (A) below:

**(A) Determination of:**

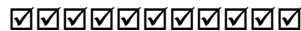
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| 1) pH and Alkalinity                                 | 2) Hardness                              |
| 3) Chlorides   | 4) Chlorine demand and residual chlorine |
| 5) Turbidity and optimum dose of alum                | 6) MPN                                   |
| 7) Sulphates   | 8) Fluorides and Iron                    |
| 9) Total Solids, Dissolved Solids & Suspended Solids | 10) Sludge Volume Index (SVI)            |
| 11) Dissolved Oxygen                                 | 12) BOD and COD                          |

**B) Site Visit to Water Treatment Plant:**

A report based on the visit to water treatment plant shall be submitted.

**Course Outcomes:** On completion of the course, the students will be able to:

- CO1: Quantify the pollutant concentration in water, wastewater and ambient air.
- CO2: Recommend the degree of treatment required for the water and wastewater.
- CO3: Analyze the survival conditions for the microorganism and its growth rate.



## BTCVL510 Transportation Engineering Laboratory

**Practical:** 2 hours / week

Practical Work consists of all experiments from (a) and at least six performances among the list (b) below and detailed reporting in form of journal and Project Reports. Practical examination shall be based on above

**a) Tests on Aggregates**

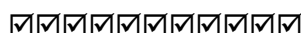
- 1) Shape Test
- 2) Specific Gravity and Water Absorption Test
- 3) Stripping Value Test
- 4) Soundness Test
- 5) CBR Test on Soil and Aggregates

**b) Test on Bituminous Materials**

- 6) Penetration Test
- 7) Softening Point Test
- 8) Flash and Fire Point Test
- 9) Ductility Test
- 10) Viscosity Test
- 11) Specific Gravity Test
- 12) Demonstration of Marshall Test
- 13) Pavement design exercise based on flexible pavement consisting of bituminous concrete.
- 14) Visit to Road construction site for studying different construction equipment's.

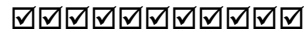
**Course Outcomes:** On completion of the course, the students will be able to:

- Perform tests on various road construction materials.
- Perform CBR tests on local soils to determine subgrade properties needed for roadways.



# BTCVF511 Seminar on Topic of Field Visit to works related to Building Services

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of execution of building services such as electrification, plumbing, air-conditioning, acoustics, etc. It is desirable to collect basic information on components, tools and plants, construction equipment, safety precautions, etc. Intention of the work is to introduce the student to the chronological order of execution of works and generate data on vocabulary of terms in field.



## BTCVE506A Materials, Testing & Evaluation

### Course Objectives:

1. To provide an overview to the students about various types of civil engineering materials used in constructions along with their properties.
2. To enable students to know details of various tests to be performed on civil engineering materials to evaluate their quality to know their suitability for use in construction.

**Teaching Scheme:** (3 Lectures) hours / Week

### Course Contents

#### Module1:

(8 Lectures)

Basic Properties of Materials: importance of materials in civil engineering construction, types of materials such as ceramics, concrete, composites, optical /electronics materials, glass, metals, nano-materials ,polymers and plastics, wood and other materials. some basic properties of materials such as temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion ,mechanical properties of metals ,stress, strain modulus of elasticity, ,stress-strain behavior, elastic and plastic deformations, elastic properties of materials, tensile properties, ductility, resilience and toughness ,compressive, shear and torsional deformation, hardness. Variability of material properties.

#### Module2:

(8 Lectures)

Civil Engineering Materials: introduction to cement and concrete, uses of cement, strength of cement and concrete ,sand, coarse aggregates, mortar and grouts, masonry mortars, rendering, cementitious grouts, RCC, clay bricks ,calcium silicate bricks, concrete blocks., rubbles, steel , steel grades, mechanical properties of steel, different applications, floor and roofing tiles, slates, timber, strength of timber ,Engineered wood products, metals, glass for glazing, glass fibres, glass wool, bituminous materials, binder properties, binder mixtures, asphalt mixture.

#### Module3:

(4 Lectures)

Composite Materials: RCC, FRC, steel/concrete composite bridge decks, fibre reinforced plastics structural insulated panels.

#### Module4:

(4 Lectures)

Comparison of Different Materials, Introduction, comparison of strengths of various materials, comparison for environmental impact, health and safety.

#### Module 5:

(6 Lectures)

New Techniques in Constructions—Introduction,3D printing, photo catalytic admixture, self-healing concrete, zero cement concrete ,hemp lime, wood-glass epoxy composites, bamboo.

#### Module 6:

(6 Lectures)

Material Testing ,Machines And Equipment Requirements---Necessity of material testing, various testing methods, destructive tests, classification of destructive tests---static, impact and cyclic testing, non-destructive testing—its classification ,visual inspection, penetration test, magnetic detection, ultrasonic test, radiography test and spark test. Types of testing machines, UTM and CTM, force and displacement controlled machines, loading frames. Hardness testing machines, fracture tests.

**Recommended Books:**

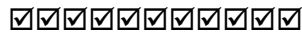
- S.V. Deodhar. (1990), 'Civil Engineering Materials', Allied Publishers, N. Delhi.
- S.C Rangwala. (1983), 'Civil Engineering Materials', Dhanpat Rai and Sons, N. Delhi.

**References:**

- B.I.S., 1980, 'National Building Code of India', ISI, New Delhi.

**Course Outcomes:** The required course for emphasis in development engineering will help students

1. To develop skill among students to construct strong and durable structures by applying knowledge of material science.
2. To make the students aware of quality assurance and control in their real life as a professional.



## BTCVE506C Development Engineering

**Course Objectives:**

The main objectives of the course are:

1. To provide an overview to the students of the various fields within planning, such as community development, urban planning and sustainability, challenges at rural level, rural development.
2. To enable students to develop professional capabilities through field and design work in real world problems in the field of planning and development of urban and rural areas.

**Teaching Scheme:** (3 Lectures) hours / Week

### Course Contents

**Module1:****(6 Lectures)**

Introduction to Development Engineering: need of development engineering, core disciplines and concept, major issues in development; urban development; rural development; socioeconomic development; scientific social research, formulation of research problem, field work and data collection, report drafting

**Module2:****(6 Lectures)**

Design of Sustainable Communities: Concept and development of sustainable communities; Sustainable design, principles, building regulations, codes and standards - ANSI, ASTM, ASHRAE, approval process; green buildings- green building techniques- energy solutions, site solutions, exterior and interior solutions, Certification -BREEAM, GRIHA, NAHB, LEED, IGBC;

**Module3:****(6 Lectures)**

Town / City Planning: Town Planning- history of town planning in India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum redevelopment; Smart city planning- introduction to city planning, infrastructure elements of smart city planning, dimensions of smart cities - global standards and performance benchmark; smart solutions- e governance, waste management, water management, energy management, urban mobility, citizen services, other services such as tele-medication and education, trade facilitation, skill development; GIS for planning

**Module4:****(6 Lectures)**

Planning and Development of Rural Areas: District administration, District Planning, introduction to various sectors of rural areas such as drinking water, waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy; issues and challenges associated with these sectors; People's participation and role in development of rural areas; various schemes and policies floated by state and central government - phases in the schemes; life cycle costing of these schemes.

**Module5:****(6 Lectures)**

Geoinformatics for Planning and Development: Introduction to Geoinformatics; Advantages, benefits and limitations; Interdisciplinary applications; Data extraction; use of Geoinformatics for planning, mapping and preparation of layouts.

**Module6:****(6 Lectures)**

Development aspects: Urban and Rural: Planning and designing of a model town / city and using AutoCad and/ or GIS. Visit to a village or small town - The project will be carried out in groups. Problem faced by the villagers pertaining to various sectors or existing schemes; define the need, method, tools and techniques for development; deliver technology based solution.

**Recommended Books:**

- Chand, M. and Puri, U.K.( 1983), 'Regional Planning in India', Allied Publishers, N. Delhi.
- Kaiser, E. J ., et.al. (1995), 'Urban Land use Planning', (ed) Urbana, University of Illinois Press.
- Sundaram, K.V. 1985 'Geography & Planning', Concept Publishing Co., New Delhi.
- Ayyar, C.P.V. (1987), 'Town Planning in Early South India', Mittal Publications, Delhi.
- Reeder, L. Hoboken, NJ, 'Guide to green building rating systems', John Wiley & Sons, Inc., 2010.
- Longley, P.A., Michael F. Goodchild, Maguire, D.J., Rhind, D. W. (2005), 'Geographic Information Systems and Science', Second Edition 2005: John Wiley & Sons, New York.
- Desai, V. (2005), 'Rural Development of India', Himalaya publishing house, Mumbai.
- Rau, S.K. (200 I), 'Global Search for Rural Development', NIRD, Hyderabad

**References:**

- Institute of Town Planners, India, Ministry of Urban Affairs & Employment, Government of India, New Delhi, UDPFI Guidelines, 1996.
- Miles R. Simon, 1970, 'Metropolitan Problems' Methuen Publications, Canada.
- B.I.S., 1980, "National Building Code of India", ISI, New Delhi.
- ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings Except Low - Rise Residential Buildings
- ASHRAE Standard 90. 1, Energy Standard for Buildings Except Low-Rise Residential Buildings

**Course Outcomes:** The required course for emphasis in development engineering will help students

1. To develop multi scaled perspective about decisions in the built environment,
2. To expose the students to the analysis and evaluation of real world problems aiming to bring desired change in the society.



## BTCVE506D Business Communication & Presentation Skills

**Teaching Scheme:** (3 Lectures) hours / Week

### Course Contents

**Module 1: Language for Technical Purpose and Presentation Tools**

Technical vocabulary, Sentence structures, Computer Aids, Graphical presentations

**(03 Lectures)**

**Module 2: Formal Written Communication**

Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules.

**(03 Lectures)**

**Module 3: Project Proposals and Reports**

Abstract, Aims, Background & significance, Design & methods, writing a sample proposal, Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. **(06 Lectures)**

**Module 4: Leadership Skill and Team Building, Working.**

Leadership Skills: Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies. Need of team, Effective teams, Group development **(06 Lectures)**

**Module 5: Business Meetings**

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, Taking notes and publishing minutes **(06 Lectures)**

**Module 6: Presentation Skills**

Use of presentation tools, Presentation, nonverbal techniques, handling questions **(04 Lectures)**

**References:**

- S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
- Ann Masters & Harold R. W., Personal Development for Life & Work,10e,Cengage, Learning India Private Limited,2011.





