SIR PADAMPAT SINGHANIA UNIVERSITY

Udaipur

SCHOOL OF ENGINEERING

Course Curriculum of 4-Year B.Tech. Degree Programme in Civil Engineering (Batch-2020-24)

Credit Structure

B.Tech. Core		B.Tech. Elective	
Category	**Credits**	**Category**	**Credits**
Departmental Core Subjects	145	Departmental Level Optional Courses	17
Basic Sciences Subjects	36	University Level Optional Courses	6
Ability Enhancement Courses	7		
Total	188	Total	23
		Grand Total	211

Distribution of Total Credits & Contact Hours in All 8 Semesters

S. No.	Semester	Credits/Semester	Contact hours/week
1	I	28	34
2	II	28	35
3	III	23	27
4	IV	28	34
5	V	27	33
6	VI	26	33
7	VII	27	31
8	VIII	24	31
Total		211	--

Course Structure: B. Tech. 2020-2024

Semester - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-1001	Engineering Mechanics	5	0	1	6
2	EC-1001	Basic Electrical Engineering	4	0	1	5
3	ME-1001	Basic Workshop Practice – I	0	0	2	2
4	MA-1001	Applied Mathematics – I	4	1	0	5
5	PH-1001	Applied Physics – I	3	0	1	4
6	CH-1001	Applied Chemistry – I	3	0	1	4
7	CH-1002	Environmental Studies	2	0	0	2
					Total Credits	28
8	EP-1999	Endeavour Project (Beyond the Syllabus)				
					Total Contact hours/week	34

Semester - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-1001	Structured Programming Approach	4	0	1	5
2	ME-1002	Engineering Drawing	3	0	2	5
3	ME-1003	Basic Workshop Practice – II	0	0	2	2
4	MA-1002	Applied Mathematics – II	4	1	0	5
5	PH-1002	Applied Physics – II	3	0	1	4
6	CH-1003	Applied Chemistry – II	3	0	1	4
7	HU-1001	Communication Skills	2	1	0	3
					Total Credits	28
8	EP-1999	Endeavour Project (Beyond the Syllabus)				3
					Total Contact hours/week	35

Semester - III

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	MA-2002	Advanced Engineering Mathematics - I	4	1	0	5
2	CE-2001	Surveying - I	4	0	0	4
3	CE-2002	Surveying - I Lab	0	0	1	1
4	CE-2003	Strength of Materials	4	0	0	4
5	CE-2004	Strength of Materials Lab	0	0	1	1
6	CE-2005	Engineering Geology	3	0	0	3
7	CE-2006	Engineering Geology Lab	0	0	1	1
8	CE-2007	Fluid Mechanics - I	3	0	0	3
9	CE-2008	Fluid Mechanics - I Lab	0	0	1	1
					Total Credits	23
10	EP-2999	Endeavour Project (Beyond the Syllabus)				
					Total Contact hours/week	27

Semester - IV

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	MA-2006	Advanced Engineering Mathematics - II	4	1	0	5
2	CE-2009	Surveying - II	3	0	0	3
3	CE-2010	Surveying - II Lab	0	0	2	2
4	CE-2011	Structural Analysis - I	4	1	0	5
5	CE-2012	Building Design & Drawing	2	0	0	2
6	CE-2013	Building Design & Drawing Lab	0	0	2	2
7	CE-2014	Building Materials & Construction Technology	4	0	0	4
8	CE-2015	Building Materials & Construction Technology Lab	0	0	1	1
9	CE-2016	Fluid Mechanics - II	3	0	0	3
10	CE-2017	Fluid Mechanics - II Lab	0	0	1	1
					Total Credits	28
11	EP-299	Endeavour Project (Beyond the Syllabus)				3
					Total Contact hours/week	34

Semester - V

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-3001	Structural Analysis – II	4	0	0	4
2	CE-3002	Structural Analysis – II Lab	0	0	1	1
3	CE-3003	Geotechnical Engineering– I	3	0	0	3
4	CE-3004	Geotechnical Engineering– I Lab	0	0	1	1
5	CE-3005	Applied Hydraulics	3	0	0	3
6	CE-3006	Applied Hydraulics Lab	0	0	1	1
7	CE-3007	Environmental Engineering - I	3	0	0	3
8	CE-3008	Environmental Engineering - I Lab	0	0	1	1
9	CE-3009	Transportation Engineering - I	3	0	0	3
10	CE-3010	Transportation Engineering - I Lab	0	0	1	1
11	CE-31XX	Department Level Optional Course - I	3	0	0	3
12	CE-31XX	Department Level Optional Course - I Lab	0	0	1	1
13	HU-3001	Business and Communication Ethics	1	1	0	2
					Total Credits	27
14	EP-3999	Endeavour Project (Beyond the Syllabus)				
					Total Contact hours/week	33

Semester - VI

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-3011	Geotechnical Engineering – II	3	0	0	3
2	CE-3012	Geotechnical Engineering – II Lab	0	0	1	1
3	CE-3013	Design and Drawing of Steel Structures	4	0	0	4
4	CE-3014	Design and Drawing of Steel Structures Lab	0	0	1	1
5	CE-3015	Transportation Engineering – II	3	0	0	3
6	CE-3016	Transportation Engineering – II Lab	0	0	1	1
7	CE-3017	Environmental Engineering – II	3	0	0	3
8	CE-3018	Environmental Engineering – II Lab	0	0	1	1
9	CE-3019	Water Resource Engineering - I	3	0	0	3
10	CE-3020	Water Resource Engineering - I Lab	0	0	1	1
11	CE-31XX	Department Level Optional Course - II	3	0	0	3
12	CE-31XX	Department Level Optional Course - II Lab	0	0	1	1
13	CE-3021	Software Applications in Civil Engineering	0	0	1	1
					Total Credits	26
14	EP-3999	Endeavour Project (Beyond the Syllabus)				3
					Total Contact hours/week	33

Semester - VII

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-4001	Quantity Survey Estimation and Valuation	4	0	0	4
2	CE-4002	Quantity Survey Estimation and Valuation Lab	0	0	1	1
3	CE-4003	Theory of Reinforced Concrete Structures	4	0	0	4
4	CE-4004	Theory of Reinforced Concrete Structures Lab	0	0	1	1
5	CE-4005	Water Resource Engineering - II	3	0	0	3
6	CE-4006	Water Resource Engineering - II Lab	0	0	1	1
7	CE-41XX	Departmental Level Optional Course - III	3	0	0	3
8	CE-41XX	Departmental Level Optional Course - III Lab	0	0	1	1
9	XX-XXXX	University Level Optional Course – I	3	0	0	3
10	CE-4100	Minor Project	0	0	3	3
11	CE-4200	Summer Internship	-	-	-	3
					Total Credits	27
12	EP-4999	Endeavour Project (Beyond the Syllabus)				
					Total Contact hours/week	31

Semester - VIII

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-4007	Design and Drawing of Reinforced Concrete Structures	4	1	0	5
2	CE-4008	Construction Management	4	1	0	5
3	CE-41XX	Departmental Level Optional Course - IV	4	0	0	4
4	CE-41XX	Departmental Level Optional Course - IV Lab	0	0	1	1
5	XX-XXXX	University Level Optional Course – II	3	0	0	3
6	CE-4300	Major Project	0	0	6	6
					Total Credits	24
7	EP-4999	Endeavour Project (Beyond the Syllabus)				3
					Total Contact hours/week	31

List of Department Level Optional Course(s) - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-3106	Advanced Surveying	3	0	0	3
2	CE-3107	Advanced Surveying Lab	0	0	1	1
3	CE-3108	Advanced Concrete Technology	3	0	0	3
4	CE-3109	Advanced Concrete Technology Lab	0	0	1	1
5	CE-3110	Building Services and Repairs	3	0	0	3
6	CE-3111	Building Services and Repairs Lab	0	0	1	1
7	CE-3112	Advanced Structural Mechanics	3	0	0	3
8	CE-3113	Advanced Structural Mechanics Lab	0	0	1	1

List of Department Level Optional Course(s) - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-3114	Advanced Construction Equipment	3	0	0	3
2	CE-3115	Advanced Construction Equipment Lab	0	0	1	1
3	CE-3116	Traffic Engineering and Management	3	0	0	3
4	CE-3117	Traffic Engineering and Management Lab	0	0	1	1
5	CE-3118	Ground Improvement Techniques	3	0	0	3
6	CE-3119	Ground Improvement Techniques Lab	0	0	1	1
7	CE-3120	Advanced Structural Analysis	3	0	0	3
8	CE-3121	Advanced Structural Analysis Lab	0	0	1	1

List of Department Level Optional Course(s) - III

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-4106	Pre-stressed Concrete	3	0	0	3
2	CE-4107	Pre-stressed Concrete Lab	0	0	1	1
3	CE-4108	Solid Waste Management	3	0	0	3
4	CE-4109	Solid Waste Management Lab	0	0	1	1
5	CE-4110	Structural Dynamics	3	0	0	3
6	CE-4111	Structural Dynamics Lab	0	0	1	1
7	CE-4112	Application of GIS and Remote Sensing	3	0	0	3
8	CE-4113	Application of GIS and Remote Sensing Lab	0	0	1	1
9	CE-4114	Foundation Analysis and Design	3	0	0	3
10	CE-4115	Foundation Analysis and Design Lab	0	0	1	1
11	CE-4116	Applied Hydrology and Flood Control	3	0	0	3
12	CE-4117	Applied Hydrology and Flood Control Lab	0	0	1	1
13	CE-4118	Pavement Sub-grade and Materials	3	0	0	3
14	CE-4119	Pavement Sub-grade and Materials Lab	0	0	1	1

List of Department Level Optional Course(s) - IV

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-4120	Advanced Design of Steel Structures	4	0	0	4
2	CE-4121	Advanced Design of Steel Structures Lab	0	0	1	1
3	CE-4122	Industrial Waste Treatment	4	0	0	4
4	CE-4123	Industrial Waste Treatment Lab	0	0	1	1
5	CE-4124	Pavement Design and Construction	4	0	0	4
6	CE-4125	Pavement Design and Construction Lab	0	0	1	1
7	CE-4126	Bridge Engineering and Design	4	0	0	4
8	CE-4127	Bridge Engineering and Design Lab	0	0	1	1
9	CE-4128	Appraisal and Implementation of Infrastructure Projects	4	0	0	4
10	CE-4129	Appraisal and Implementation of Infrastructure Projects Lab	0	0	1	1
11	CE-4130	Soil Dynamics	4	0	0	4
12	CE-4131	Soil Dynamics Lab	0	0	1	1
13	CE-4132	Design of Hydraulics Structures	4	0	0	4
14	CE-4133	Design of Hydraulics Structures Lab	0	0	1	1

List of University Level Optional Course(s) - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-4151	Disaster Management and Mitigation Measures	3	0	0	3
2	CS-4151	Management Information System	3	0	0	3
3	CS-4152	Cyber Security & Laws	3	0	0	3
4	EC-4151	Design of Experiments	3	0	0	3
5	EC-4152	Energy Audit & Management	3	0	0	3
6	EC-4153	Development Engineering	3	0	0	3
7	ME-4151	Product Lifecycle Management	3	0	0	3
8	ME-4152	Reliability Engineering	3	0	0	3
9	ME-4153	Operation Research	3	0	0	3

List of University Level Optional Course(s) - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	BM-4151	Finance Management	3	0	0	3
2	BM-4152	Entrepreneurship Development & Management	3	0	0	3
3	BM-4153	Human Resource Management	3	0	0	3
4	BM-4154	Professional Ethics & CSR	3	0	0	3
5	CE-4152	Environmental Management	3	0	0	3
6	CS-4153	Research Methodology	3	0	0	3
7	CS-4154	Digital Business Management	3	0	0	3
8	EC-4154	IPR & Patenting	3	0	0	3
9	ME-4154	Project Management	3	0	0	3

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Semester - I

(Departmental Core Subject)

CE-1001 L-T-P-C
Engineering Mechanics 5-0-1-6

Objective: *The subject deals with the concepts of static & dynamic systems involving kinematic & dynamic analysis etc.*

Course Outcome: *Students must be able to draw free body diagrams, determine the resultant of forces and/or moments, determine the Centroid, to determine efficiency of simple machines with consideration of friction and second moment of area of sections and Newton's laws and conservation laws to elastic collisions and motion of rigid bodies. They should be able to analyze statically determinate planar frames, motion and calculate trajectory characteristics.*

Course Content

Module 01: System of Coplanar forces

Resultant of Concurrent forces, Parallel forces, Non-Concurrent Non-Parallel system of forces, Moment of force about a point, Couples, Varignon's Theorem. Distributed Forces in plane. Center of Gravity and Centroid for plane Laminas.