## Semester- VI

§:Students should register for the CVF 705 in Semester VI to undergo training during vacation after semester VI and appear at examination in Semester VII. Result shall appear in Grade-sheet of Semester VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC601	Design of Concrete Structures I	3	1	-	3
02	BTCVC602	Foundation Engineering	2	1	-	3
03	BTCVC603	Concrete Technology	2	-	✓	2
04	BTCVC604	Project Management	2	1	-	2
05	CVE3	<b>Elective III</b>	3	-	-	3
06	BTCVC606	Building Planning and Design	2	-	✓	2
<b>Practical / Drawing and/or Design</b>						
07	BTCVL607	Concrete Technology Laboratory	-	-	2	1
08	BTCVL608	Building Planning, Design and Drawing Laboratory	-	-	4	2
09	BTCVM609	Community Project (Mini Project)	-	-	2	1
10	BTCVS610	Seminar on Topic of Field Visit Road Construction	-	-	1	AU
11	BTCVF611	Industrial Training <sup>§</sup>	-	-	2	--
Sub-Total			<b>14</b>	<b>3</b>	<b>11</b>	
<b>Total</b>			<b>28</b>			<b>19</b>
<b>Elective III</b>						
	BTCVE605A	Waste Water Treatment				
	BTCVE605B	Operations Research				
	BTCVE605C	Geographic Data Analysis and Applications				
	BTCVE605D	Advanced Engineering Geology				
	BTCVE605E	Advanced Soil Mechanics				
	BTCVE605F	Design of Masonry and Timber Structures				

### BTCVC601 Design of Concrete Structures - I

**Teaching Scheme:** (2 Lectures + 1 Tutorial) hours/week

#### Course Contents

**Module 1:**

**(5 Lectures)**

Basic Aspects of Structural Design, Introduction to Design Philosophies, Stress Strain behaviour of Materials, Permissible stresses, Comparison of Different Philosophies, Estimation of Loads

#### Working Stress Method

**Module 2:**

**(5 Lectures)**

Stress block parameters, Balanced, under reinforced and over reinforced section: Modes of failure, properties of singly and doubly reinforced rectangular section beams, Analysis and Design of Singly and Doubly Reinforced Beams

One Way and Two Way Slab: Behavior of slabs, types, support conditions, analysis and design with various conditions

**Module 3: (4 Lectures)**

Analysis and Design of Axially and Eccentrically Loaded Columns, Isolated Column Footings, Staircases, Design of dog-legged and open well stair case, effective span and load distribution

#### Limit State Method

**Module 4: Introduction to Limit State Approach**

**(5 Lectures)**

Introduction to Limit State Approach, Types and Classification of Limit States, Characteristics Strength and Characteristics Load, Load Factor, Partial Safety Factors

**Module 5: Limit State of Collapse (Flexure)****(7 Lectures)**

Limit State of Collapse (Flexure): Analysis and Design of Singly and Doubly Reinforced Rectangular Beam Sections, properties of Flanged (L and T) sections, Analysis and Design of Flanged Beams

**Module 6: Limit States of Collapse (Shear and Bond)****(7 Lectures)**

Limit States of Collapse (Shear and Bond): Shear Failure, Types of Shear Reinforcement, Design of Shear Reinforcement, Bond – Types, Factors Affecting, Resistance, Check for Development Length, detailing of reinforcement

**Text Books**

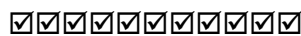
- IS: 456-2000, IS: 456-1978, Bureau of Indian Standards, New Delhi
- Karve and Shah, “Limit State Theory & Design”, Structures Publications, Pune
- Jain A.K., “Reinforced Concrete Design (Limit State)”, Nemchand Brothers, Roorkee
- Sinha and Roy, “Fundamentals of Reinforced”
- Sinha S.N., “Reinforced Concrete Design, Vol. I, II”, Tata Mc-Graw Hill
- Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi
- Mehra H. and V.N. Vazirani, “Limit State Design of Reinforced Concrete Structures”, Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-162-9
- Vazirani V.N. and Ratwani M.M., “Design of Reinforced Concrete Structures”, Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-232-8

**Reference Books**

- Punmia B.C., “Reinforced Concrete Design, Vol. I, II”, Laxmi Publications
- Relevant Publications by Bureau of Indian Standards, New Delhi

**Course Outcomes:** On completion of the course, the students will be able to:

- Comprehend to the various design philosophies used for design of reinforced concrete.
- Analyze and design the reinforced concrete slab using limit state and working state method.
- Analyze and design the reinforced concrete beam using limit state and working state method.
- Analyze and design the reinforced concrete column using limit state and working state method.



## BTCVC602 Foundation Engineering

**Teaching Scheme:** (3 Lectures + 1 Tutorial) hours/week

### Course Contents

**Module 1:****(6 Lectures)**

**Introduction,** General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations

**Module 2:****(7 Lectures)**

**Bearing Capacity Analysis** - Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for  $N_c$ , Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion

**Module 3:****(5 Lectures)**

**Foundations for Difficult Soils** - Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative

Measures for Expansive Soils, Modification of Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,

**Module 4:** (5 Lectures)

**Shallow Foundations:** Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of Isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation

**Module 5:** (7 Lectures)

**Deep foundations:** Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles, Group Action of Piles,

**Caissons Foundations:** Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties And Remedial Measures

**Sheet Piles:** Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations

**Module 6:** (6 Lectures)

**Slope Stability:** Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use

#### Text Books

- Kasamalkar, B.J., "Foundation Engineering", Pittsburgh vintage Grand Prix
- Murthy V.N.S., "Soil Mechanics and Foundation Engineering", CRC Press 2002
- Arora K.R., "Soil Mechanics and Foundation Engineering", Standard publication 2009
- Punmia B. C., "Soil Mechanics And Foundation Engineering", Laxmi publication 16th 2017
- Nayak N.V., "Foundation Design Manual", Dhanpat Rai And Sons
- Brahma S.P., "Foundation Engineering", Tata McGraw-Hill 5th Edition
- Braja Das, "Principles of Geotechnical Engineering", Engage Learning 9th edition
- Bowles J.E., "Foundation analysis & Design", McGraw-Hill Higher Education 5th edition

#### References Books

- Teng W.C., "Foundation Design", Prentice-Hall Inc
- Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall; 7th edition
- Lee, "Sheet Piles" Concrete Publication, 1961
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS 6403:1981, IS 1904:1986, IS 4091:1979

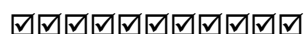
**Course Outcomes:** On completion of the course, the students will be able to:

To predict soil behavior under the application of loads and come up with appropriate solutions to foundation design queries.

Analyze the stability of slope by theoretical and graphical methods.

Analyze the results of in-situ tests and transform measurements and associated uncertainties into relevant design parameters.

Synthesize the concepts of allowable stress design, appropriate factors of safety, margin of safety, and reliability.



# BTCVC603 Concrete Technology

Teaching Scheme:(2 Lectures) hours/week

## Course Contents

### Module 1

(4 Lectures)

Materials for Concrete: Cement, Manufacturing Process, Physical Properties, Hydration of Cement, hydration products, Chemical Compounds in Cement, Types of Cement, Aggregates: Classification of aggregates, Physical Properties, Bulking of Sand, Mechanical Properties, Water: Specifications of Water to be used For Concrete

### Module 2

(4 Lectures)

Properties of Fresh Concrete -Types of Batching, Mixing, Transportation, Placing Including Pumping and Compaction Techniques for Good Quality Concrete, Workability, Factors affecting workability, Methods of Measuring Workability, Segregation and Bleeding, setting time, Curing of Concrete, Types of curing, Temperature Effects on Fresh Concrete

### Module 3

(3 Lectures)

Admixtures In Concrete: Types, Plasticizers and Super-plasticizers and their Effects On Workability, Air Entraining Agents, Accelerators, Retarders, Pozzolanic Admixtures, Green concrete, Bonding Admixtures, Damp-Proofing Admixtures, Construction Chemicals

### Module 4

(4 Lectures)

Desired Properties of Concrete, Strength, Durability &Im-permeability, Characteristic Strength, Compressive, Tensile and Flexure of Concrete, **Bond Strength**, Tests on Concrete, Modulus of Elasticity, Effect of W/C Ratio and admixtures on Strength, **Types of concrete**, High Strength and High Performance Concrete

### Module 5

(4 Lectures)

Creep and Shrinkage of Concrete, Significance, Types of Shrinkage and Their Control, Factors Affecting Creep. Durability of Concrete: Minimum & Maximum Cement Content, Strength & Durability Relationship, Exposure to Different Conditions, Factors Contributing to Cracks in Concrete, Sulphate Attack, Alkali Aggregate Reaction (AAR),factors affecting on AAR, Deteriorating effects of AAR, Chloride Attack, Corrosion of Steel (Chloride Induced)

### Module 6

(6 Lectures)

**Concrete Mix Design**, Nominal Mix Concrete, Factors Governing Mix Design, Methods Of Expressing Proportions, Trial Mixes, Acceptance Criteria, Factors Causing Variations, Field Control, Statistical Quality Control, Quality Measurement in Concrete Construction., Non-destructive Testing of Concrete

## Text Books

- Gambhir M. L. “Concrete Technology”, Tata Mc-Graw Hill 2015 15th edition
- Shetty M. S. “Concrete Technology”, S. Chand 2005.
- Krishnaswamy, “Concrete Technology”, DhanapatRai and Sons

## Reference Books

- Orchard, “Concrete Technology”, Applied Science Publishers
- Neville A. M., “Concrete Technology”, Pearson Education
- Neville A. M., “Properties of Concrete”, Pearson Education
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS:10262(2009), IS:456 (2009), IS 4926 (2003)

**Course Outcomes:**On completion of the course, the students will be able to:

CO1: Understand the various types and properties of ingredients of concrete.

CO2: Understand effect of admixtures on the behavior of the fresh and hardened concrete.

CO3: Formulate concrete design mix for various grades of concrete.

# BTCVC604 Project Management

Teaching Scheme: (2 Lectures +1 Tutorial) hours/week

## Course Contents

- Module 1:** (6 Lectures)  
Introduction, Steps in Project Management, fundamentals of material, machinery and manpower management in Project, Bar Chart, Mile stone chart, Development of network, Fulkerson's Rule, Introduction to CPM, Time estimates, floats, critical path
- Module 2:** (4 Lectures)  
Network Compression, Least Cost and Optimum Duration, Resource Allocation, Updating Calculations for Updated Network
- Module 3:** (4 Lectures)  
Introduction to PERT, concept of probability, normal and beta distribution, central limit theorem, time estimates, critical path, slack, probability of project completion
- Module 4:** (5 Lectures)  
Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation, cash – flow diagram, economic comparisons – discontinuing methods, non-discontinuing criteria
- Module 5:** (5 Lectures)  
Linear break even analysis – problems, quality control – concept, statistical methods – control charts
- Module 6:** (5 Lectures)  
Total quality management– philosophy of Juran, Deming, importance, Quality Circle implementation, introduction to ISO 9000 series and 14000 series, Introduction to Computer Aided Project Management

### Text Books

- Roy Pilcher, "Project Cost Control in Construction", Sheridan House Inc. (Feb 1988)
- Gupta R.C. "Statistical Quality Control", khanna publishers 9th edition
- Layland Blank and Torquin, "Engineering Economics", Mc-Graw-Hill Edition
- Naik B. M. "Project Management", Stosius Inc./Advent Book division
- Khanna O.P., "Work Study", Dhanpatrai publication
- Srinath L. S. "CPM PERT", Affiliated East-West Press (Pvt) Ltd

### Reference Books

- Antill and Woodhead, "C.P.M. in Construction Practice", Wiley-Interscience 4th edition 1990
- Taylor. G.A., "Management and Engineering Economics", Mc-Graw Hill 4th edition
- Roy Pilcher, "Principles of Construction Management" Mc-Graw Hill Higher Education 2nd revision

**Course Outcomes:** On completion of the course, the students will be able to:

- Understand various steps in project Management, different types of charts.
- Construct network by using CPM and PERT method.
- Determine the optimum duration of project with the help of various time estimates.
- Know the concept of engineering economics, economic comparisons, and linear break even analysis problems.
- Understand the concept of total quality Management including Juran and Deming's philosophy.



# BTCVC606 Building Planning and Design

Teaching Scheme: 2 Lectures hours/week

## Course Contents

### Planning of Buildings

#### Module 1:

(6 Lectures)

Principles of building planning, significance sun diagram, wind diagram, orientation, factors affecting, and criteria under Indian condition, concept of green building: aspect at planning level, construction stage and operational level.

#### Module 2:

(6 Lectures)

Building planning byelaws & regulations as per SP-7, National Building Code of India group 1 to 5, planning of residential building: bungalows, row bungalows, apartments and twin bungalows, procedure of building permission, significance of commencement, plinth completion or occupancy certificate

#### Module 3:

(6 Lectures)

Traditional constructions using stone, brick, timber, bamboo, mud, lime, etc. low cost housing-materials & methods (conceptual introduction only), maintenance, repairs, rehabilitation

### Building Services

#### Module 4: Plumbing Systems

(10 Lectures)

Various materials for system like stoneware, GI, AC, CI, PVC, HDPE and various types of traps, fittings, chambers, need of septic tank, concept of plumbing & drainage plan, introduction to rainwater harvesting, concept of rain water gutters, rainwater outlet & down tank systems

**Electrification:** wiring types, requirements & location of various points, and concept of earthing

**Fire resistance in building:** Fire protection precautions, confining of fire, fire hazards, characteristics of fire resisting materials, building materials and their resistance to fire

#### Module 5: Ventilation

(10 Lectures)

Definition, necessity of ventilation, functional requirements, various system & selection criteria.

**Air conditioning:** Purpose, classification, principles, various systems

**Thermal Insulation:** General concept, Principles, Materials, Methods, Computation of Heat loss & heat gain in Buildings

#### Module 6: Introduction to Acoustics

(10 Lectures)

Absorption of sound, various materials, Sabine's formula, optimum reverberation time, conditions for good acoustics

Sound insulation: Acceptable noise levels, noise prevention at its source, transmission of noise, Noise control-general considerations

### Reference Books

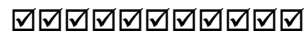
- Shah, Kale, Pataki, "Building Drawing", Tata McGraw- Hill
- Sane Y. S., "Building Design and Drawing", Allied Book Stall, Pune
- Jain V.K., "Automation Systems in Smart and Green Buildings", Khanna Publishers, N. Dehli ISBN No 978-81-7409-237-3
- Jain V.K., "Handbook of Designing and Installation of Services in High Rise Building Complexes", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-245-8
- Deodhar S.V., "Building Science and Planning", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-199-8
- Jain A.K., "The Idea of Green Building" Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-256-4
- SP 7- National Building Code Group 1 to 5- B.I.S. New Delhi
- I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings

**Course Outcomes:** On completion of the course, the students will be;

To plan buildings considering various principles of planning and bye laws of governing body.

Comprehend various utility requirements in buildings

Understand various techniques for good acoustics.

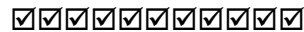


## BTCVL607 Concrete Technology Laboratory

**Practical:** 2 Hours / Week

Term work shall consist of performing minimum five experimental sets from the list below.

- 1) Testing of Cement: Consistency, Fineness, Setting Time, Specific Gravity,
- 2) Soundness and Strength Test for Cement
- 3) Testing of Aggregates: Specific Gravity, Sieve Analysis, Bulking of Fine Aggregate, Flakiness Index, Elongation Index and Percentage Elongation
- 4) Placement Tests on Concrete: Workability Tests: Slump, Compaction,
- 5) Strength Tests on Concrete: Compression, Flexure, Split & Tensile Test,
- 5) Effects of Admixture: Accelerator, Retarder, Super Plasticizer,
- 6) Exercise and verification of Concrete Mix Design,
- 7) Non-destructive Testing for Concrete.



## BTCVL608 Building Planning Design and Drawing Laboratory

**Practical:** 4 hours / week

Term work shall consist of detailed report of in form of set of drawings mentioned below. In practice sessions, free-hand sketching in drawing book shall be insisted.

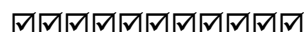
- 1) Imperial size sheets based on actual measurement of existing residential building consisting of plan, elevation, section passing through staircase, Site plan. Area statement & brief specifications.
- 2) Planning & design of a building (Minimum G+1): Full set of drawings for:
  - 1) Municipal Submission drawing as per local statutory body bye-laws such as Town Planning, Municipal Council or Corporation Authorities.
  - 2) Foundation / Center Line Drawing.
  - 3) Furniture layout plan.
  - 4) Electrification plan.
  - 5) Water supply & drainage plan.
  - 6) Project report giving details of Drainage System, Water Supply System, Water Tank, Septic Tank Design of terrace Drainage System.
- 3) Setting out of planned building actually on ground using conventional or modern surveying instruments

It is desirable to use drawings produced in this submission for carrying out structural design under BTCVL708 and / or BTCVL806 in next semesters. If this is implemented, student shall get extra 10% weightage limited to maximum limit.

**Course Outcomes:** On completion of the course, the students will be able to:

Draw plan, elevation and section of load bearing and framed structures.

Draw plan, elevation and section of public structures.



## BTCVM 609 Community Project (Mini Project)

Student shall choose a topic of his interest in consultation with faculty in the department. The topic for community project may be related to Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. It is desirable to obtain industry or community sponsorship. Simplified tools or devices may be presented in form of working model and a brief report stating development. A power point presentation shall also be submitted.



## BTCVS610 Seminar on Topic of Field Visit Road Construction

Student shall visit to ongoing construction sites in field to witness and collect information from works of execution of roads. It is desirable to collect basic information on components of roads, construction machinery, etc. Intention of the work is to introduce the student to the sequential order of execution of road works, preparation of road alignment and various surveys



## BTCVF611 Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII.



## Elective III

### BTCVE605A Waste Water Treatments

**Teaching Scheme:** (3 Lectures) hours/week

**Pre Requisites:** Environmental Engineering

#### Course Contents

##### Module 1: Wastewater Treatment

(5 Lectures)

Introduction of wastewater, its types and various sources, Concept of sewage, sullage and storm water, Necessity of treatment of waste water

**Preliminary treatment:** screening and grit removal units, oil and grease removal, Primary treatment,

**Secondary treatment:** Activated sludge process, trickling filter, sludge digestion, drying bed. Stabilization pond, septic tank, soakage system, Imhoff Tank, recent trends and advanced wastewater treatment: nutrient removal, solids removal

##### Module 2: Low cost wastewater treatment methods

(7 Lectures)

Principles of waste stabilization pond, Design and operation of oxidation pond, aerobic & anaerobic Lagoons, Aerated Lagoon, Oxidation ditch, Septic tank. Concept of recycling of sewage Disposal of waste water-stream pollution, Self Purification, DO sag curve, Streeter Phelp's Equation, Stream classification, disposal on land, effluents standards for stream and land disposals

##### Module 3: Industrial Waste Water Treatment Management

(6 Lectures)

**Sources of Pollution:** Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters – Effects of industrial effluents on sewers and treatment plants, Prevention vs Control of Industrial Pollution



**Pre and Primary Treatment:** Equalization, Proportioning, Neutralization, Oil Separation by Floatation, Prevention v/s Control of Industrial Pollution

**Module 4: Waste Water Treatment Methods (7 Lectures)**

Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process–Reverse osmosis– Chemical Oxidation–Ion Exchange – Air Stripping and Absorption Processes – Special Treatment Methods – Disposal of Treated Waste

**Common Effluent Treatment Plants (CETPs):** Need, Planning, Design, Operation & Maintenance Problems

**Module 5: Environmental Sanitation (6 Lectures)**

Communicable diseases, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control

**Insects and Rodent Control**–Mosquitoes, life cycles, factors of diseases control methods - natural &chemical, Fly control methods and fly breeding prevention, Rodents and public health, plague control methods, engineering and bio-control methods

**Module 6:Rural Sanitation (5 Lectures)**

Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems, Rural sanitation improvement schemes

**Text Books**

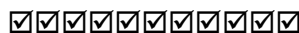
- Manual on sewerage and sewage Treatment-Government of India Publication
- Masters G.M., “Introduction to Environmental Engineering and Science”
- Metcalf & Eddy, “Waste Water Engineering Treatment & Disposal”, Tata McGraw Hill, 1982
- Garg S.K., “Sewage Disposal and Air Pollution Engineering”, Khanna Publishers
- Rao M.N.&Datta, Waste water treatment
- EhalersVictor& Earnest W Steel, Municipal and Rural sanitation

**Reference Books**

- Peavey, Rowe D.R. and Tchobanoglous, “Environmental Engineering”, McGraw-Hill Book Co.
- Viessman and Hammer, “Water Supply and Pollution Control”, Harper Collins College Pub.
- Hammer M.J., “Water and Waste water Technology”, Prentice-Hall of India Private Limited
- Canter, “Environmental Impact Assessment”, Tata McGraw Hill Publication
- Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi

**Course Outcomes:**On completion of the course, the students will be able to:

- Determine the sewage characteristics and design various sewage treatment plants.
- Understand municipal water and wastewater treatment system design and operation.
- Apply environmental treatment technologies and design processes for treatment of industrial waste water.
- Understand the rural sanitation schemes.