Module 02: Equilibrium of system of coplanar forces

Condition of equilibrium for concurrent forces, parallel forces and Non concurrent Non-Parallel general forces and Couples. Types of support, loads, Beams, Determination of

reactions at supports for various types of loads on beams. Analysis of plane trusses by using Method of joints and Method of sections (Excluding pin jointed frames).

Module 03: Forces in space

Resultant of Non-coplanar force systems: Resultant of Concurrent force system, Parallel force system and Non-concurrent nonparallel force system. Equilibrium of Non-coplanar force systems: Equilibrium of Concurrent force system, Parallel force system and Non-concurrent nonparallel force system. Friction: Introduction to Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges, ladders.

Module 04: Kinematics of Particle

Velocity & acceleration in terms of rectangular co-ordinate system, Rectilinear motion, Motion along plane curved path, Tangential & Normal component of acceleration, Motion curves (a-t, v-t, s-t curves), Projectile motion, Relative velocities.

Module 05: Kinematics of Rigid Bodies

Introduction to general plane motion, Instantaneous center of rotation for the velocity, velocity diagrams for bodies in plane motion, (up to 2 linkage mechanism).

Module 06: Kinetics of a Particle: Force and Acceleration

Introduction to basic concepts, D'Alemberts Principle, Equations of dynamic equilibrium, Newton's Second law of motion. Kinetics of a Particle: Work and Energy: -Principle of Work and Energy, Law of Conservation of Energy. Kinetics of a Particle: Impulse and Momentum: Principle of Linear Impulse and Momentum. Law of Conservation of momentum. Impact and collision.

List of Experiments

S. No.	Title of the Experiment	Module
1.	Polygon law of coplanar forces.	02
2.	Non concurrent non parallel (general).	03
3.	Bell crank lever.	03
4.	Support reaction for beam.	02
5.	Simple / compound pendulum.	04

6.	Inclined plane (to determine coefficient of friction).	03
7.	Collision of elastic bodies (Law of conservation of momentum).	06
8.	Moment of Inertia of fly wheel.	05
9.	Screw friction by using screw jack.	03

Text/Reference Books

1. Engineering Mechanics. Hibblar R.C. McMillan USA. 1994.
2. Vector Mechanics for Engineers. Beer F. P. & Johnson E. R. Tata McGraw Hill. 2000.
3. Engineering Mechanics. Meriam J. L. Wiley. 2017.
4. Engineering Mechanics Statistics and Dynamics. Singer F. L. & Collins H. Raw Publication. 1975.
5. Engineering Mechanics Statistic and Dynamics. MacLean W. G., Best C. L. & Nelson E. W. Tata McGraw Hill, 2017.
6. Engineering Mechanics Statics and Dynamics. Tayal A. K. Umesh Publication. 2011.

Digital Material

1. Engineering Mechanics Lab. Virtual Labs. (http://eerc01-iiith.vlabs.ac.in).
2. Engineering Mechanics. Prof. Manoj Harbola. NPTEL (https://nptel.ac.in/courses/122104015/).

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Semester - I

(Departmental Core Subject)

EC-1001 L-T-P-C
Basic Electrical Engineering 4-0-1-5

Objective: *The aim of this course is to develop an understanding of the basics of DC circuits & its applications, 1-Φ AC circuits & its applications, operation of 1-Φ transformer, 3-Φ AC circuits & its applications, and DC electrical machines.*

Course Outcome: *Students will be able to evaluate D.C. & 1-Φ AC circuits using network theorems, illustrate constructional features and operation of 1-Φ transformer, evaluate 3-Φ AC circuits, illustrate working principle of DC machines and conduct experiments on D.C. circuits and AC circuits.*

Course Content

Module 01: DC Circuits (Only Independent Sources)

Kirchhoff ’s laws, Ideal and practical voltage and current source, Mesh and Nodal analysis, Super node and Super mesh analysis, Source transformation, Star-delta transformation, Superposition theorem, Thevenin’s theorem, Norton’s theorem, Maximum power transfer theorem, (Source transformation not allowed for Superposition theorem, Mesh and Nodal analysis).

Module 02: AC Circuits

Generation of alternating voltage and currents, RMS and Average value, form factor, crest factor, AC through resistance, inductance and capacitance, R-L, R-C and R-L-C series

and parallel circuits, phasor diagrams, power and power factor, series and parallel resonance, Q factor and bandwidth.

Module 03: Three Phase Circuits

Three phase voltage and current generation, star and delta connections(balanced load only), relationship between phase and line currents and voltages, Phasor diagrams, Basic principle of wattmeter, measurement of power by one and two wattmeter methods.

Module 04: Single Phase Transformer

Construction, working principle, emf equation, ideal and practical transformer, transformer on no load and on load, phasor diagrams, equivalent circuit, OC and SC test, regulation and efficiency.

Module 05: DC Machines

Principle of operation of DC motors and DC generators, construction and classification of DC machines, emf equation.

List of Experiments (Minimum Six)

S. No.	Title of the Experiment	Module
1.	Mesh and Nodal analysis.	01
2.	Verification of Superposition Theorem.	01
3.	Verification Thevenin's Theorem.	01
4.	Study of R-L series and R-C series circuit.	02
5.	R-L-C series resonance circuit	02
6.	R-L-C parallel resonance circuit.	02
7.	Relationship between phase and line currents and voltages in three phase system (star & delta)	03
8.	Power and phase measurement in three phase system by one wattmeter method.	03
9.	Power and phase measurement in three phase system by two wattmeter method.	03
10.	OC and SC test on single phase transformer	04

Text/Reference Books

1. Basic Electrical Engineering. Mittal V.N.and Mittal A. Tata McGraw Hill (Revised 2nd Edition). 2010.
2. Electrical Engineering Fundamentals. Toro V.D. PHI Second edition. 2011.
3. Electrical and Electrical Technology. Huges E. Pearson Education (Tenth edition). 2015.
4. Theory and Problems of Basic Electrical Engineering Kothari D.P. & Nagrath I.J. PHI. 2011.
5. Electrical Engineering. Thalreja B.L. Vol-I and II. 2012.
6. Basic Electrical Engineering. Singh S.N. PHI. 2011.

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Semester - I

(Departmental Core Subject)

ME-1001 L-T-P-C
Basic Workshop Practice – I 0-0-2-2

Objective: *The aim of this course is to impart training to help the students develop engineering skill sets, inculcating respect for physical work and hard labor in addition to some amount of value addition by getting exposed to interdisciplinary engineering domains.*

Course Outcome: *Students will be able to perform different skill sets of various engineering domains.*

Course Content

Note: The syllabus and Term – work to be done during semester I and Semester II is given together. Individual Instructor for the course is to design the jobs for practice and demonstration and spread the work over entire two semesters. The two compulsory trades (Trade 1 – Fitting and Trade 2 – Carpentry) shall be offered in separate semesters. Select any four trade topics (two per semester) out of the topic at trade 3 to 11. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term – work.

Module 01: Fitting (compulsory)

Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. Term work to include one job involving following operations: filing to size, one simple male- female joint, drilling and tapping

Module 02: Carpentry (compulsory)

Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning.

Module 03: Forging (Smithy)

At least one workshop practice job (Lifting hook and handle) is to be demonstrated.

Module 04: Welding

Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.

Module 05: Machine Shop

At least one turning job is to be demonstrated.

Module 06: Electrical board wiring

House wiring, staircase wiring, wiring diagram for fluorescent tube light, Godown wiring and three phase wiring for electrical motors.

Module 07: PCB Laboratory Exercises

Layout drawing, Positive and negative film making, PCB etching and drilling, Tinning and soldering technique.

Module 08: Sheet metal working Brazing

Use of sheet metal, working hand tools, cutting, bending , spot welding.

Module 09: Plumbing

Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.

Module 10: Masonry

Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.

Module 11: Hardware and Networking

Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery,

CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one). Basic troubleshooting and maintenance. Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping.

Term work:

Term work shall consist of respective reports and jobs of the trades selected, Laboratory work (Job and Journal) and Attendance (Practical and Theory).

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Semester - I

(Basic Sciences Subjects)

MA-1001 L-T-P-C
Applied Mathematics - I 4-1-0-5

Objective: *To provide students with sound foundation in applied mathematics & hands on experience in using Scilab software to handle the problems in different engineering disciplines.*

Course Outcome: *Learner will be able to apply the concepts of complex numbers, nth order derivatives of standard functions, expansion of functions as an application of successive differentiation, principles of operations for different types of matrices, the basic principles of partial differentiation & their role in finding maxima & minima, Jacobian, to various types of engineering problems & to apply SCILAB programming techniques to model problems based on solution of simultaneous linear algebraic equations.*

Course Content

Module 01: Complex Numbers

(Pre-requisite: Review of Complex Numbers-Algebra of Complex Number, Different representations of a Complex number & other definitions, D'Moivre's Theorem.)

Powers & Roots of Exponential & Trigonometric Functions. Expansion of $\sin^n \theta$, $\cos^n \theta$ in terms of sines & cosines of multiples of θ & Expansion of sinnθ, cosnθ in powers of sinθ, cosθ. Circular functions of complex number & Hyperbolic functions. Inverse Circular & Inverse Hyperbolic functions. Separation of real & imaginary parts of all types of Functions.

Module 02: Logarithm of Complex Numbers, Successive Differentiation

Logarithmic functions, Separation of real & Imaginary parts of Logarithmic Functions. Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) & problems.

Module 03: Matrices

(Pre-requisite: Inverse of a matrix, addition, multiplication & transpose of a matrix.)

Types of Matrices (symmetric, skew-symmetric, Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices & properties of Matrices). Rank of a Matrix using Echelon forms, reduction to normal form, PAQ in normal form, system of homogeneous & non – homogeneous equations, their consistency & solutions. Linear dependent & independent vectors. Application of inverse of a matrix to coding theory.

Module 04: Partial Differentiation

Partial Differentiation: Partial derivatives of first & higher order. Total differentials, differentiation of composite & implicit functions. Euler's Theorem on Homogeneous functions with two & three independent variables (with proof). Deductions from Euler's Theorem.

Module 05: Applications of Partial Differentiation, Expansion of Functions

Maxima & Minima of a function of two independent variables, Jacobian. Taylor's Theorem (Statement only) & Taylor's series, Maclaurin's series (Statement only). Expansion of e^x, sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x), log(1+x), $\sin^{-1}(x)$, $\cos^{-1}(x)$, $\tan^{-1}(x)$, Binomial series.