## **BTCVE605C Geographic Data Analysis and Applications**

**Teaching Scheme:** (3 Lectures) hours / Week

**Pre Requisites:** Mathematics - I and Mathematics – II

### **Course Contents**

**Module 1: (6 Lectures)**

Basic concepts of GIS- Information systems, spatial and non-spatial information, geographical concepts and terminology, advantages of GIS, basic components of GIS, commercially available GIS hardware and software, organization of data in GIS.

**Module 2:****(6 Lectures)**

GIS data- Field data, statistical data, Maps, aerial photographs, satellite data, points, lines and areas features, vector and raster data, advantages and disadvantages, data entry through keyboard, digitizers and scanners, digital data, preprocessing of data rectification and registration, interpolation techniques.

**Module 3:****(6 Lectures)**

Data management- DBMS, various data models, run-length encoding, quadtrees, data analysis-data layers, analysis of spatial and non-spatial data, data overlay and modeling, data processing: raster based and vector based, data presentation –hardcopy devices, softcopy devices.

**Module 4:****(6 Lectures)**

Remote sensing and GIS integration- Principles of electromagnetic remote sensing, imaging characteristics of remote sensing systems, extraction of metric and descriptive information from remotely sensed images, integration of remote sensing &GIS.

**Module 5:****(6 Lectures)**

Digitizing, Editing and Structuring of map data: Digitizing: manual, semiautomatic and automatic, editing: error detection and correction, tolerances, topology creation, Attribute map generation.

Digital Elevation Model: Need of DEM, Various structures of DEM: line,

**Module 6:****(6 Lectures)**

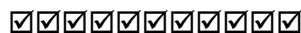
Applications of GIS- Map revision, land use, agriculture, forestry, archaeology, municipal geology, water resources, soil erosion, land suitability analysis, change detection

**Term Work:**

Each student to appear for at least one written test during the semester. At least 10 assignments based on above syllabus and the graded answer paper for the semester test to be submitted.

**Text/Reference Books:**

- 1.Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, Prentice Hall. India.
- 2.Kang-tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill
- 3,Deepankar Chakrabarti, Suchandra Choudhury Sujit Choudhury, “Introduction to Geographic Information Technology”, Kindle Edition
- 4.ChakrabortyDebashis, “Fundamentals of Geographic Information Systems”
- 5.Sabins F F, “Remote Sensing Principles and Interpretation”
6. KataraPratibha, “Remote Sensing and GIS Technology”



## BTCVE605D Advanced Engineering Geology

**Teaching Scheme:** (3Lectures) hours/week

**Pre Requisites:** Engineering Geology

### Course Contents

**Module 1****(6 Lectures)**

Stratigraphy and Indian geology: geological time scale, physiographic divisions of India and their geological, geomorphologic and tectonic characteristics, study of important geological formations of India namely: Vindhyan, Gondwana, and Deccan traps with respect to: distribution, lithology, tectonics, economic importance etc. significance of these studies in civil engineering

**Module 2****(6 Lectures)**

**Sub-surface exploration:**Steps in geological studies of project site, engineering consideration of structural features, exploratory drilling, preservation of cores, core logging, graphical representation of core log, limitations of exploratory drilling method, numerical problems on core drilling, introduction to geological map

**Sub-surface water:**Runoff, fly off and percolation of surface water, juvenile, connate and meteoric water, water table, zones of subsurface water, perched water table, aquifer theory

### Module 3

(8 Lectures)

**Engineering geology of Deccan traps:**Types of basalts and associated volcanic rocks, engineering characteristics, infillings of gas cavities, compact and amygdaloidal basalt as construction material, effect of jointing, hydrothermal alteration and weathering on engineering behaviour, tail channel erosion problem in Deccan trap region, suitability for tunnelling, problems due to columnar basalt, dykes, red bole, tachylitic basalt, volcanic breccias and fractures, laterites: origin, occurrence and engineering aspects, ground water bearing capacity of rocks of Deccan trap region, percolation tanks

### Module 4

(6 Lectures)

**Geology of soil formations:**Soil genesis, geological classification of soils, residual and transported soils, soil components, characteristics of soils derived from different types of rocks, nature of alluvium and sand from rivers of Deccan trap region, scarcity of sand

### Module 5

(6 Lectures)

**Geophysics:**Various methods: magnetic, gravitational and electrical resistivity methods, applications of electrical resistivity method using Wennerconfiguration in civil engineering problems such as: finding thickness of over burden and depth of hard rock, locating the spot for ground water well, seepage of water finding,

**Rock mechanics:**General principles, engineering properties of rocks and their dependence upon geological characters, in-built stresses in rocks, measurements of these stresses

### Module 6

(6 Lectures)

Plate tectonics, seismic zones of world, seismic activity of Deccan trap region, various theories on the origin of the seismic activity of Deccan trap region, prediction of earthquake, earthquake resistant constructions, numerical problems based on seismic data, cause and prediction and preventive measurement of landslide in Deccan trap region.

### Text Books

- Gupte R. B., “A Text Book of Engineering Geology”, Pune VidyarthiGrihaPrakashan, Pune.
- Gokhale K.V.G.K. and Rao D. M., “Experiments in Engineering Geology”, TMN, New-Delhi.
- Mukerjee P. K., “A Text Book of Geology”, The World Press Pvt. Ltd., Calcutta.
- Prabin Singh, “Engineering and General Geology”, S. K. Katariya and sons, Delhi.

### Reference Books

- Tyrrell G. W., “Principles of Petrology”, B. I. Publication Pvt. Ltd., New Delhi.
- Holmes A., “Principles of Physical Geology”, ELBS Chapman & Hall, London.
- Billings M. P., “Structural Geology”, Prentice Hall of India Private Ltd., New Delhi.
- Farmer L. W., “Engineering Properties of Rocks”, Champman & Hall, London.
- Reddy, “Engineering Geology for Civil Engineering”, Oxfard & IBH Publishing Co. N. Delhi.
- SathyaNarayanSwamiB. S., “Engineering Geology”, DhanpatRai & Co.(P) Ltd, Delhi

**Course Outcomes:** On completion of the course, the students will be able to:

- 1) Understand geological time scale and physiographic division of India and their geological characteristics and different geological formation in India.
- 2) Perform sub surface exploration and interpret core log.
- 3) Solve numerical problem based on core drilling and seismic data.
- 4) Familiar with origin of earthquake, seismic wave and landslide in Deccan trap.



# BTCVE 605E Advanced Soil Mechanics

**Teaching Scheme:** (3Lectures) hours/week

**Pre Requisites:** Soil Mechanics

## Course Contents

### Module 1: Introduction to Clay Minerals (6 Lectures)

Introduction to Clay mineralogy; Gravity forces, surface forces and their dependency on particle size; Primary and Secondary valence bonds; Structural units of clay minerals; Electrical charges on clay minerals; Structural composition and behavior of the minerals like Kaolinite, Montmorillonite, Illite, Halloysite etc.

### Module 2: Stress Distribution in Soil (8 Lectures)

Boussinesq's equation for point load, vertical pressure under loaded circular area and uniformly loaded rectangular area. Newmark's method for uniformly distributed loads, preparation and use of Newmark's chart.

### Module 3: Earth work and Earth moving Equipments (4 Lectures)

Planning of Earth work, Earth moving equipment: dozers, scrapers, loader-backhoe, excavators; compaction equipments: static and drum rollers, vibratory rollers, sheep-foot rollers, pneumatic tyre rollers, small compactors; selection of equipments.

### Module 4: Ground Improvement and Modifications (6 Lectures)

Improvement by excavating and replacing, mixing additives, applications, in-situ ground improvement- compaction piles, compaction with dynamics loads, pre-loading using sand drains, grouting, replacing existing soils with stronger soil in bore hole, response of sands and clays to externally applied stress, impact compaction of sands, vibratory compaction in sands, types of drains.

### Module 5: Reinforced Soils (6 Lectures)

Soil reinforcement and its applications, Mechanism of soil reinforcement; Geosynthetics: Introduction; Geotextile, Geojute, Geomembrane, Geogrid, Applications of Geosynthetics in Civil Engineering, testing of geotextile, using Geogrids as a reinforcements, design with geo-synthetics.

### Module 6: Grouting and injection methods (6 Lectures)

Principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

## Text Books

- Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Pub. And Distri. N. Delhi
- Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
- Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
- Shashi K Gulathi and ManojDatta, "Geotechnical Engineering", Mc-Graw Hill Publications (India) Pvt. Ltd.

## Reference Books

- Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
- Taylor D.W., "Fundamentals of Soil mechanics"
- Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York

- Scott R. F., “Principal of soil mechanics”
- Lambe T.W, “Soil Testing” by Willey Eastern Ltd., New Delhi
- Donald P. Coduto, Man-Chu Ronald Yeung, William A. Kitch, “ Geotechnical Engineering”, Pearson Publications

**Course Outcomes:** On completion of the course, the students will be able to:

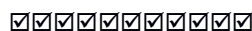
CO1: Behavior of soil based on its particle size and mineral content

CO2: Ability to understand the Earth work equipment

CO3: Ability to understand the necessity of ground improvement and potential of a ground for improvement

CO4: Understand the soil reinforcement mechanisms

CO5: Understand the grouting and injection methods.