Module 06: Indeterminate forms, Numerical Solutions of Transcendental Equations & System of Linear Equations

Indeterminate forms, L- Hospital Rule, problems involving series. Solution of Transcendental Equations: Solution by Newton Raphson method & Regula –Falsi Equation. Solution of system of linear algebraic equations, by (1) Gauss Elimination Method, (2) Gauss Jacobi Iteration Method, (3) Gauss Seidal Iteration Method. (Scilab programming for above methods is to be taught during lecture hours).

Text/Reference Books

1. Higher Engineering Mathematics. Ramana B.V. 1st Ed. Tata McGraw-Hill Education.
2. Higher Engineering Mathematics. Dass H.K. 3rd Ed. S Chand & Co Ltd. 2014.

3. Higher Engineering Mathematics. Grewal B.S. 42nd Ed. Khanna Publishers. 2012.
4. Advanced Engineering Mathematics. Kreyszig E. 10th Ed. Wiley Eastern. 2012.
5. Calculus & Analytic Geometry. Thomas G.B. & Finney R.L. 9th Ed. Addison-Wesley. 1998.
6. Advanced Engineering Mathematics. Jain R.K. & Iyengar S.R.K. 3rd Ed. Narosa Publishing House. 2010.
7. Calculus - Vol.2. Apostol T. M. 2nd Ed. Wiley. 2003.

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Semester - I

(Basic Sciences Subjects)

PH-1001 L-T-P-C
Applied Physics - I 3-0-1-4

Objective: *The objective of this course is to introduce the notion of crystal structure, quantum physics & their applications in understanding the electrical and thermal properties of various materials and band theory of solids. It also introduces the concepts of electrostatics & magnetostatics leading to the Maxwell's electromagnetic waves and their applications.*

Course Outcome: *After completing this course students will be able to*

1. Classify solids on the basis of crystallography and to use XRD techniques for analysis of crystal structure.

2. To solve the quantum wave mechanics problems.

3. To comprehend the basic concepts of semiconductor physics and apply the same to the electronic devices.

4. To develop the understanding of electrodynamics, Maxwell's equations and their use in telecommunication and transmission systems.

5. Apply the concepts of electromagnetism in various engineering applications

Course Content

Module 01: Crystal Structure

Introduction to crystallography; Introduction to crystallography; Unit cells, Crystal structures: simple cubic, face-centered cubic, body-centered cubic, hexagonal close-

packed crystal structures.

Study of characteristics of unit cell of Diamond, ZnS, NaCl and HCP; Miller indices of crystallographic planes & directions; interplanar spacing; X-ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer; Frenkel and Schottky crystal defects; Ionic crystal ligancy (3,4,6,8); Liquid crystal phases.

Module 02: Quantum Mechanics

Introduction, Wave particle duality; de Broglie wavelength; experimental verification of de Broglie theory; properties of matter waves; wave packet, phase velocity and group velocity; wave function; physical interpretation of wave function; Heisenberg's uncertainty principle; electron diffraction experiment and gama ray microscope experiment; applications of uncertainty principle; Schrodinger's time dependent wave equation; time independent wave equation; motion of free particle; Particle trapped in one dimensional infinite potential well.

Module 03: Semiconductor Physics

Splitting of energy levels for band formation; Classification of semiconductors(direct & indirect band gap, elemental and compound); Conductivity, mobility, current density (drift & diffusion) in semiconductors(n type and p type); Fermi Dirac distribution function; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on Fermi level; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Breakdown mechanism (Zener & avalanche), Hall Effect

Applications of semiconductors: Rectifier diode, LED, Zener diode, Photo diode, Photovoltaic cell, BJT, FET, SCR., MOSFET

Module 04: Electrodynamics

Cartesian, Cylindrical and Spherical Coordinate system, Scaler and Vector field, Physical significance of gradient, curl and divergence, Determination of Maxwell's four equations. Applications-design of antenna, wave guide, satellite communication etc.

Module 05: Charged Particle in Electromagnetic Fields

Fundamentals of Electromagnetism, Motion of electron in electric field (parallel ,perpendicular, with some angle); Motion of electron in magnetic field (Longitudinal and Transverse); Magnetic deflection; Motion of electron in crossed field; Velocity Selector; Velocity Filter, Electron refraction; Bethe's law; Electrostatic focusing; Magnetostatic

focusing; Cathode ray tube (CRT);Cathod ray Oscilloscope (CRO) Application of CRO: Voltage (dc,ac), frequency, phase measurement.

List of Experiments (any ten)

S. No.	Title of the Experiment	Module
1.	Verification of Biot Savart's law	05
2.	Study of variation of magnetic field along the axis of a circular coil and determination of the radius of the coil	05
3.	Determination of frequency of AC mains using Sonometer	06
4.	Determination of the characteristic constant or ballistic constant of a ballistic galvanometer	06
5.	Determination of the ratio of e/m for the electron using the helical method	06
6.	Determination of electronic charge by Millikan's oil drop method	06
7.	Determination of capacitance of a parallel plate capacitor with and without dielectric material	05
8.	Determination of Planck's constant using light emitting diode	02
9.	Determination of temperature coefficient, reverse saturation current and energy band gap of a P-N junction	03
10.	Determination of the charge carrier concentration and Hall coefficient of a given semiconductor using Hall experiment setup	03
11.	Use of CRO for measurement of frequency, amplitude and phase angle	06
12.	Study of Diamond, ZnS, NaCl crystal structure.	01
13.	Study of HCP structure.	01
14.	Study of Miller Indices, Plane and direction	01
15.	Computer simulation of hydrogen atom wave function and corresponding probabilities densities	Beyond the syllabus

Text/Reference Books

1. A textbook of Engineering Physics. Avadhanulu & Kshirsagar. S. Chand. 2010.
2. Applied Solid State Physics. Ranikant..Wiley India Pvt Ltd. 2011.
3. Solid State Electronic Devices. Streetman B.G. 6th Ed. Prentice Hall Publisher. 2006.
4. Physics of Semiconductor Devices. Sze S.M. 3rd Ed. John Wiley & Sons. 2008

5. Modern Engineering Physics. Vasudeva. 9th Ed. S. Chand. 2013.
6. Concepts of Modern Physics. Beiser A. 6th Ed.Tata McGraw Hill. 2002.
7. Engineering Physics. Rajendran V. Tata McGraw Hill. 2010.
8. Introduction to Solid State Physics. Kittle C. 8th Ed. John Wiley & Sons publisher. 2012.
9. Engineering Physics. Malik H. K. McGraw Hill. 2010.
10. Engineering Physics. Bhattacharya D. K. Oxford.
11. Classical Electrodynamics. Jackson J. D. 3rd Ed. Wiley. 2007.
12. Introduction to Electrodynamics. Griffiths D. J. 4th Ed. Pearson publication. 2015.

Digital Material

1. Power Point Slides covering the course lectures shall be uploaded on the local server connected through Intranet
2. Course content, video demonstration, problem sets etc. shall be made available on the course page of the Moodle site developed by the course teacher.

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Semester – I

(Basic Sciences Subject)

CH-1001 L-T-P-C
Applied Chemistry-I 3-0-1-4

Objective: *The subject deal with the concepts related to applied chemistry & develops a scientific attitude by means of distinguishing, analyzing & solving various engineering problems. It also provides in-depth knowledge of water chemistry, corrosion chemistry, colloids, polymers and lubricants. The course also provides necessary knowledge of chemical bonding concept relevant to various industries.*

Course Outcome: *After completing this course students will be able to*

1. Apply the knowledge of water chemistry in the field of boiler science, water treatment, disinfection and water softening methods as well as it will be helpful in the field of biotechnology.

2. Apply the knowledge of polymers in the synthesis, properties and uses in the field of fabrication technology.

3. Apply the knowledge of thermodynamics in studying different chemical systems in equilibrium obeying Gibb's phase rule.

4. Apply the knowledge of lubricants, types, properties and mechanisms to avoid resistance.

Course Content

Module 01: Water

Impurities in water,Hardness of water, Determination of Hardness of water by EDTA method and problems. Softening of water by hot and cold lime soda method and numerical problems. Zeolite process and numericals problems. Ion Exchange process

and numericals problems. Potable water standard as per BIS w.r.t. i) pH, ii) Alkalinity, iii)TDS, iv) Hardness; Drinking water or Municipal water- Treatments removal of microorganisms by adding Bleaching powder, Chlorination(no breakpoing chlorination),Disinfection by Ozone, Electrodialysis, Reverse Osmosis, and Ultra Filtration. BOD,COD- definition and significance, sewage treatment(only activated sludge process), Numerical problems related to COD.

Module 02: Polymers

Introduction to polymers, Classification, Types of polymerization, Thermoplastic and Thermosetting plastic; Compounding of plastic, Fabrication of plastic by Compression, Injection, Transfer and Extrusion moulding, Preparation, properties and uses of Phenol formaldehyde, PMMA, Kevlar, Effect of heat on the polymers(Glass transition temperature), Viscoelasticity, Conducting Polymers, Engineering Plastics,Polymers in medicine and surgery. Rubbers: Natural rubber- latex,Drawbacks of natural rubber, Vulcanization of rubber, Preparation,properties and uses of Buna-S, Silicone and Polyurethane rubber.

Module 03: Lubricants

Introduction, Defintion, Mechansim of lubrication, Classification of lubricants, Solid lubricants(graphite & Molybdenum disulfphide, Semisolid lubricants, Liquid lubricants, Additives in blended Oils, Important properties of lubricants- Definition and significance of –Viscosity, Viscosity Index, Flash and Fire Points, Clound and pour points, Oiliness. Emulsification, Acid Value and numericals problems, Saponification value and numerical problems.

Module 04: Phase Rule

Gibb’s Phase Rule, Terms involved with examples, One component system(Water) Reduced Phase Rule, Two Component system(Pb-Ag),Advantages and limitations of Phase Rule.

Module 05: Important Engineering Materials

Cement- Manufacture of Portland Cement, Chemical Composition and Constitution of Portland Cement, Setting and Hardening of Portland Cement, Concrete, RCC and Decay. Nanomaterials, preparation (laser and CVD) method, properties and uses of CNTS, Fullerenes- properties and uses.

List of Experiments

S. No.	Title of the Experiment	Module
1.	To determine the temporary and permanent hardness of water sample.	01
2.	Removal of hardness using ion exchange column.	01
3.	To determine acid value of a lubricating oil.	03
4.	To determine free acid pH of different solutions using pH meter.	02
5.	To determine metal ion concentration using colorimeter.	01
6.	To determine flash and fire point of a lubricating oil.	03
7.	To determine Chloride content of water by Mohr's method.	01
8.	To determine melting point or glass transition temperature of a polymer.	02
9.	Molecular weight of a polymer by Oswald Viscometer.	03
10.	To determine percentage of lime in cement.	05
11.	Hardening and setting of cement using Vicat's apparatus.	05
12.	Determination of viscosity of lubricating oil by Redwood's Viscometer.	03
13.	The Process of Making Soap	Beyond the syllabus

Text/Reference Books

1. Engineering Chemsitry. Jain and Jain. Dhanpat Rai.
2. Engineering Chemistry. Dara & Dara. S..Chand.
3. Engineering Chemistry. Wiley India. ISBN-9788126519880.
4. A Textbook of Engineering Chemistry. Chawla S. Dhanpat Rai.

Digital Material

1. https://youtu.be/CWOJW4357Bg- Water
2. https://youtu.be/CLMdkexbt3E - Lubricants
3. https://youtu.be/v7FGOT2gnCY - Phase rule
4. https://youtu.be/1xWBPZnEJk8 - Nanomaterials
5. https://youtu.be/NwhEp46YCXE- Cement

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Semester – I

(Ability Enhancement Course)

CH-1002 L-T- P-C
Environmental Studies 2-0-0-2

Objective: *This paper introduces the students to the basics of Environmental science. Major issues like renewable & non-renewable sources of energy, pollution problems & social impact of the environment are discussed from a scientific perspective. This course also provides an insight on management of natural resources. Global issues like acid rain, ozone depletion, climate changes & population explosion are also discussed.*

Course Outcome: *After completing this course students will be able to*

1. Illustrate Depleting Nature of Environmental Resources, Global Environmental Crisis.

2. Adapt to 3R (Reuse, Recovery, Recycle).

3. Study different control measures related to Environmental Pollution.

4. Motivating students to participate in environment protection and environment improvement.

5. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.

Course Content

Module 01: Multidisciplinary Nature of Environmental Studies

Scope and Importance Need for Public Awareness Depleting Nature of Environmental resources such as Soil, Water, Minerals, and Forests. Global Environmental Crisis related to Population, Water, Sanitation and Land. Ecosystem: Concept, Classification, Structure of Ecosystem, overview of Food chain, Food web and Ecological Pyramid.

Module 02: Sustainable Development

Concept of sustainable development Social, Economical and Environmental aspect of sustainable development. Control Measures: 3R (Reuse, Recovery, Recycle), Appropriate Technology, Environmental education, Resource utilization as per the carrying capacity.

Module 03: Environmental Pollution

Air Pollution: Sources, Effects of air pollution with respect to Global Warming, Ozone layer Depletion, Acid Rain,Photochemical smog, Two Control Measures- Bag house Filter, Venturi scrubber .Case Study: Bhopal Gas Tragedy Water Pollution: Sources and Treatment, Concept of waste waters -Domestic &Industrial and treatment. Case Study: Minamata Disease. Land Pollution: Solid waste, Solid waste Management by Land filling, Composting. Noise Pollution; Sources and Effects• E-Pollution: Sources and Effects.

Module 04: Environmental Legislation

Overview Ministry of Environment and Forests (MoE&F). Organizational structure of MoE&F. Functions and powers of Central Control Pollution Board. Functions and powers of State Control Pollution Board. Environmental Clearance, Consent and Authorization Mechanism. Environmental Protection Act Any two case studies pertaining to Environmental Legislation.

Module 05: Renewable sources of Energy

Limitations of conventional sources of Energy. Various renewable energy source Solar Energy: Principle, Working of Flat plate collector & Photovoltaic cell.Wind Energy: Principle, Wind Turbines.

Module 06: Environment and Technology

Role of Technology in Environment and health Concept of Green Buildings, Indoor air pollution Carbon Credit: Introduction, General concept. Disaster management: Two Events: Tsunami, Earthquakes, Techniques of Disaster Management Case Study: Earthquake in Japan

Text/Reference Books

1. Textbook of Environmental studies Bharucha E. University Press.
2. Environmental Studies. Rajagopalan R. Oxford University Press.
3. Essentials of Environmental Studies by Joseph K. & Nagendran. Pearson Education.
4. Renewable Energy. Boyle G. Oxford Publications.

5. Perspective of Environmental Studies. Kaushik & Kaushik. New Age International.
6. Environmental Studies. Basak A. Pearson Education.
7. Textbook of Environmental Studies. Dave & Katewa. Cengage Learning.
8. Environmental Studies Joseph B. Tata McGraw Hill.

Digital Material

1. Swayamprabha Channel no: 04 (NPTEL) Environmental Science

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Semester - II

(Departmental Core Subject)

CS-1001 L-T-P-C
Structured Programming Approach 4-0-1-5

Objective: *The objective of this course is to familiarize the logic of structured programming approach and to provide exposure in developing algorithm, flowchart and thereby writing efficient codes for user defined problem.*

Course Outcome: *Learner will be able to illustrate the basic terminology used in computer programming, the concept of data types, variables and operators using C, design and Implement control statements and looping constructs in C, apply function concept on problem statements, demonstrate the use of arrays, strings, structures and files handling in C, demonstrate the dynamics of memory by the use of pointers to construct various data structures.*

Course Content

Module 01: Introduction to Computer, Algorithm and Flowchart

Basics of Computer: Turing Model, Von Neumann Model, basics of Positional Number System, introduction to Operating System and component of an Operating System. Algorithm & Flowchart : Three construct of Algorithm and flowchart: Sequence, Decision (Selection) and Repetition.

Module 02: Fundamentals of C Programming

Character Set, Identifiers and keywords, Data types, Constants, Variables. Operators: Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators. Expression, statements, Library Functions, Preprocessor. Data Input and Output: getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ), Structure of C program .

Module 03: Control Structures

Branching: If statement, If-else Statement, Multiway decision. Looping: while , do-while, for. Nested control structure: Switch statement, Continue statement Break statement, goto statement.

Module 04: Functions and Parameters

Function: Introduction of Function, Function Main, Defining a Function, Accessing a Function, Function Prototype, Passing Arguments to a Function, Recursion. Storage Classes: Auto, Extern, Static, Register

Module 05: Arrays, String, Structure and Union

Array: Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array. String: Basic of String, Array of String , Functions in String.h Structure: Declaration, Initialization, structure within structure, Operation on structures, Array of Structure. Union: Definition, Difference between structure and union , Operations on a union

Module 06: Pointer and File

Pointer :Introduction, Definition and uses of Pointers, Address Operator, Pointer Variables, Dereferencing Pointer, Void Pointer, Pointer Arithmetic, Pointers to Pointers, Pointers and Array, Passing Arrays to Function, Pointers and Function, Pointers and two dimensional Array, Array of Pointers, Dynamic Memory Allocation. 6.2 Files: Types of File, File operation- Opening, Closing, Creating, Reading, Processing File.

List of Experiments

S. No.	Title of the Experiment	Module
1.	Algorithm and flowchart-based problems	01
2.	Basic calculation, conversion-based programs	02
3.	Decision making statement & operator-based programs	03

4.	Loop based programs	03
5.	Multi way decision making statement-based programs	03
6.	Function based programs	04
7.	Array based programs	05
8.	Strings based programs	05
9.	Structure based programs	05
10.	Pointers based programs	06
11.	File handling-based programs	06

Text/Reference Books

1. Basics of Computer Science. Forouzan B. Cengage Learning.
2. Programming Techniques through Venkateshmurthy C. M. G. Pearson Pub.
3. Programming in ANSI. Balaguruswamy C. E. Tata McGraw-Hill Edu.
4. Programming in C. Day P. & Gosh M. Oxford University Press.
5. Let Us C. Kanetkar Y. BPB Pub.

Digital Material

1. https://nptel.ac.in/courses/106104128/
2. https://www.tutorialspoint.com/cprogramming/

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Semester - II

(Departmental Core Subject)

ME-1002 L-T-P-C
Engineering Drawing 4-0-1-5

Objective: *The objective of this course is to teach and train proper understanding of the theory of projection, impart the knowledge of reading a drawing, improve the visualization skill, teach basic utility of computer aided drafting (CAD) tool.*

Course Outcome: *Student will be able to apply the basic principles of projections in 2D drawings, apply the basic principles of projections in converting 3D view to 2D drawing, read a given drawing, visualize an object from the given two views, use CAD tool to draw different views of a 3D object, use CAD tool to draw an object in 3D.*

Course Content

Module 01: Introduction to Engineering Drawing

Types of Lines, Dimensioning Systems as per IS conventions. Engineering Curves: - Basic construction of Cycloid, Involutes and Helix (of cylinder) only.

**Introduction to Auto CAD:- Basic Drawing and Editing Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting and Printing.

Module 02: Projection Point, Lines and Plan

Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines.

@Projection of Planes:- Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes).

Module 03: Projection of Solids, Section of Solids, Development of Lateral Surfaces of Sectioned Solids

Projection of Solids:- (Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method.

Section of Solids:- Section of Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron & Cone cut by plane perpendicular to at least one reference plane.(Exclude Curved Section Plane). Use change of position or Auxiliary plane method.

Development of Lateral Surfaces of Sectioned Solids: - Lateral surface development of Prism, Pyramid, Tetrahedron, Hexahedron, Cylinder, Cone with section plane inclined to HP or VP only. (Exclude DLS of a solid with a hole in it and Reverse Development), (Exclude Reverse Development).

Module 04: Orthographic and Sectional Orthographic Projections

- Different views of a simple machine part as per the first angle projection method recommended by I.S.
- Full or Half Sectional views of the Simple Machine parts.
- **Drawing of orthographic projections using Auto CAD.

Module 05: Isometric Views and Introduction to 3D in Auto CAD

Isometric Views: - Isometric View/Drawing of blocks of plain and cylindrical surfaces using plain/natural scale only. (Exclude Spherical surfaces).

- **Drawing of Isometric views using Auto CAD.
- @Reading of Orthographic Projections.
- **Orthographic Reading using Auto CAD.

**Introduction to 3D in AutoCAD: - Working in 3-dimensions, Viewing 3D Objects, Basic wireframe models, Extruding, simple revolved objects. Boolean operations.

****Should be covered during Auto CAD practical sessions.**

@ Should be covered only in Term work. (i.e. Questions will not be asked for the End semester Examination).

TERM WORK:

Component – 1

Drawing Sheet – 1: Projection of Solids (3 Problems)

Drawing Sheet – 2: Section of Solids and Development of lateral surfaces (2 Problems)

Drawing Sheet – 3: Orthographic Projection without section (2 Problems)

Drawing Sheet – 4: Orthographic Projection with section (2 Problems)

Drawing Sheet – 5: Isometric Views (3 Problems)

Component -2

One A-3 size sketch book consisting of:-

1) Two problems each from Engineering Curves, Projection of Lines, Planes and Solids. One problem from Section of solids without DLS and one problem from section of solids with DLS of that sectioned Solid.

2) Two problems from Orthographic Projections (with Section), One problem on Reading of Orthographic projections and Two problems on Isometric views.

Component-3

Printouts **(preferably on A3 size sheet)** of each from:

1. Orthographic Projections with Section – 3 problems.
2. Isometric Views – 4 problems
3. Reading of Orthographic Projections – 1 problem.

Note: - 2 hrs /week Auto CAD Practical is essential for completing the Auto CAD Drawings and take required printouts.

Text/Reference Books

1. Engineering Drawing (Plane and solid geometry). Bhatt N.D. Charotar Publishing House Pvt. Ltd.
2. Machine Drawing. Bhatt N.D. & Panchal V.M. Charotar Publishing House Pvt. Ltd.
3. Engineering Drawing. Shah M.B. & Rana B.C. Pearson Publications.
4. Engineering Graphics. Shah P.J. S Chand Publications.
5. Engineering Drawing. Dhananjay A.J. Tata McGraw Hill.
6. CAD Soft Technologies: Auto CAD 2012 (For engineers and Designers)", Prof. Tickoo S. & Verma G. Dreamtech Press. NewDelhi.

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Semester - II

(Departmental Core Subject)

ME-1003 L-T-P-C
Basic Workshop Practice – II 0-0-2-2

Objective*: The aim of this course is to impart training to help the students develop engineering skill sets, inculcating respect for physical work and hard labor in addition to some amount of value addition by getting exposed to interdisciplinary engineering domains*.