## Semester – VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 701	Design of Concrete Structures II	2	1	-	3
02	BTCVC 702	Infrastructure Engineering	3	-	-	3
03	BTCVC 703	Water Resources Engineering	2	1	-	3
04	BTCVC 704	Professional Practices	2	1	✓	3
05	CVE4	<b>Elective IV</b>	3	-	-	3
06	CVE5	<b>Elective V</b>	3	-	-	3
<b>Practical / Drawing and/or Design</b>						
07	BTCVL707	Professional Practices Laboratory	-	-	2	1
08	BTCVL708	Design & Drawing of Steel Structures	-	-	4	2
09	BTCVP709	Project Stage-I	-	-	2	1
10	BTCVF710	Industrial Training	-	-	-	AU
Sub-Total			<b>15</b>	<b>3</b>	<b>08</b>	
<b>Total</b>						<b>22</b>
<b>Elective IV</b>						
	BTCVE705A	Plastic Analysis and Design				
	BTCVE705B	Machine Foundations				
	BTCVE705C	Modern Surveying Techniques	-	-	-	-
	BTCVE705D	Engineering Economics				
	BTCVE705E	Ground Improvement Techniques				
<b>Elective V</b>						
	BTCVE706A	Advanced Structural Mechanics				
	BTCVE706B	Town and Urban Planning				
	BTCVE706C	Construction Economics & Finance				
	BTCVE706D	Intelligent Transportation Systems	-	-	-	--
	BTCVE706F	Waste Water Treatment				
	BTCVE706F	Tunneling and Underground Excavations				

# BTCVC 701 Design of Concrete Structures II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

## Course Contents

### Limit State Method for RC Structures

#### Module 1:

(6 Lectures)

Limit State of Collapse (Torsion) - Types of torsion, behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and Torsion

#### Module 2:

(6 Lectures)

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), detailing of reinforcement, and construction of Interaction diagrams for uni-axial bending, concept of bi-axial bending

### Prestressed Concrete

#### Module 3:

(5 Lectures)

Introduction to prestressed concrete, concepts, types, systems and methods of pre stressing,

#### Module 4:

(5 Lectures)

Stress analysis for rectangular and symmetrical I sections, Pressure Line, Cable Profiles

#### Module 5:

(4 Lectures)

Losses in Prestressing for Pre-tensioned & Post tensioned members

#### Module 6:

(4 Lectures)

Design of Rectangular and Symmetrical I sections, Design of End Block

### Text Books

- IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
- Karve & Shah, "Limit State Theory & Design", Structures Publications, Pune
- Lin T.Y., "Prestressed Concrete", John Willey & Sons New York
- Jain A.K., "Reinforced Concrete Design (Limit State)", Nemchand Brothers, Roorkee
- Sinha S.N., "Reinforced Concrete Design", Vol. I, II, Tata Mc-Graw Hill
- Sinha & Roy, "Fundamentals of Reinforced Concrete", S. Chand & Co. New Delhi
- Sinha & Roy, "Prestressed Concrete", S. Chand & Co. New Delhi
- Krishnaraju N., "Prestressed Concrete", Tata Mc-Graw Hill

### Reference Books

- Punmia B.C., "Reinforced Concrete Design", Vol. I, II, Laxmi Publications
- Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi
- Relevant Publications by Bureau of Indian Standards, New Delhi
- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

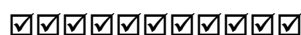
**Course Outcomes:** On completion of the course, the students will be;

Able to identify the behavior, analyze and design of the beam sections subjected to torsion.

Able to analyze and design of axially and eccentrically loaded column and construct the interaction diagram for them.

Understand various concepts, systems and losses in pre-stressing.

Able to analyze and design the rectangular and symmetrical I-section pre-stressed beam/girders.



# BTCVC 702 Infrastructure Engineering

Teaching Scheme:(3 Lectures) hours/week

## Course Contents

### Module 1:

(5Lectures)

Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, subgrade formation, fixtures and fastenings, Geometric Design of tracks- Horizontal Alignment, Vertical Alignment

### Module 2:

(5 Lectures)

Points and Crossings: Standard types, Design of simple turnout, various types of Junctions, Stations and Yards: Purpose, Location, Site selection, general layouts of Terminus and Junction, Signaling and Interlocking, Construction and Maintenance of Track, Modern trends in Railways

### Module 3:

(5 Lectures)

Tunnel Engineering: Shape and Size of Tunnel Shafts, Pilot Tunnels, Tunneling in Hard Rock, Tunneling in Soft Materials, Drilling-Patterns, Blasting, Timbering, Mucking, Tunnel Lining, Advances In Tunneling Methods, Safety Measures, Ventilation, Lighting and Drainage of Tunnels

### Module 4:

(6 Lectures)

Dock and Harbor Engineering: Inland Water Transport in India, Tides, Winds and Waves Erosion, Transport of Sediments, Beach Drift, Littoral Drift, Sand Bars, Coast Protection, Classification of Ports and Harbors, Site Selection, Features of Break Waters, Jetties, Wharves, Piers, Facilities required, Dry Docks, Wet Docks, Lift Docks, Floating Docks, Spillways, Navigational Aids, Lighthouses, Terminal Buildings, and Dredging- Special Equipments

### Module 5:

(6 Lectures)

Bridge Engineering: Determination of design discharge, Linear Water Way, Economical Span, Location of Piers and Abutments, Afflux, Scour, Depth, Standard Specification For Bridges: Indian Road Congress Bridge Code, Aesthetics in Bridge Design, Bridge Foundations, Types, Components, Foundations in Special Conditions, Foundation Failures, Piers For Viaducts, Construction Aspects of Various Types of Bridges: Launching, erection and performance of Bridges, Bridge bearings

### Module 6:

(5 Lectures)

Airport Engineering: Planning, Airport Surveys, Site Selection, Zoning Laws, Runways, Geometric Design, Airport Capacity, Terminal Buildings, Parking Systems, Taxiways, Hangers, Airport Drainage, Air Traffic Control, Airport Lighting

### Text Books

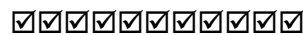
- Antia K. F., "Railway Engineering", New Book Company Pvt. Ltd
- Saxena and Arora, "A Course in Railway Engineering," DhanpatRai& Sons Delhi
- Quinn, "Planning and Construction of Docks and Harbours", Tata McGraw Hill, Latest Edition
- Oza, "Dock and Harbour Engineering", Chartor Publishing House, Anand
- Shrinivasan, Rangawala, "Dock, Harbour and Tunnel Engineering", Chartor Publishing House
- Arora N. L., "Transportation Engineering", IPH New Delhi
- Bindra S. P., "Bridge Engineering", Dhanpatrai and Sons
- Khanna and Arora, "Airport Engineering" 6th Edition, Nemchand& Bros., 1999
- Rangawala, "Airport Engineering", Charotar Publishing House Pvt. Limited
- Hariharan K. V., "Multimodal Transport & Infrastructure Development in India", Shroff Publishers, Mumbai

### References

- Publications of Bureau of Indian Standards, New Delhi, Relevant To the SylLaboratoryus
- Cormick H. F., “Dock and HarbourEngineering”Giffin Publisher
- Raina V K, “Handbook for Concrete Bridges” Vol. 1 and 2, Shroff Publishers, Mumbai
- Horonjeff, “Planning and Design of Airports”,Fifth edition

**Course Outcomes:**On completion of the course, the students will be able to:

- Know about the basics and design of various components of railway engineering
- Understand the types and functions of tracks, junctions and railway stations.
- Know about the aircraft characteristics, planning and components of airport
- Understand the types and components of docks and harbors.



## BTCVC 703 Water Resources Engineering

**Teaching Scheme:**(2 Lectures+ 1 Tutorial hours/week)

### Course Contents

**Module 1: Introduction**

**(6 Lectures)**

Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, difference between weir, barrage and dam, methods of distribution of water, development of irrigation in India

Introduction to hydrology: hydrologic cycle, rain, surface and ground water

**Water Requirement of Crops**

Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

**Module 2: Reservoirs and Dams**

**(6 Lecturers)**

Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam,

**Module 3: Spillway Weirs and Canals**

**(8 Lectures)**

Spillway, Necessity and Different Types, Location of Spill Ways, Selection Criterion, Gates For Spillways,

Weirs on Permeable Foundations: Theories of Seepage, Bligh’s Creep Theory, Limitations of Bligh’s Creep Theory, Khosla’s Theory, Piping and Undercutting,

Canals: Types, Alignment, Kennedy’s and Lacey’s Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining : Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

**Module 4: Lift Irrigation**

**(6 Lectures)**

Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy’s law, permeability, safe yield of basin.

Lift irrigation schemes: Various components and their design principles (Only concepts)

**Module 5: Hydrology**

**(6 Lectures)**



Hydrology, measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

**Module 6: Water logging and drainage**

**(6 Lectures)**

Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures

Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara

**Text Books**

- Varshney R. S., Gupta & Gupta, “Theory and Design of Irrigation Structures”, Vol. I & II
- Punamia B. C. Pandey B. B. and Lal, “Irrigation and Water Power Engineering”, Standard Publishers, New Delhi
- Garg S. K., “Irrigation Engineering & Hydraulic Structures”, Khanna Publishers, N. Delhi, ISBN NO: 978-81-7409-047-9
- Priyani, “Irrigation and Water Power”, Charotar Publishing House, Anand
- Bharat Singh, “Irrigation”, Nemchand Brothers, Roorkee
- Subramanya K., “Engineering Hydrology”, Tata Mc-Graw Hill Company Limited, N. Delhi

**References Books**

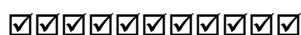
- USBR, “Design of Small Dam”, OXFORD & IBH, Publishing Company
- Justinn, “Engineering for Dam” Vol. I, II, III, Creager and Hinds
- Leliavsky, “Design of Hydraulic Structures” Vol. I & II,
- C B I & P “River Behaviour, Management and Training”
- Circular of Government of Maharashtra, 18 February 1995, “Design of Canals”

**Course Outcomes:** On completion of the course, the students will be able to:

CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.

CO2: Understand various irrigation structures and schemes.

CO3: Develop basis for design of irrigation schemes.



## **BTCVC 704 Professional Practices**

**Teaching Scheme:**(2 Lectures + 1 Tutorial) hours/week

**Pre Requisites:**Building Construction

### **Course Contents**

**Module 1: Quantity Surveying**

**(4 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates, specifications: purpose general and detailed specifications for various items of work, prime cost, provisional sums and provisional quantities, taking out quantity, P.W.D. method, recording of measurements

**Module 2: Costing**

**(6 Lectures)**

Analysis of rates for various items of construction of civil engineering works, standard schedule of rate, price escalation, detailed and approximate estimates for buildings, R.C.C works, culverts, earthwork for canals, roads including hill roads and other civil engineering works

**Module 3: Tendering**

**(6 Lectures)**

Types, preparation of tender papers, conditions of contracts, competitive bidding, types of bids, invitation of tenders, scrutiny

and acceptance of tenders, award of jobs, introduction to B.O.T. and similar other basis of execution,

**Module 4: Contracts**

**(4Lectures)**

Essentials of legally valid contract, types and forms of contract between various agencies, organizational set up of P.W.D. classification of works, method of carrying out work in P.W.D. mode of payment, bill forms, introduction to arbitration

**Module 5: Valuation**

**(4 Lectures)**

Principles, types, price and cost, attributes of value, valuer and his duties, factors affecting the valuation of properties, methods of valuation, different types of lease

**Module 6:**

**(6 Lectures)**

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

**Text Books**

- Dutta B. N., “Estimating and Costing”, UBS Publishers Distributors
- NanavatiRoshan, “Professional Practice Estimating and Valuation”, Laksmi book Depot
- Patil B. S., “Civil Engineering Contracts and Estimates”, Universities Press, 3rd edition
- Bhasin P. L., “Quantity Surveying”, S.Chand and Co. Ltd Revised 3rd edition
- Rangwala S. C., “Elements of Estimating and Costing”, Charotar Publication 8th edition
- Birdi, “Estimating and Costing”, DhanpatRai Publication 1988 28th edition
- Chakraborty M., “Estimating, Costing & Specification in Civil Engineering”, M.Chakraborty Publication
- Rangwala S. C., “Valuation of real Properties”, Charotar Publication,2011

**References**

- Govt. of Maharashtra P.W.andHousing DepartmentPublication edition 1979 and 1981
- P. W. D. Maharashtra, “Standard Specifications”, Volumes I & II
- C.P.W.D. Specifications
- C.P.W.D. Schedule of Rates
- P.W.D. Maharashtra Schedule of Rates
- Publications of Bureau of Indian Standards: IS 1200 all parts, and other relevant

**Course Outcomes:**On completion of the course, the students will be able to:

Understand the importance of preparing the types of estimates under different conditions for various structures.

Know about the rate analysis and bill preparations and to study about the specification writing.

Know the various types of contract, accounts in PWD, methods for initiating the works in PWD and tendering.

Understand the valuation of land and buildings, various methods and factors affecting valuation.



## **Elective IV**

### **BTCVE705APlastic Analysis and Design**

**Teaching Scheme:** (3 Lectures) hours/week

**Pre Requisites:** Engineering Mechanics, Mechanics of Solids, Structural Mechanics I, Structural Mechanics-II, Design of Steel Structures

#### **Course Contents**

**Module 1:**

**(5Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

- Module 2:** (7 Lectures)  
Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms, bending moment diagram at collapse
- Module 3:** (7 Lectures)  
Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance
- Module 4:** (6 Lectures)  
Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force
- Module 5:** (6 Lectures)  
Design of portal frames, design of corner connection with and without haunches
- Module 6:** (5 Lectures)  
Consideration of deformations, calculation of deflections for plastically deformed structures

#### Text Books

- Bureau of Indian Standards, “Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)”.
- Bureau of Indian Standards, “IS: 800 Code of Practice for General Construction in Steel”
- Arya A.S. and Ajmani J.L., “Design of Steel Structures”, Nemchand & Bros., Roorkee
- Ramchandra, “Design of Steel Structures Vol – II”, Standard Book House, Delhi
- Neal B.G., “Plastic Method of Structural Analysis”, Chapman & Hall
- Beedle L.S., “Plastic Design of Steel Frames”, John Wiley & Sons

#### References

- Bureau of Indian Standards, “Handbook for Structural Engineers SP 6”
- INSDAG Kolkata, “Teaching Resource for Structural Steel Design”
- “Steel Designers Manual” ELBS

**Course Outcomes:** On completion of the course, the students will be able to:

Understand modes of structural collapse

Perform the plastic analysis and design of various determinant and in-determinant structures.



## Elective V

### BTCVE706B Town and Urban Planning

**Teaching Scheme:** Lectures: 4 Hours / Week

#### Course Contents

**Module 1:** Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

**Module 2:** Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence Stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

**Module 3:** Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

**Module 4:** Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

**Module 5:** Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

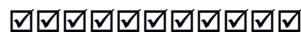
**Module 6:** Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach

#### Text Books

- Gandhi N.K., "Town and Country Planning",
- Hiraskar G.K., "Town and country Planning"
- Rangwala S.C., "Town Planning", Charotar Publications, Anand
- Sundaram K.V., "Urban and Regional Planning in India", Vikash Publishing House Pvt. Ltd.
- MRTP Act 1966
- Land Acquisition Act - 1894
- Misra S.N., "Rural Development Planning-Design and Method", Satvahan Publications, N. Delhi

#### Reference Books

- Lewis Kuble, "Town and Country Planning"
- Gallion, "The Urban Pattern", Eisner



## BTCVL707 Professional Practices Laboratory

**Practical:** 2 Hours / Week

Term work include detailed study and working of following set of assignments

1) Detailed estimate for a two storied RCC or load bearing wall building

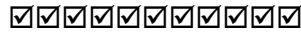
2) Preparing detailed estimate for any four of the following:

- a) A small culvert
- b) A stretch of a road about 1 Km. long including earthwork
- c) A reach of canal about 1 Km. long
- d) A percolation tank
- e) A factory shed of steel frame
- f) Water supply scheme
- g) Drainage scheme
- h) Water Treatment plants.

3) Valuation report including valuation certificate for any one of the following:

- a) A building for residential purpose or commercial purpose
- b) A hotel
- c) A theatre

- d) Any one construction machine.
- 4) Drafting of Detailed specification for any five civil engineering items. This shall include at least one item each from Roads, Irrigation works, Water Supply, Sanitation and buildings
- Assignment (1) and (2) shall include Rate Analysis of at least two items.



## BTCVL708 Design & Drawing of Steel Structures

**Practical:**4 Hours / Week **Term Work:** 50 Marks

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures from Group A and B. Student may use IS 800 1984 or 2007.

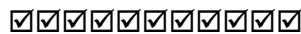
### Group A

- 1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases
- 2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases
- 3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases
- 4) G + 3 Building Structure

### Group B

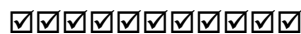
- 1) Foot Bridge: Analysis using Influence lines for Main Truss, Cross Beams, Raker, Joint Details
- 2) Plate Girder: Analysis and Design of Rivetted or Welded Plate Girder.
- 3) Elevated Water Tank: Analysis and Design of Staging and Tank Body.
- 4) Steel Chimneys

**Course Outcomes:** On completion of the course, student will be able to simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.



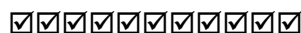
## BTCVP709Project Phase I

Term work shall consist of detailed report for chosen topic and final working proposed in next semester. Report shall summarise the literature survey, spell out the scope of work, proposed methodology and expected results. It is desirable to have a topic sponsored by Industry or research organization or community.



## BTCVF710Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII.



## Semester – VIII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 801	Introduction to Earthquake Engineering	2	1		3
02	CVE6	<b>Elective VI</b>	3	-		3
03	CVE7	<b>Elective VII</b>	3	-		3
04	CVE8	<b>Elective VIII</b>	3	-		3
<b>Practical / Drawing and/or Design</b>						
05	BTCVL805	Earthquake Engineering Laboratory	-	-	2	1
06	BTCVL806	Design and Drawing of RC Structures	-	-	4	2
07	BTCVF807	Self-Study Report based on field visit to Infrastructure Project Works	-	-	2	1
08	BTCVP808	Project Stage-II	-	-	8	4
Sub-Total			<b>11</b>	<b>1</b>	<b>16</b>	
<b>Total</b>			<b>28</b>			<b>20</b>
<b>Elective VI</b>						
	BTCVE802A BTCVE802B BTCVE802C BTCVE802D BTCVE802E	Limit State Design of Steel Structures Construction Techniques Pavement Management System Composite Materials Disaster Preparedness & Planning Management	-	-	-	-
<b>Elective VII</b>						
	BTCVE803A BTCVE803B BTCVE803C BTCVE803D	Bridge Engineering Structural Audit Design of Hydraulic Structures Environmental Impact Assessment and Life Cycle Analyses	-	-	-	-
<b>Elective VIII</b>						
	BTCVE804A BTCVE804B BTCVE804C BTCVE804D BTCVE804E	Rock Mechanics Water Power Engineering Water Resources Economics Planning and Management Finite Element Method Repair & Rehabilitation of Structures	-	-	-	-
<b>Overall Total</b>			<b>50+168 = 218</b>			<b>127</b>

### BTCVC 801 Introduction to Earthquake Engineering

**Teaching Scheme:** (2 Lectures +1 Tutorial) hours/week

#### Course Contents

**Module 1:**

**(5 Lectures)**

Elements of seismology: Terminology, structure of the earth, causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquakes, Accelerogram, prominent earthquakes of India

**Module 2:**

**(5 Lectures)**

Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral

**Module 3:**

**(6 Lectures)**

Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on

design spectrum, design spectrum of IS 1893, evaluation of lateral loads

**Module 4:**

**(6 Lectures)**

Principles of Earthquake Resistant Design (EqRD), planning aspects, resistance of structural elements and structures for dynamic load, design criteria, ductile detailing of RCC members, energy absorption, provisions of IS 13920

**Module 5:**

**(6 Lectures)**

Construction aspects of masonry and timber structures, retrofitting and strengthening techniques of low cost and low rise buildings, provisions of IS 4326

**Module 6:**

**(6 Lectures)**

Dynamic properties of soils, field and Laboratory tests, site evaluation, behavior under dynamic loads, effect on bearing capacity, settlement, liquefaction

**Text Books**

- IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of Indian Standards, New Delhi.
- Chopra A.K. (2001), "Dynamics of Structures", 2<sup>nd</sup> Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.
- Mario Paz, "Structural Dynamics", CBS Publication.
- Arya A.S., "Elements of Earthquake Engineering", South Asian Pub., New Delhi.

**Reference Books**

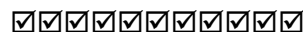
- Clough R.W. and Penzien J.(1993), "Dynamics of Structures", McGraw Hill New York
- Humar J. L., "Dynamics of Structures", 2nd Edition (2002), Swets and Zeitlinger, Netherlands.
- FarzadNaiem, "The Seismic Design Handbook", Kluwer Academic Pub. (2001), Massachusetts, ISBN: 0-7923-7301-4.
- Dowrick D. J., "Earthquake Resistant Design for Engineers & Architects", John Wiley and Sons Ltd. ISBN: 0-471-91503-3.
- Pauley T. and Priestley M.J.N., "Seismic Design of Reinforced Concrete and Masonry Buildings", (1992) John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.
- Nayak N. V., "Foundation Design Manual", Dhanpatrai and Sons, Delhi.
- Housner G.W. & Hudson D. E., "Applied Mechanics- Dynamics", East-West Edition, N. Delhi.
- Kramer S. L., "Geotechnical Earthquake Engineering", Pearson Education

**Course Outcomes:** On completion of the course, the students will be able to:

Capture complexities in earthquake resistant design of structures

Grasp Nature of earthquake vibration and associated forces on structures

Understand importance of designing the building to targeted seismic performance.



## **BTCVL805Earthquake Engineering Laboratory**

**Practical:**2 Hours / Week

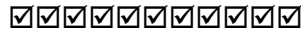
Term work includes detailed study and working on minimum 03 of following set of assignments:

- 1) Planning of earthquake resistant building
- 2) Construction of design response spectra
- 3) Evaluation of lateral loads on multi-storeyed building as per IS 1893
- 4) Ductile detailing of members as per IS 13920
- 5) Detailing of masonry structures

**Laboratory Work:**

The students are expected to perform **any 03** experiments out of list given below and submit report of same;

- Dynamics of a three-storied building frame subjected to harmonic base motion
- Dynamics of a three-storied building frame subjected to periodic (non harmonic) base motion
- Vibration isolation of a secondary system.
- Dynamics of a vibration absorber.
- Dynamics of beams.
- Dynamics of free-standing rigid bodies under base motions.