Course Outcome*: Students will be able to perform different skill sets of various engineering domains*.

Course Content

Detailed Syllabus is given in Basic Workshop Practice-I

Term work

Term work shall consist of respective reports and jobs of the trades selected, Laboratory work (Job and Journal) and Attendance (Practical and Theory).

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Semester - II

(Basic Sciences Subjects)

MA-1002 L-T-P-C
Applied Mathematics - II 4-1-0-5

Objective: *To provide students with sound foundation in applied mathematics & hands on experience in using Scilab software to handle the problems in different engineering disciplines.*

Course Outcome: *Learner will be able to apply the concepts of First Order & first degree Differential equation, Higher Order Linear Differential equation, Beta & Gamma function, Double & Triple integrals of different coordinate systems to various types of engineering problems & to apply SCILAB programming techniques to solve differential equations to model complex engineering activities.*

Course Content

Module 01: Differential Equations of First Order & First Degree

Exact differential Equations, Equations reducible to exact form by using integrating factors. Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation. Simple application of differential equation of first order & first degree to electrical & Mechanical Engineering problem (no formulation of differential equation).

Module 02: Linear Differential Equations with Constant Coefficients & Variable Coefficients of Higher Order

Linear Differential Equation with constant coefficient-complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax}, sin(ax+b), cos (ax+b), x^n , e^{ax} V, xV. Cauchy's homogeneous linear differential equation & Legendre's differential

equation, Method of variation of parameters.

Module 03: Numerical solution of ordinary differential equations of first order & first degree, Beta & Gamma Function

Taylor's series method, Euler's method, Modified Euler method, Runga-Kutta fourth order formula (SciLab programming is to be taught during lecture hours).

Beta & Gamma functions & their properties.

Module 04: Differentiation under Integral sign, Numerical Integration & Rectification

Differentiation under integral sign with constant limits of integration.

Numerical integration by Trapezoidal, Simpson's 1/3rd, Simpson's 3/8th rules (all with proof). (Scilab programming on the numerical integration methods is to be taught during lecture hours)

Rectification of plane curves.

Module 05: Double Integration

Double integration-definition, Evaluation of Double Integrals. Change the order of integration, Evaluation of double integrals by changing the order of integration & changing to polar form.

Module 06: Triple Integration & Applications of Multiple Integrals.

Triple integration definition & evaluation (Cartesian, cylindrical & spherical polar coordinates).

Application of double integrals to compute Area, Mass, Volume. Application of triple integrals to compute volume.

Text/Reference Books

1. Higher Engineering Mathematics. Ramana B.V. 1st Ed. Tata McGraw-Hill Education.
2. Higher Engineering Mathematics. Dass H.K. 3rd Ed. S Chand & Co Ltd. 2014.
3. Higher Engineering Mathematics. Grewal B.S. 42nd Ed. Khanna Publishers. 2012.
4. Advanced Engineering Mathematics. Kreyszig E. 10th Ed. Wiley Eastern. 2012.
5. Calculus & Analytic Geometry. Thomas G.B. & Finney R.L. 9th Ed. Addison-Wesley. 1998.
6. Advanced Engineering Mathematics. Jain R.K. & Iyengar S.R.K. 3rd Ed. Narosa Publishing House. 2010.

7. Calculus - Vol.2. Apostol T. M. 2nd Ed. Wiley. 2003.

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Semester - II

(Basic Sciences Subjects)

PH-1002 L-T-P-C
Applied Physics - II 3-0-1-4

Objective: *Objective of this course is to introduce the wave nature of light using various optical phenomena like interference, diffraction & polarization. The principles of working of optical fiber, lasers and their applications will be introduced. The fundamental principles and techniques used in the emerging disciplines like superconductivity, nanoscience and nanotechnology, acoustics and its application in design of auditorium, ultrasonic waves, their generation and applications will also be discussed.*

Course Outcome: *After completing this course students will be able to*

1. Understand the concepts of wave phenomena: interference, diffraction and polarization

2. Identify various applications of optical fibres.

3. Understand the principle, construction and working of various LASERs and their applications.

4. Understand the concept of superconductivity and applications to SQUID and Magnetic levitation.

5. Comprehend the significance of nanoscience & nanotechnology and its applications

6. Apply the reasons for acoustic defects and use this in the proper design of a hall/auditorium.

7. Use the knowledge of piezoelectric and magnetostriction effect for production of ultrasonic waves and its application in various fields.

Course Content

Module 01: Interference, Diffraction and Polarization of light

Interference by division of amplitude and by division of wave front; Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film(angle of wedge and thickness measurement); Newton's rings Applications of interference - Determination of thickness of very thin wire or foil; determination of refractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surface flatness; Anti-reflecting films and Highly reflecting film. Diffraction of Light –Fraunhoffer diffraction at single slit, Fraunhoffer diffraction at double slit, Diffraction Grating, Resolving power of a grating, dispersive power of a grating Application of Diffraction - Determination of wavelength of light with a plane transmission grating

Basics of polarization, production of polarized light, Malus law and Brewster's law Double refraction, half wave and quarter wave plate, analysis of polarized light Optical activity, specific rotation, Laurent's half shade Polarimeter.

Module 02: Lasers

Quantum processes as absorption, spontaneous emission and stimulated emission; metastable states, population inversion, pumping, resonance cavity, Einsteins's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser-Holography (construction and reconstruction of holograms) and industrial applications(cutting, welding etc), Applications in medical field

Module 03: Fiber Optics

Total internal reflection; Numerical aperture; critical angle; angle of acceptance; number; number of modes of propagation; types of optical fiber; Losses in optical fibre (Attenuation and dispersion). Applications of optical fibre - Fibre optic communication system; sensors (Pressure, temperature, smoke, water level), applications in medical field

Module 04: Nanoscience & nanotechnology

Introduction to nanoscience and nanotechnology, surface to volume ratio, two main approaches in nanotechnology -bottom up technique and top down technique; important tools in nanotechnology such as scanning electron microscope, transmission electron

microscope, atomic force microscope. nano materials: methods to synthesize nanomaterials (Ball milling, Sputtering, Vapour deposition, solgel), properties and applications of nanomaterials.

Module 05: Superconductivity

Introduction, Meissner Effect; Type I and Type II superconductors; BCS Theory (concept of Cooper pair); Josephson effect, Applications of superconductors- SQUID, MAGLE

Module 06: Acoustics & Ultrasonics

Conditions of good acoustics; Reflection of sound(reverberation and echo); absorption of sound; absorption coefficient; Sabine's formula; acoustic design of a hall; common acoustic defects and acoustic materials

ultrasonic wave generation; magnetostriction oscillator; piezoelectric oscillator; applications of ultrasonic: eco sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; Industrial applications of ultrasonic (soldering, welding, cutting, drilling)

List of Experiments (any ten)

S. No.	Title of the Experiment	Module
1.	Determination of wavelength of sodium light source using Newton's rings method	01
2.	Determination of wavelength of monochromatic light source using Fresnel's biprism	01
3.	Determination of the wavelength of monochromatic light using Michelson interferometer	01
4.	Determination of wavelength of laser using single slit diffraction	01
5.	Determination of the wavelength of prominent lines of mercury using plane transmission grating	01
6.	Determination of specific rotation of sugar solution using polarimeter	01
7.	Determination of refractive index and dispersive power of prism material using spectrometer	01
8.	Determination of numerical aperture of an optical fiber cable	03
9.	Determination of wavelength of He-Ne laser using millimeter scale as a grating	02
10.	Determination of wavelength of Diode laser using single slit / double slit and obtain diffraction patterns of different apertures	02

11.	Study of divergence of laser beam	02
12.	Determination of width of a slit using single slit diffraction experiment (laser source)	02
13.	Determination of the height of a distant object/building with the help of sextant	06
14.	Study of ultrasonic distance meter.	06
15.	Determination of velocity of ultrasonic waves using quartz crystal	06
16.	Computer simulation of undammed, damped and forced pendulum	Beyond the syllabus

Text/Reference Books

1. A textbook of Engineering Physics. Avadhanulu & Kshirsagar. S.Chand. 2010.
2. Applied Solid State Physics Ranikant. Wiley India Pvt Ltd. 2011.
3. Concepts of Modern Physics. Beiser A. 6th Ed.Tata McGraw Hill.2002.
4. Engineering Physics. Rajendran V. Tata McGraw Hill.2010.
5. Introduction to Solid State Physics. Kittle C. 8th Ed. John Wiley & Sons publisher. 2012.
6. Engineering Physics. Malik H. K. McGraw Hill. 2010.
7. Fundamentals of Optics. Jenkins and White. 4th Ed. McGraw-Hill. 2001.
8. Optics. Ghatak A. 5th Ed. Tata McGraw Hill. 2012.
9. A textbook of Optics. Subramanyam N. and Brijlal. S.Chand. 2006.
10. Introduction to Nanotechnology. Charles P. Poole, Jr., Frank J. Owens, Wiley India Edition. 2003.
11. Nano: The Essential. Pradeep T. Mcgraw Hill Education. 2008.

Digital Material

1. Power Point Slides covering the course lectures shall be uploaded on the local server connected through Intranet
2. Course content, video demonstration, problem sets etc. shall be made available on the course page of the Moodle site developed by the course teacher.

Detailed Syllabus for B. Tech. Degree Programme
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Semester – II

(Basic Sciences Subject)

CH-1003 L-T- P-C
Applied Chemistry-II 3-0-1-4

Objective: *The objective of this course is to provide in-depth knowledge of necessary phenomenon related to chemical industry, fundamentals of inorganic, organic & applied chemistry applicable to various industries is also included. The concepts of corrosion phenomenon, alloys and complete idea of various types of fuels used in the industry are also incorporated in the course. Green Chemistry is also a part of this course content.*

Course Outcome: *After completing this course students will be able to*

1. Illustrate composition and properties of different types of alloys and the process of powder metallurgy

2. Illustrate principles of green chemistry.

3. Illustrate properties and applications of different types of composite materials.

4. Illustrate properties and classification of various types of fuels used in industries.

5. Illustrate various concepts of inorganic and organic chemistry in the chemical analysis

Course Content

Module 01: Corrosion

Introduction: Types of Corrosion (I) Dry or Chemical Corrosion i) Due to oxygen ii) due to other gases. (II) Wet or Electrochemical Corrosion :- Mechanism i) Evolution of hydrogen type ii) Absorption of oxygen. Types of Electro-Chemical Corrosion – Galvanic cell corrosion, Concentration cell corrosion (differential aeration), pitting corrosion, Intergranular corrosion, Stress Corrosion , Polarization. Factors affecting the rate of

corrosion :- Nature of metal, position in galvanic series, potential difference, overvoltage, relative area of the anodic and cathodic parts, purity of metal, nature of the corrosion product, temperature, moisture, influence of pH, concentrations of the electrolytes. •Methods to Decrease the rate of Corrosion :- Proper designing, using pure metal, using metal alloys, Cathodic protection – i) Sacrificial anodic protection, ii) Impressed current method, Anodic protection method, Metallic coatings, hot dipping , galvanizing, tinning, metal cladding, metal spraying, Electroplating, Cementation,

Organic Coatings ,Paints only constituents and their functions.