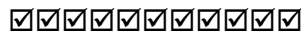


**BTCVL806 Design and Drawing of RC Structures**

**Practical:** 4 Hours / Week

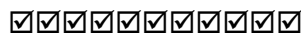
Term work shall consist of detailed analytical report for structural design and drawing of the following RC structures:

- A) G + 2 Building
- B) Any one of the following
  - 1) Retaining wall
  - 2) Elevated water tank: analysis and design of staging and tank body.
  - 3) Staircase of special form such as helicoidal stair
  - 4) Shell roofs
  - 5) Special foundation type such as combined footing, raft, pile foundation



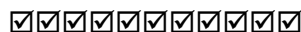
**BTCVF807 Self-Study Report based on field visit to Infrastructure Project Works**

Student shall visit to any one ongoing construction site in field to witness and collect necessary information from works of execution of infrastructure works such as bridges, railways, airports, docks, harbors, tunnels, industrial establishments, planned cities, etc. It is desirable to collect basic information on aspects of planning, operation, various specializations involved, etc. Intention of the work is to introduce the student to data on vocabulary of terms in field.



**BTCVP808 Project Phase II**

Term work shall consist of detailed report for chosen topic and output of final working proposed in previous semester. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student.





# Elective VI

## BTCVE802B Construction Techniques

**Teaching Scheme:** 3 Lectures hours/week

**Pre Requisites:** Project Management

### Course Contents

**Module 1:**

**(6 Lectures)**

Introduction, planning of a new project, site access and services, mechanical and manual construction, excavation in earth: Understanding basics and functions of equipment, earthmoving equipment - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates, drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities

**Module2:**

**(6 Lectures)**

Excavation in hard rock, Rippers, jack hammers, drills, compressors and pneumatic equipment, blasting explosives, detonators, fuses, drainage in excavation – necessity and methods of dewatering

**Module3:**

**(6Lectures)**

RMC Plant, layout and production capacity, type of concrete mixers, machinery for vertical and horizontal transportation of concrete, grouting, Shotcreting, under water concreting, Type of formwork, Slip formwork, equipment for placing of concrete in normal and difficult situations

**Module 4:**

**(6 Lectures)**

Prefabricated construction: Relative economy, steel construction: planning and field operations, erection equipment, cranes of various types such as tower, crawler, luffing jib tower crane, floating and dredging equipment

**Module 5:**

**(6 Lectures)**

Road construction aspects, asphalt mixing and batching plant (Hot Mix Plant), sensor paver for rigid roads, crushing plants belt conveyers, cableway, construction of a new railway track, aspects of bridge construction

**Module6:**

**(6 Lectures)**

Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

**Text Books**

- Peurifoy R.L. “Construction, Planning, Equipment & Methods”, McGraw hill Book Co. N.Delhi
- VermaMahesh, “Construction Equipment”, Metropolitan book Co.,New York
- Singh J., “Heavy Construction - Planning, Equipment & Methods”, Oxford & IBH Pub., N.Delhi
- Taylors, “Reinforced Concrete Bridges”,

**Reference Books**

- Quin, “Planning and Construction of Docks and Harbors”,Mc-Graw Hill Company, New York.
- Stubbs, “Hand Book of Heavy Construction”,Mc-Graw Hill Inc,US 2nd edition.
- Boyes R.G.H, “Structural & cut off Diaphragm Walls”, Applied Science Publishers Ltd. London.
- Ataev S. S., “Construction Technology”, Mir Publishers, Mascow.

**Course Outcomes:**On completion of the course, the students will be able to:

1. Understand the planning of new project with site accessibility and services required.
2. Comprehend the various civil construction equipment's.
3. Familiar with layout of RMC plant, production, capacity and operation process.
4. Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.

# BTCVE802C Pavement Management System

**Teaching Scheme:** (3 Lectures) hours/week

**Pre Requisites:** Transportation Engineering I, Transportation Engineering II

## Course Contents

### Module 1:

(6 Lectures)

Need of pavement management system, Pavement distresses in flexible/rigid pavements causes and remedies. Visual Surface distress survey procedures and techniques. Serviceability Indicators for roads. Measurement of Serviceability Indicators using various equipments like Bump Indicator, Skid tester, Distress surveys & Benkelman Beam.

### Module 2:

(6 Lectures)

Functional evaluation of pavements- Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Riding Quality, Roughness Measurements, Skid Resistance, Roughness, and Safety Aspects. Inventory System. Classification of maintenance operations, Routine, Periodic, Special. Common types of maintenance: Potholes, Cracked surface, Ruts & undulations, Reasons for repetitive occurrence,

### Module 3:

(6 Lectures)

Maintenance Methodology - Resurfacing, Interface treatments, Bituminous Thin Surface Courses- Seal Coat, Surface Dressing, Premixed carpet, Mixed seal surfacing, Micro asphalt concrete (MAC), Bituminous Surface Courses: Semi-Dense Bituminous Concrete, Bituminous Concrete, and Bitumen Mastic. Road maintenance in high rainfall areas. Choice of materials. Modified bitumen & geo-fabrics. Maintenance alternatives including recycling.

### Module 4:

(6 Lectures)

Pavement Management/ Maintenance Management System-Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design, Construction and Maintenance, Rehabilitation and Feedback Systems, Examples of HDM package, Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

### Module 5:

(6 Lectures)

Prediction Deterioration Models- Factors affecting performance, Types of prediction models, Prediction deterioration model development, Method to assess the precision and accuracy of the developed model.

### Module 6:

(6 Lectures)

Pavement Structural Design and Economic Analysis; Emerging Technology in Pavement Management Systems.

**Text/Reference Books:**



# BTCVE802E Disaster Preparedness & Planning Management

**Teaching Scheme:** Lectures: 3 Hours/Week

**Pre Requisites:** Mathematics - I and Mathematics – II

## Course Contents

### Module 1: Introduction

(6 Lectures)

Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

### Module 2: Natural Disasters

(6 Lectures)

Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunamis, landslides, coastal erosion, soil erosion, forest fires etc.); hazard and vulnerability profile of India.

### Module 3: Manmade Disasters

(6 Lectures)

Manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

**Module 4: Disaster Impacts**

**(6 Lectures)**

Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

**Module 5: Disaster Risk Reduction (DRR)**

**(6 Lectures)**

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

**Module 6: Disasters, Environment and Development**

**(6 Lectures)**

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

**Text/Reference Books:**

- <http://ndma.gov.in/> (Home page of National Disaster Management Authority).
- <http://www.ndmindia.nic.in/> (National Disaster management in India, Ministry of Home Affairs).
- Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
- Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
- Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.



## **BTCVE803A Bridge Engineering**

**Teaching Scheme:** (3 Lectures) hours/week

**Pre Requisites:** Transportation Engineering, Infrastructure Engineering, Hydraulic Engineering I & II

### **Course Contents**

**Module 1: Introduction**

**(4 Lectures)**

History of bridges, components and definitions, classification of road bridges, span length, classical examples of each type, people involved in the total process, history of analysis

**Module 2: Selection of site and initial decision process**

**(8 Lectures)**

Survey and alignment, geotechnical investigations and interpretations

**River Bridge:** Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard.

**Road Bridge:** Selection of bridge site and planning, collection of bridge design data, vertical clearance.

**Module 3: Standard loading for bridge design as per different codes**

**(6 Lectures)**

**Road Bridges:** IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept, equivalent loads, traffic load, width of roadway and footway, use of influence lines for maximum forces in members, transverse distribution of live loads among deck longitudinal, load combinations for different working state and limit state designs.

**Railway Bridges:** Loadings for railway bridges, rail road data, pre-design considerations, rail road v/s highway bridges.

**Module 4: Superstructures**

**(6 Lectures)**

Selection of main bridge parameters, design methodologies, choices of superstructure types: orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis (Preferable), different types of superstructure (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge.

**Transverse analysis of bridge:** Slab bridge and voided slab bridge, beam-slab bridge, box girder bridge, temperature analysis, distortional analysis, effects of differential settlement of supports, reinforced earth structures.

**Typical details:** Slab bridge, slab-girder bridge (straight/skew), box girder bridge (straight/skew).

**Module 5: Substructure**

**(4 Lectures)**

Pier, abutment, wing walls, importance of soil structure interaction

**Foundations:** open foundation, pile foundation, well foundation, examples - simply supported bridge, continuous bridge.

**Module 6: Bearings and deck joints**

**(6 Lectures)**

Different types of bridge bearings and expansion joints, Design of bearings and joints.

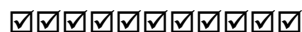
**Parapets for highway bridges:** Definitions, classification of bridge parapets, various details

**Text/Reference Books**

- Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.
- Raju N. K., Design of Bridges, Oxford & IBH.
- Ponnuswamy S., Bridge Engineering, Tata McGraw Hill
- Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4<sup>th</sup> Edition, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation), 2<sup>nd</sup> Edition, Shroff Publishers,
- Raina V. K., Field Manual for Highway and Bridge Engineers", 3<sup>rd</sup> Edition, Shroff Publishers, Mumbai
- Raina V. K., "World of Bridges", Shroff Publishers, Mumbai

**Course Outcomes:** On completion of the course, the students will be able to:

1. Understand components of bridges and its various types.
2. Understand site selection criteria and comprehend various forces acting on bridges.
3. Analyze bridge structures using different analysis techniques.
4. Understand the importance of different types of bridge bearings.



## **BTCVE803B Structural Audit**

**Teaching Scheme:** (3 Lectures ) hours/week

**Pre Requisites:** All subjects related to Structural analysis and Foundation Engineering

### **Course Contents**

**Module 1: Introduction to Structural Audit**

**(06 Lectures)**

Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed.

Aspects of audit of Masonry buildings, RC frame buildings, Steel Structures

**Module 2: Causes and types of deterioration in Structures**

**(06 Lectures)**

Causes of deterioration in structures: Permeability of concrete, capillary porosity, air voids, Micro cracks and macro cracks,

corrosion of reinforcing bars, sulphate attack, alkali silica reaction,.

Causes of deterioration in Steel Structures: corrosion, Uniform deterioration, pitting, crevice, galvanic, laminar, Erosion, cavitations, fretting, Exfoliation, Stress, causes of defects in connection

**Module 3: Elementary aspects of Non Destructive Testing (06 Lectures)**

Concrete Strength Assessment: Rebound hammer, Ultrasonic Pulse velocity, Penetration resistance, Pull out test, Chemical test: Carbonation test, Chloride test, Corrosion potential assessment, Fire damage assessment: Differential thermal analysis, X ray diffraction, Structural Integrity and soundness assessment: Radiography, Impact echo test, dynamic testing of structure, Interpretation and evaluation of test results.

**Module 4: Strength Evaluation of Existing Structures (06 Lectures)**

Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in RC structures

**Module 5: Approach to conduct Structural Audits (06 Lectures)**

Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation

**Module 6: Structural Audit Report (06 Lectures)**

Study of sample Structural audit report for up-gradation of existing building, Audit for continuation of usage of old Buildings, Audit for Buildings damaged due to Earthquakes, Fire,

**References**

- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

**Outcomes:**

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

- Gain the knowledge of Bye laws, procedure of Structural audit and study the typical problems in structures.
- Aware of causes and types of deterioration in structures.
- Develop skills for use of various Nondestructive tests required during auditing of structures.
- Strength evaluation of existing structures.
- Acquire knowledge of legal procedure to conduct structural audits.
- Prepare a Structural audit report.

## **BTCVE804ARock Mechanics**

**Teaching Scheme:**Lectures: 3 hours/week

**Pre Requisites:**Engineering Geology

### **Course Contents**

**Module 1 (6 Lectures)**

Introduction, Development of Rock Mechanics, Applications of Rock Mechanics

**Module 2 (8 Lectures)**

Rock sampling, Determination of Density, Porosity, Water Absorption, Uni-axial Compressive Strength, Tensile Strength, Shear Strength, Flexural Strength, Swelling and Slake Durability, Permeability and Point Load Strength, Tri-axial Compressive Test. Factors affecting Strength and Deformation of Rocks, In-situ Determination of Strength, Geophysical Methods

**Module 3 (6 Lectures)**

Classification, Rock Mass Classification, Rock Quality Designation, Rock Structure Rating, Geo-mechanics and NGI Classification Systems

**Module 4 (4 Lectures)**

Methods of Improving Rock Properties, Rock Reinforcement & Rock Bolting

**Module 5 (6 Lectures)**

Stability of Rock Slopes, Modes of Failure, Methods of Analysis, Prevention and Control of Rock Slope Failure, Monitoring

and Maintenance

**Module 6**

**(6 Lectures)**

Foundations on Rocks, Shallow Foundations, Pile and Well Foundations, Basement Excavation, Foundation Construction, Allowable Bearing Pressure, Tunnels: Rock Stresses and Deformations, Rock Support Interaction, Design of Tunnel Lining

**Text Books**

- Vulukuri and Lama, “Hand Book on Mechanical Properties of Rocks”, Vol. I to IV
- Central Board of Irrigation and Power , “Manual on Rock Mechanics”
- Varma B. P., “Rock Mechanics for Engineers”, Khanna Publications
- Stag and Zienkiewicz, “Rock Mechanics in Engineering Practice”, John Wiley and Sons, India
- SubinoyGangopadhyay , “Engineering Geology ”,oxford university

**References**

- Goodman R. E., “Introduction to Rock Mechanics”, John Wiley and Sons, India
- Obert and Duvall, “Rock Mechanics and Hydraulic Structures”, John Wiley and Sons, India
- Winterkorn and Fang, “Foundation Engineering Hand Book”
- Relevant Indian Standards.

**Course Outcomes:**On completion of the course, the students will be able to:

CO1: Understand the mechanism of rock under various conditions.

CO2: Able to determine the engineering properties of rocks and sub-surface conditions

CO3: Identify various cause of slope failure and suggest some preventive measures for them.



## **BTCVE804B Water Power Engineering**

**Teaching Schemes:** Lectures: 3 Hours/Week

### **Course Contents**

**Module 1**

**(06 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

**Module 2**

**(08 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

**Module 3**

**(06 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

**Module 4**

**(06 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

**Module 5**

**(06 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants

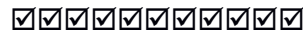
Tidal Power Stations: Necessity, Advantages, Classification, Limitations

#### Text Books

- Dandekar and Sharma, “Water Power Engineering”, Vikas Pub. House Pvt. Ltd.
- Bhattacharya P. K., “Water Power Engineering”, Khanna Publications, New Delhi
- Deshmukh M. M. “Water Power Engineering”, Dhanapatrai and Sons N. Delhi

#### References

- Creager and Justin, “Hydro – Electric Hand Book”
- Brown G., “Hydro-electric Engineering Practice”, Vol. I to III
- Mosonvi, “Water Power Development”



## BTCVE804D Finite Element Method

**Teaching Schemes:** Lectures: 3 hours/week

### Course Contents

#### Module 1: Introduction to FEM & Approximate Methods(06 Lectures)

Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin’s Method), Variational Calculus (Hamilton’s Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kantorovich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure in FEM.

#### Module 2: One Dimensional FE Analysis(06 Lectures)

Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials),  $C^0$  Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses)

#### Module 3: FE Analysis by Direct Approach(06 Lectures)

$C^1$  Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin’s Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Simple applications to Beams.

#### Module 4: Two Dimensional FE Analysis(06 Lectures)

Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal’s Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems

#### Module 5: Three Dimensional FE Analysis(06 Lectures)

3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, FEA of Axi-symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (all contents at introductory level)

#### Module 6: Computer Implementation of FEM(06 Lectures)

Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to softwares, elementary problem solving using freeware

**Guidelines for Assignments:** Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

**Guidelines for Class Test:** Class test shall cover syllabus of any three consecutive Modules.

**References:**

- M. Mukhopdhyay, Concept and Application of Finite Element Analysis, Oxford and IBH Publishing Co. Pvt. Ltd.
- O.C.Zienkiewicz & R.L.Taylor, The Finite Element Method Vol. I & II, Tata McGraw Hill
- J.N.Reddy, An introduction to the Finite Element Method, Tata McGraw Hill Pub.
- R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons
- Hutton D.V., Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub.
- C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub.
- C. S. Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
- T.R.Chandrupatla and Belegundu, Introduction to the Finite Element in Engineering Pearson Education
- Bathe K.J., Finite Element Procedures, PHI learning pvt.ltd
- Y.M.Desai, T.I Eldho, Finite Element Method with application in Engineering, Pearson, Delhi
- S. S. Bhavikatti., Finite Element Analysis, New Age International Publication.

**Outcomes:**

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

- Understand the different energy methods in structural analysis and basic concepts of finite element method.
- Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
- Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin’s Method.
- Solve 2-D problems using knowledge of theory of elasticity.
- Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics.
- Analyze 1D, 2D, and 3D structures using different software packages based on FEM.

## **BTCVE804E Repair & Rehabilitation of Structures**

**Teaching Schemes:** Lectures: 3 hours/week

### **Course Contents**

**Module 1: Serviceability and Durability (06 Lectures)**

Quality Assurance for Concrete Construction, Permeability, Thermal Properties and Cracking, Distress Monitoring, Causes for Distress, Effects of Climate, Temperature, Chemicals, Wear and Erosion, Corrosion Mechanism, Effects of Cover Thickness

**Non Destructive Testing:** Ultrasonic and Sonic Test, Rebound Hammer Test, Strength Evaluation of Existing Structures

**Module 2: Cracks in Structures (06 Lectures)**

Causes, Thermal and Shrinkage cracks, Cracks due to Vegetation and Trees, Foundation Movements, Types and their Fatality, Diagnosis Techniques for Repair.

**Moisture Penetration**

Sources of Dampness, Moisture Movement from Ground, Reasons for Ineffective Dampening, Leakage in Concrete Slabs, Pitched Roofs, Dampness in Solid Walls, Condensation, Remedial treatments, Chemical Coatings.

**Module 3: Steel Structures and Masonry (06 Lectures)**

Types and Causes of Deterioration, Preventive Measures, Repair Procedure, Brittle Failure, Defects in Connections, Welded Joints: Test for Defects; Mechanism of Corrosion, Methods of Corrosion Protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection.



## **Masonry Structures**

Discoloration and Weakening of Stones, Preservation, Chemical Preservatives, Brick Masonry Structures, Distress and Remedial Measures.

### **Module 4: Materials for Repairs(06 Lectures)**

Essential Parameters for Repair Material, Premixed Cement Concrete and Mortar, Sulphur Infiltrated Concrete, Fiber Reinforced Concrete, Special Elements for Accelerated Strength Gain, Expansive Cement, Polyester Resin.

**Polymer Concrete:** Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application

**Polymer Modified Concrete:** Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application, Epoxy Concrete and Mortar: Epoxies, Physical and Mechanical Properties, General Guidelines

**Surface Coatings:** Essential Parameters, Types, Characteristics.

### **Module 5: Maintenance and repair strategies(06 Lectures)**

Definitions: Maintenance, Repair and Rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive Measures on Various Aspects Inspection, Assessment Procedure for Evaluating a Damaged Structure, Causes of Deterioration,

#### **Techniques for Repairs**

Repairs using Mortars and Dry Packs, Concrete Replacement, Surface Impregnation, Rust Eliminators and Polymers Coating for Rebar During Repair Foamed Concrete, Vacuum Concrete, Guniting and Shotcrete, Injection: Epoxy, Resin, Polymer Modified Cement Slurry; Shoring and Underpinning. Propping and Supporting: False Work,

### **Module 6: Strengthening of Existing Structures(06 Lectures)**

General Principle, Relieving Loads, Stress Reduction, Strengthening of Super Structures (Beam, Column, Slab including Joints) for Tension, Compression, Flexural, and Shear respectively, Jacketing (RCC, Plate, Fiber ,Wrap), Bonded Overlays, Reinforcement Addition, Strengthening of Masonry Structure.

**Guidelines for Assignments:** Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

**Guidelines for Class Test:** Class Test shall cover Syllabus of any Three Modules.

#### **References:**

- Johnson. S.M., "Deterioration, maintenance and repair of structures", McGraw-Hill book company, New York, 1965.
- R. T. Allen and S. C. Edwards, "Repair of concrete structures", Blakie and Sons, UK, 1987.
- Denison Campbell, Allen and Harold Roper, "Concrete structures", Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.
- SP25-84, "Hand book on causes and prevention of cracks on buildings", Indian standards.
- M. S. Shetty, "Concrete Technology- Theory and Practice", S. Chand and Company, New Delhi, 1992.
- Gambhir, "Concrete Technology".
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#### **Outcomes:**

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

- Understand factors of Serviceability and Durability of Structures.
- Determine crack width, effect of crack on materials, effect of moisture on structures.
- Understand methods for protection of steel structures and masonry structures.
- Understand various materials and methodologies used for repairing of structures.
- Understand and implement techniques used for repairing and maintenance of structure.
- Understand procedure to strengthen the existing structures and structural elements.