Module 02: Alloys

Introduction, purpose of making alloys, Ferrous Alloys, plain carbon steel, heat resisting steels, stainless steels (corrosion resistant steels), effect of the alloying element, Ni, Cr, Co, Mg, Mo, W, and V.Non-Ferrous Alloys- Alloys of Al – i) Duralumin ii) Megalumen. Alloys of Cu-Brasses– i) Commercial brass ii) German Silver. Bronzes – i) Gun metal ii) High – phosphorus bronze. Alloys of pb – i) Wood's metal. ii) Tinman's solders. Their composition (Reference 1 by Jain & Jain), properties & uses.Powder Metallurgy :- Introduction, methods of metal powder formation (1) (a) Mechanical pulverization (b) Atomization (c) Chemical reduction (d) Electrolytic process (e) Decomposition. (2) Mixing & blending (3) Sintering. (4) Compacting: - Various methods such as i) cold pressing. ii) Powder injection moulding. iii) Hot compaction. Applications of powder metallurgy. Manufacture of oxide & non-oxide ceramic powders only i) Alumina ii) Silicon Carbide

Module 03: Fuels

Definition, Classification of fuels – solid, Liquid & Gaseous. Calorific value – def. Gross or Higher C.V. & Net or lower C.V. units of heat (no conversions). Dulong's formula & numericals for calculations of Gross & Net C.V. Analysis of coal – i) Proximate Analysis with numericals and its importance ii) Ultimate Analysis with numericals and its importance, Characteristic properties of the good fuel. Liquid Fuels – Crude petroleum oil; its composition & classification & mining (in brief). Refining of crude oil i) separation of water ii) Separation of 'S' & iii) Fractional distillation with diagram & composition table.Cracking – Definition; Types of cracking – I) Thermal Cracking– (a) Liquid phase thermal cracking b) Vapour phase thermal cracking. II) Catalytic Cracking – (a) Fixed

– bed catalytic cracking (b) Moving – bed catalytic cracking. Advantages of Catalytic Cracking.Petrol : Refining of petrol, unleaded petrol (MTBE use of catalytic converter), power alcohol. Knocking, Octane number (antiknocking agents), Cetane number Combustion: calculations for requirement of only oxygen & air (by weight & by volume only) for given solid, liquid & gaseous fuels.Bio-diesel, Method to obtain Biodiesel from vegetable oils (Trans-esterification), advantages and disadvantages of Biodiesel.Fuel cells- Definition, types and applications.

Module 04: Composite Materials

Introduction, Constitution i) Matrix phase ii) Dispersed phase. Characteristic properties of composite materials Classification – A) Particle – reinforced composites i)Large – particle composites ii) Dispersion – strengthened Composites. B) Fiber – Reinforced Composites (i) Continuous aligned (ii) Discontinuous (short) (a) aligned (b) randomly oriented. (C) Structural Composites – (i) Laminates (ii) Sandwich Panels Adhesives Introduction, Adhesive action, Physical Factors Influencing Adhesive action, Chemical Factors Influencing, Adhesive action, Bonding Processes by adhesives.

Module 05: Green Chemistry

Introduction, Twelve Principles of Green chemistry, numericals on atom economy, synthesis, adipic acid and indigo. Green solvents (ionic liquid supercritical CO2), and products from natural materials.

List of Experiments

S. No.	Title of the Experiment	Module
1.	Estimation of Zn- Complexometric titration	02
2.	Estimation of Ni- Complexometric titration	02
3.	Estimation of Al- Complexometric titration	02
4.	Flue gas analysis using Orsat’s apparatus	03
5.	Estimation of Fe from plain carbon steel	04
6.	Estimation of Ni by gravimetric method.	04
7.	Estimation of Sn- iodometric titration	04
8.	Estimation of Cu- iodometric titration	04

9.	Estimation of percentage moisture in coal	03
10.	To determine percentage ash in coal.	03
11.	To estimate the emf of Cu-Zn system by potentiometry.	05
12.	Demonstration of Electroplating	03
13.	The Process of Making Biodiesel.	Beyond the Syllabus

Text/Reference Books

1. Engineering Chemsitry. Jain & Jain. Dhanpat Rai.
2. Engineering Chemistry. Dara & Dara. S.Chand.
3. Engineering Chemistry. Wiley India. ISBN-9788126519880.
4. A Text Book of Engineering Chemistry. Chawla S. Dhanpat Rai.
5. A Text Book of Green Chemistry. Ahluwalia V.K. Springer.

Digital Material

1. https://youtu.be/-tTNrgLUdYs?list=PLvfdyaivecUGuljfNKj0qcfITjTggsWAI-
2. https://youtu.be/KgUmNQD6m5Q-
3. https://youtu.be/jRVg4ue-_Ic-
4. https://youtu.be/vexA_Rscx2g-
5. https://youtu.be/B45LMANkcKI-

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Semester – II

(Ability Enhancement Course)

HU-1001 L-T-P-C
Communication Skills 2-1-0-3

Objectives: *To develop proficiency in writing and speaking; to guide and teach the students to utilize the principles of professional business and technical writing for effective communication in the global world; and to develop appropriate email etiquette to achieve clarity in communication.*

Course Outcomes: *The student will be able to acquire fluency & communicate messages with clarity, precision & confidence; apply effective communication skills in a variety of public & interpersonal settings; speak convincingly before an audience with the help of an expanded vocabulary; write well-worded letters and other forms of business communication; and practice the unique qualities of professional rhetoric & writing style, such as sentence conciseness, clarity, accuracy, honesty & avoiding wordiness or ambiguity.*

Course Content

Module 01: **Communication Theory**

Concept and Meaning, Communication cycle, Objectives, Barriers to communication (linguistic and semantic, psychological, physical, mechanical, cultural), Methods of communication (verbal and non-verbal), Networks of communication (formal and informal), Language skills (listening, speaking, reading, writing), Corporate communication: Digital Content Creation.

Module 02: Business Correspondence

Principles of Business Correspondence, Parts of a business letter, Formats (Complete block and Modified block).

Types of letters: Enquiry, Reply to enquiry, Claim, Adjustment and Sales letter.

Module 03: Grammar and Vocabulary

Common errors, Concord (subject- verb agreement), Pairs of confused words, Lexicon (Enriching vocabulary through one-word substitutes, synonyms, antonyms, etc.).

Module 04: Summarization and Comprehension

Passages to test the analytical skills and expression.

Module 05: Technical writing

Techniques to define an object, writing instructions, language exercises based on types of expositions (description of an object, explanation of a process).

Module 06: Information Communication Technology (ICT) enabled Communication Media

E-mail, Blog and Website.

Text/ Reference Books

1. Essentials of Business Communication. Pal R. & Korlahalli J. Sultan Chand & Sons. 2011.
2. Technical Communication. Raman M. & Sharma S. Oxford University Press. 2004.
3. Effective Technical Communication. Rizvi A. 11th Ed. Tata McGraw-Hill Publishing Company Ltd. 2005.
4. Technical Writing & Professional Communication for non-native speakers of English. Huckin T.N.& Leslie A. Olsen, McGraw-Hill. 1991.
5. Business Correspondence & Report-writing. Sharma R.C.& Mohan K. 5th edition Tata McGraw-Hill Education. 2017.
6. Business and Professional Communication Concepts and Practices. Benjamin & Harper J. Collins College Publishers. 1993.
7. Communication Skills for Effective Management. Ghanekar, A. Everest Publishing House, Pune. 1996.

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Semester - III

(Basic Sciences Subjects)

MA-2002 L-T-P-C
Advanced Engineering Mathematics - I 4-1-0-5

Objective: *To understand and learn the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane, the complex mapping, standard mappings, cross ratios and fixed point, the Laplace Transform, Inverse Laplace Transform of various functions, its application, Z-transform and the concept of Fourier Series, its complex form and enhance the problem solving skill.*

Course Outcome: *Learner will be able to understand the complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function, plot the image of the curve by a complex transformation from z-plane to w-plane, expand the periodic function by using Fourier series and complex form of Fourier series, concept of Laplace transform and inverse Laplace transform of various functions and its application to solve ordinary differential equations, the concept of Z- transformation and its inverse of the given sequence, the concept of Correlation and Regression and apply all these concepts to the engineering problems.*

Course Content

Module 01: Laplace Transform

Function of bounded variation, Laplace Transform of standard functions such as 1, t^n, e^{at}, sin(at), cos(at), cosh(at), sinh(at). Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof) $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)\,du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$. Heaviside Unit step function, Direct Delta

function, Periodic functions and their Laplace Transform. Inverse Laplace Transform: Linearity property, use of theorems to find inverse Laplace Transform, Partial fractions method and convolution theorem (without proof). Applications to solve initial and boundary value problems involving ordinary differential equations with one dependent variable.

Module 02: Complex variables

Functions of complex variable, Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof), Cauchy-Riemann equations in polar coordinates.

Milne- Thomson method to determine analytic function f(z) when it's real or imaginary or its combination is given; Harmonic function, orthogonal trajectories; Mapping: Conformal mapping, standard transformations such as translation, rotation and magnification, inversion and reflection, linear transformation, bilinear transformation, cross ratio, fixed points.

Module 03: Complex Integration

Line integral of a function of a complex variable, Cauchy's theorem for analytic function, Cauchy's Goursat theorem (without proof), properties of line integral, Cauchy's integral formula and deductions; Singularities, Classification of singularities

Taylor's and Laurent's series development (without proof); Residue at isolated singularity and its evaluation; Residue theorem, application to evaluate real integral of type: $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta$ and $\int_{-\infty}^{\infty} f(x)\, dx$.

Module 04: Fourier Series

Orthogonal and orthonormal functions, Construction of orthonormal set; Dirichlet conditions; Fourier series of periodic function with period 2π and 2L; Fourier series of even and odd functions, Half range sine and cosine series; Parsvel's identities (without proof); Complex form of Fourier series.

Module 05: Partial Differential Equations

Classification of partial differential equations of second order, Heat equation, Wave equation, Laplace equation; Method of Separation of variables, Solution of one dimensional heat conduction equation, steady state configuration for heat flow, solution of one dimensional wave equation, transverse vibrations of an elastic string, Laplace

equation in rectangular region, Use of Fourier series and applications of Laplace transform in solving these equations; Numerical Solution of Partial differential equations using Bender-Schmidt Explicit Method and simplified Crank-Nicolson implicit method.

Module 06: Correlation, regression and Curve Fitting

Correlation, Co-variance, Karl Pearson Coefficient of Correlation and Spearman's Rank Correlation Coefficient (non-repeated and repeated ranks); Regression coefficient & Lines of Regression; Curve fitting by the method of least squares- fitting of the curves of the form: $y = a\,x + b$, $y = a\,x^2 + b\,x + c$ and $y = a\,e^{bx}$.

Text/Reference Books

1. Higher Engineering Mathematics. Ramana B.V. 1st Ed. Tata McGraw-Hill Education.
2. Higher Engineering Mathematics. Dass H. K. 3rd Ed. S Chand & Co Ltd. 2014.
3. Higher Engineering Mathematics. Grewal B.S. 42nd Ed. Khanna Publishers. 2012.
4. Advanced Engineering Mathematics. Kreyszig E. 10th Ed. Wiley Eastern. 2012.
5. Advanced Engineering Mathematics. Jain R. K. & Iyengar S. R. K. 3rd Ed. Narosa Publishing House. 2010.
6. Fundamentals of Mathematical Statistics. Gupta S.C. & Kapoor V. K. 11th Ed. S. Chand & Sons. 2002.
7. Probability statistics and random processes. Veerarajan T. 3rd Ed. Tata McGraw-Hill Education. 2008.
8. Probability, Random Variables and Stochastic Processes. Papoulis A & Unnikrishna Pillai S. 4th Ed. McGraw-Hill. 2008.
9. Complex Variables and Applications. Brown J. W.& Churchill R. V. 7th Ed., Mc-Graw Hill. 2004.
10. Complex Variables- Introduction and Applications. Ablowitz M. J. & Fokas A. S. Indian Ed. Cambridge University Press. 1998.
11. Complex Analysis for Mathematics and Engineering. Mathews J. H. & Howell R. W. 3rd Ed., Narosa.1998.
12. Elements of Partial Differential Equations. Sneddon I.N. McGraw Hill.1957.
13. Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem. Haberman R. 4th Ed. PH. 1998.

Detailed Syllabus for B. Tech. Degree Programme
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Semester - III

(Departmental Core Subject)

CE-2001 L-T-P-C
Surveying - I 4-0-0-4

Objective: *Objective of this subject is to understand appropriate methods of surveying based on accuracy and precision required availability of resources, economics and duration of project, study techniques for measurement of distance, setting offsets, calculate area and volume using surveying instruments.*

Course Outcome: *On completion of the course, the learners will be able to apply principles of surveying and leveling for civil engineering works, measure vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems. Learners will also able to perform various practical and hence projects using different surveying instruments. They will able to apply geometric principles for computing data and drawing plans and sections; analyze the obtained spatial data and compute areas and volumes and represent 3D data on plane surfaces (2D) as contours.*

Course Content

Module 01: Introduction

Definition, principles, objectives, classification, technical terms, uses and necessity of surveying. Units of measurement, surveying measurement and errors, type of errors and their corrections (including numerical), corrections for wrong scales, accuracy and precision, stages of survey operations.

Chaining, Ranging and offsetting: Definitions, Principles, Types, Instruments required, methods, obstacles (including numerical), sources of errors, conventional signs and symbols.

Electronic Distance Measurement: Working Principles, types, applications in surveying

Module 02: Measurement of Directions and Angles

Basic definitions, meridians, bearings, magnetic and true bearings, compasses, prismatic and surveyor's, temporary adjustments, declination, dip, local attraction

Types of traverse, procedures, control establishments, Conversion of WCB into RB and vice-versa, Traverse Survey and Computations of interior angles of a closed Traverse. Adjustment of closing error, correction for local attraction.

Module 03: Levelling and its application

Introduction to levelling, basic terms and definitions, types of instruments, construction and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, temporary and permanent adjustments

Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of missing data, distance to the visible horizon, corrections due to curvature and refraction, reciprocal levelling, Numerical problems

Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors, difficulties in levelling work, corrections and precautions in levelling work.

Module 04: Plane Tabling, Contouring, Area and Volume

Plane Table Surveying: Definition, principles, accessories required for plane table surveying, merits and demerits, temporary adjustments, Different methods of plane table surveying, Errors in plane table surveying, Use of telescopic alidade.

Contouring: definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring. Grade contour: definition and use.

Area: Area of an irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods.

Planimeter: types including digital planimeter, area of zero circle, uses of planimeter.

Volume: Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans.

Module 05: Theodolite Traversing

Various parts and axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration.

Different methods of running a theodolite traverse, Latitudes and departures, rectangular coordinates, traverse adjustments by Bowditch's, transit and modified transit rules, Gales Traverse Table, Numerical Problems.

Use of theodolite for various works such as prolongation of a straight line, setting out an angle, bearing measurements. Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing.

Trigonometrical Levelling: Problems on one plane and two plane methods,

Module 06: Tachometric surveying

Principle, purpose, uses, advantages and suitability of tacheometry, different methods of tacheometry, stadia formula, Stadia diagram and tables. Sub-tense bar method.

Application in plane table and curve setting.

Radial Contouring.

Text/Reference Books

1. Surveying & Leveling. Vol. I & Vol. II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. 1972.
2. Surveying. Vol. I & Vol. II. Punmia B.C. & Jain A.K. Laxmi Publication. 1996.
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. 1994.

Digital Material

1. https://nptel.ac.in/courses/105107122/1

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Semester - III

(Departmental Core Subject)

CE-2002 L-T-P-C
Surveying - I Lab. 0-0-1-1

Laboratory Outcome: *Students must be able to conduct field experiments related to Surveying & then collect, analyze, interpret and present the data so that it can be used in projects. Also, to study the functions of various surveying instruments, their least counts, possible errors, advantages and limitations.*

Description: *The Surveying Laboratory has a wide variety of basic and modern surveying equipment, such as GPS-based surveying equipment, total stations, Digital theodolites, and automatic levels for basic instructional and research purposes. Undergraduate students use above resources to obtain any topographic information that can help their capstone design projects, such as highway design and land development.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Computing area of polygon by chaining, ranging and offsetting and verify distances by EDM	01
2.	Measuring bearing of closed traverse using Prismatic/Surveyor's compass and computing included angle.	02
3.	Simple and differential levelling using dumpy level	03
4.	Transferring R.L from benchmark to new point by auto level/digital level with at least three change points and performing check levelling	03

5.	Measurement of horizontal angle by Repetition and Reiteration Method using Vernier Transit theodolite.	05
6.	To find the constants of a tachometer and to verify filed distances.	06
7.	To find R.L and distances by tachometric surveying.	06
8.	To find height of inaccessible tower using one plane and two plane method using Vernier Transit theodolite.	05
9.	Plane table surveying by various methods with at least four stations.	04
10.	Determination of areas of irregular figures by conventional/digital planimeter	04

Text/Reference Books

1. Surveying & Leveling. Vol. I & Vol. II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. 1972.
2. Surveying. Vol. I & Vol. II. Punmia B.C. & Jain A.K. Laxmi Publication. 1996.
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. 1994.

Digital Material

1. https://nptel.ac.in/courses/105107122/1
2. http://vlabcivil-iitr.co.in

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Semester - III

(Departmental Core Subject)

CE-2003	L-T-P-C
Strength of Materials	4-0-0-4
Pre-requisite	Engineering Mechanics

Objective:

The aim of this course is to study the engineering properties of the materials and solids and analyze the same to evaluate the stress –strain behavior & to analyze the internal forces for the statistically determinate and compound beams having internal hinges with different types of loading. This course will help learner to understand the concept and behavior of flexural members (beams) in flexure and shear, solid circular shaft for torsion, thin shells for internal stresses.

Course Outcome: *On completion of the course, the students will be able to understand and determine the engineering properties for metals and non-metals, concepts of shear force, bending moment, axial force for statically determinate beams and compound beams having internal hinges; and subsequently, its application to draw the shear force, bending moment and axial force diagrams. Students will also able to analyze the flexural members for its structural behavior under the effect of flexure (bending), shear and torsion either independently or in combination thereof, study the behavior of the structural member under the action of axial load, bending and twisting moment and the deformation behavior of axially loaded columns having different end conditions and further, evaluate the strength of such columns. The successful completion of the course will equip the*

students for undertaking the courses dealing with the analysis and design of determinate and indeterminate structures.

Course Content

Module 01: Simple Stresses and Strains

Stresses, Strains, Modulus of elasticity (E), Modulus of rigidity (G), Bulk Modulus (K), Yield Stresses, Ultimate Stress, Factor of safety, shear stress, Poisson's ratio.

Relationship between E, G and K, bars of varying sections, deformation due to self-weight, composite sections, temperature stress.

Module 02: Shear Force and Bending Moment in Beams

Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading.

Relationship between rate of loading, shear force and bending moment.

Module 03: Theory of Simple Bending: Moment of inertia, transfer theorem, polar moment of inertia.

Flexure formula for straight beam, simple problems involving application of flexure formula, section modulus, moment of resistance, flitched beams.

Strain Energy: Strain energy due to axial force, stresses in axial member and simple beams under impact loading.

Module 04: Shear Stresses in Beams: Distribution of shear stress across plane sections commonly used for structural purposes.

Theory of Simple Torsion: Torsion in circular shafts-solid and hallow, stresses in shaft when transmitting power. Concept of equivalent torsional and bending moment

Module 05: Direct and Bending Stresses

Application to member's subjected to eccentric loads, core of section, problems on chimneys, retaining walls, dams, etc. involving lateral loads.

Columns and Struts: Members subjected to axial loading, concept of buckling, Effective length, Euler's formula for columns and struts with different support conditions, Limitation of Euler's formula, Rankine's formula, Problems based on Euler's and Rankine's formulae.

Module 06: Principal Planes and Stresses

General equation for transformation of stress, principal planes and principal stresses, maximum shear stress, stress determination using Mohr's circle. Thin Cylindrical and Spherical Shells. Thin Cylindrical and spherical shells under internal pressure.

Text/Reference Books

1. Strength of Materials. Ramamrutham S. Dhanpatrai Publishers.
2. Strength of Materials. Rajput R.K. S. Chand Publications.
3. Mechanics of Structures: Vol-I. Junnarkar S. B.& Shah H.J. Charotar Publishers. Anand.
4. Strength of Materials: Subramanian, Oxford University Press
5. Strength of Materials. Rattan S.S. Tata Mc-Graw Hill. New Delhi.

Digital Material

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112107146/

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Semester - III

(Departmental Core Subject)

CE-2004 L-T-P-C
Strength of Materials Laboratory 0-0-1-1

Laboratory Outcome: *The aim of this laboratory course is to study the engineering properties of the materials and solids and analyze the same to evaluate the stress –strain behavior & to analyze the internal forces for the statistically determinate with different types of loading.*

Description: *This laboratory provides the basic knowledge of strength of materials and here, the students can perform different tests on different materials.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Tension test on mild steel bars (stress-strain behavior, Young's modulus determination)	01
2.	Tests on Tor Steel (Tension, bend and re-bend)	04
3.	Transverse Test on cast iron.	06
4.	Shear Test on mild steel, cast iron, and brass.	04
5.	Torsion Test on mild steel and cast-iron bar.	04
6.	Brinell Hardness test (any three-metal specimen)	06
7.	Rockwell Hardness test on mild steel.	06

8.	Izod / Charpy impact test (any three-metal specimen)	03

Text/Reference Books

1. Strength of Materials. Ramamrutham S. Dhanpatrai Publishers.
2. Strength of Materials. Rajput R.K. S. Chand Publications.
3. Mechanics of Structures. Vol. I. Junnarkar S. B.& Shah H.J. Charotar Publishers. Anand.
4. Strength of Materials. Subramanian, Oxford University Press
5. Strength of Materials. Rattan S.S. Tata Mc-Graw Hill. New Delhi.

Digital Material

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112107146/
3. http://sm-nitk.vlabs.ac.in/

Detailed Syllabus for B. Tech. Degree Programme
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Semester - III

(Departmental Core Subject)

CE-2005	L-T-P-C
Engineering Geology	3-0-0-3

Objective: *This course is designed to impart basic geological knowledge and to understand its significance in various civil engineering projects. The course will inspire the students to think clearly & critically the solution of the civil engineering problems in the context of geology. The course will help students to study of 'Theory of Plate Tectonics' which helps to explain much of the global-scale geology including the formation of mountains, oceans, different landforms and the occurrence and distribution of earthquakes, volcanoes, landslides etc.*

Course Outcome: *On completion of the course, the students shall be able to understand the significance of geological studies for safe, stable and economic design of any civil engineering structure. The students shall also able tom demonstrate the knowledge of geology to explain major geological processes such as formation of mountain, ocean and the occurrence and distribution of earthquakes and volcanoes, explain various geological structures like folds, faults, joints, unconformity, their origin and distribution which are very essential in the design and construction of dams, tunnels and any other major civil engineering project. At the end of this course students will able to prepare effective reports mentioning advantages and disadvantages caused due to geological condition and can evaluate any site for civil engineering project*.

Course Content

Module 01: Introduction

Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects. Internal structure of the Earth and use of seismic waves in understanding the interior of the earth, Theory of Plate Tectonics. Agents modifying the earth's surface, study of weathering and its significance in engineering properties of rocks like strength, water tightness and durability etc. Brief study of geological action of river, wind, glacier, ground water and the related landforms created by them. Building stones- Requirements of good building stones and its geological factors, controlling properties, consideration of common rocks as building stones, study of different building stones from various formations of Indian Peninsula.

Module 02: Mineralogy and Petrology

Identification of minerals with the help of physical properties, rock forming minerals, megascopic identification of primary and secondary minerals, study of common ore minerals.

Igneous Petrology - Mode of formation, Texture and structure, Classifications, study of commonly occurring igneous rocks and their engineering application.

Sedimentary Petrology - Mode of formation, Textures, characteristics of shallow water deposits like lamination, bedding, current bedding etc., residual deposits, chemically and organically formed deposits, classification, study of commonly occurring sedimentary rocks and their engineering application.

Metamorphic Petrology - Mode of formation, agents and types of metamorphism, metamorphic minerals, rock cleavage, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks and their engineering application.

Module 03: Structural Geology, Stratigraphy and Indian Geology

Structural elements of rocks, dip, strike, outcrop patterns, outliers and inliers, study of joints, unconformities and their engineering consideration. Faults and folds, their classification and importance in engineering operations.

Determination of thickness of the strata with the help of given data.

General principles of Stratigraphy, geological time scale, Physiographic divisions of India and their characteristics. Stratigraphy of Deccan Volcanic Province

Module 04: Geological Investigation, study of dam and reservoir site

Preliminary Geological Investigation and their importance to achieve safety and economy of the projects like dams and tunnels, methods of surface and subsurface investigations, Excavations-Trial pit, trenches etc.

Core Drilling - Geological logging, Inclined Drill holes. Electrical Resistivity method, Seismic method and their applications

Strengths, stability, water tightness of the foundation rocks and its physical characters against geological structures at dam sites, favourable and unfavourable geological conditions for locating dam sites.

Precautions over the unfavourable geological structures like faults, dykes, joints, unfavourable dips on dam sites and giving treatments, structural and erosional valleys.

Module 05: Tunnel Investigation and Ground Water Control

Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions, Difficulties during tunneling and methods to overcome the difficulties. Methods of tunneling in soft soil

Sources, zones, water table, unconfined and Perched water tables. Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, Cone of depression and its use in Civil engineering. Artesian well (flowing and non-flowing)

Springs seepage sites and geological structures. Different types of rocks as source of ground water

Methods of artificial recharge of ground water, geology of percolation tank.

Module 06: Geological Disasters and Control Measures

Landslides: Types, causes and preventive measures for landslides, Landslides in Deccan region

Volcano: Central type and fissure type, products of volcano and volcanic land forms.

Earthquake: Earthquake waves, construction and working of seismograph, Earthquake zones of India, elastic rebound theory Preventive measures for structures constructed in Earthquake prone areas.

Text/Reference Books

1. Foundations of Engineering Geology. Waltham A. C. 1st Ed. Blackie Academic & Professional. Chapman & Hall. 1997.
2. General Geology for Engineers. Allan K., First revised Ed. Tata McGraw Hill. 2006.
3. Engineering Geology. Kesavulu P. 2nd Ed. Oxford University Press. 1999.
4. Text book of Engineering and General Geology. Singh P. Carson Publication

Digital Material

1. https://nptel.ac.in/courses/105105170/
2. https://nptel.ac.in/courses/105105106/

Detailed Syllabus for B. Tech. Degree Programme

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Civil Engineering

Semester - II

(Departmental Core Subject)

CE-2006 L-T-P-C

Engineering Geology Laboratory 0-0-1-1

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of geotechnics and soil mechanics with emphasis on soils laboratory testing, field testing and monitoring.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Study of physical properties of the minerals.	01
2.	Identification of minerals- Quartz and its varieties, Orthoclase, Plagioclase, Muscovite, Biotite, Hornblende, Asbestos, Augite, Olivine, Tourmaline, Garnet, Actinolite, Calcite, Dolomite, Gypsum, Beryl, Bauxite, Graphite, Galena, Pyrite. Hematite, Magnetite, Chromite, Corundum, Talc, Fluorite, Kyanite.	02
3.	Identification of rocks: Igneous rocks-Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic tuffs.	03

	Sedimentary Rocks- Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestones, Laterites. Metamorphic Rocks- Mica Schists, Hornblende Schists, Slate, Phyllite, Granite Gneiss, Augen gneiss, Marbles and Quartzite.	
4.	Study of Geological maps (At least 5).	04, 05
5.	Study of core samples, RQD, Core logging.	04, 05
6.	At least two engineering problems based on field data collected during site investigation.	05, 06

Text/Reference Books

1. Foundations of Engineering Geology. Waltham A. C. 1st Ed. Blackie Academic & Professional. Chapman & Hall. 1997.
2. General Geology for Engineers. Allan K., First revised Ed. Tata McGraw Hill. 2006.
3. Engineering Geology. Kesavulu P. 2nd Ed. Oxford University Press. 1999.
4. Text book of Engineering and General Geology. Singh P. Carson Publication.

Digital Material

1. https://nptel.ac.in/courses/105105170/
2. https://nptel.ac.in/courses/105105106/

Detailed Syllabus for B. Tech. Degree Programme
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Civil Engineering

Semester - III

(Departmental Core Subject)

CE-2007 L-T-P-C
Fluid Mechanics - I 3-0-0-3

Objective: *The aim of this course is to introduce & explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Civil Engineering, etc. This course will also help to learn fluid properties & hydrostatic law & to understand the importance Various flow measuring devices and their applications.*

Course Outcome: *On completion of this course the student will be able to define various properties of fluids, state and explain different types of laws and principles of fluid mechanics. They will interpret different forms of pressure measurement and Calculate Hydrostatic Force and its Location for a given geometry and orientation of plane surface and compute force of buoyancy on a partially or fully submerged body and analyse the stability of a floating body. They will also able to derive Euler's Equation of motion and Deduce Bernoulli's equation and measure velocity and rate of flow using various devices.*

Course Content

Module 01: Properties of Fluids

Mass density, weight density, specific gravity, specific volume, viscosity, compressibility and elasticity, surface tension, capillarity, vapour pressure, types of fluids, basic concepts applicable to fluid mechanics.

Module 02: Fluid Statics

Pressure measurement: Pascal's law, hydrostatic law, pressure variation in fluids at rest. Absolute, atmospheric, gauge pressure, measurement of pressure using manometers

Hydrostatic force on surfaces: Total pressure and centre of pressure, total pressure on horizontal plane surface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks.

Buoyancy and flotation: Archimedes principle, Meta-centre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, metacentric height for floating bodies containing liquid, Time-period of Transverse oscillations of floating bodies.

Module 03: Liquids in Relative equilibrium and Fluid Kinematics

Liquids in Relative equilibrium Fluid mass subjected to uniform linear acceleration, liquid containers subjected to constant horizontal acceleration and vertical acceleration, fluid containers subjected to constant rotation with axis vertical and horizontal.

Fluid Kinematics: Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, velocity potential and stream function, streamline, streak line, path line, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity

Module 04: Introduction to Ideal flow

Introduction to ideal fluid flow, uniform flow, source and Sink, free vortex flow, superimposed flow, doublet, Flow past a half body, flow past a Rankine oval body and flow past a cylinder

Module 05: Fluid dynamics

Control volume and control surface, Forces acting on fluid in motion, NavierStokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation, Bernoulli's equation for compressible fluid and real fluid, practical applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube, rotameter.

Module 06: Flow measurement

Orifices and Mouthpieces: Classification of orifices, flow through orifices, determination of hydraulic coefficients, flow through large rectangular orifice, flow through fully

submerged and partially submerged orifice, time of emptying a tank through an orifice at its bottom. Classification of Mouthpieces, Flow through external cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's mouthpieces.

Module 07: Notches and Weirs

Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, stepped notch, Cipolleti weir, broad crested weir, ogee weir, discharge over a submerged weir, ventilation of weirs.

Text/Reference Books

1. Hydraulics & Fluid Mechanics. Modi P.N. & Seth S.M. Standard Book House. 1998.
2. Fluid Mechanics. Streeter V.L. & Wylie E.B. McGraw Hill. 1997.
3. Fluid Mechanics. B.F. White. McGraw Hill.1994.
4. Fluid Mechanics: Bansal R.K. Laxmi Publications (P) Ltd.

Digital Material

1. https://nptel.ac.in/courses/105101082/

Detailed Syllabus for B. Tech. Degree Programme
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Semester - III

(Departmental Core Subject)

CE-2008 L-T-P-C
Fluid Mechanics - I Laboratory 0-0-1-1

Laboratory Outcome: *The aim of this laboratory course is to introduce & explain experiments related to fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Civil Engineering, etc. This course will also help to learn fluid properties, hydrostatic law and to understand the working of Various flow measuring devices and their applications.*

Description: *On completion of this course the student will be able to define various properties of fluids, state and explain different types of laws and principles of fluid mechanics. They will also able to understand applications of Bernoulli's equation and measure velocity and rate of flow using various devices.*

List of Experiments (Any 9)

S. No.	Title of the Experiment	Module
1.	Determination of metacentric height.	02
2.	Verification of Bernoulli's theorem.	05
3.	Determination of coefficient of discharge through Venturimeter.	05
4.	Determination of coefficient of discharge through Orifice meter.	05

5.	Determination of coefficient of discharge through Nozzle meter.	05
6.	Determination of coefficient of discharge through Notches (Rectangular and Triangular notch).	07
7.	Determination of coefficient of discharge over weirs (Broad Crested weir and Ogee weir).	07
8.	Determination of hydraulic coefficients of orifice.	06
9.	Determination of coefficient of discharge through mouthpiece.	06
10.	Measurement of fluid pressure using various manometers & gauges	01

Text/Reference Books

1. Hydraulics & Fluid Mechanics. Modi P.N. & Seth S.M. Standard Book House. 1998.
2. Fluid Mechanics. Streeter V.L. & Wylie E.B. McGraw Hill. 1997.
3. Fluid Mechanics. B.F. White. McGraw Hill.1994.
4. Fluid Mechanics. Bansal R.K. Laxmi Publications (P) Ltd.

Digital Material

1. https://eerc03-iiith.vlabs.ac.in/
2. http://fm-nitk.vlabs.ac.in/

Detailed Syllabus for B. Tech. Degree Programme
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Semester - IV

(Basic Sciences Subjects)

MA-2006 L-T-P-C
Advanced Engineering Mathematics - II 4-1-0-5

Objective: *To inculcate an ability to relate engineering problems to mathematical context, provide a solid foundation in mathematical fundamentals required to solve engineering problems, study the basic principles of Vector analysis, complex integration, probability, test of hypothesis and correlation between data and prepare students for competitive exams.*

Course Outcome: *Learner will be able to solve the system of linear equations using matrix algebra with its specific rules, demonstrate basics of vector calculus, apply the concept of probability distribution and sampling theory, principles of vector calculus to the analysis to engineering problems, identify, formulate and solve engineering problems and illustrate basic theory of correlations and regression.*

Course Content

Module 01: Matrices

Brief revision of vectors over a real field, inner product, norm, Linear dependence and Independence and orthogonality of vectors; Characteristic polynomial, characteristic equation, characteristic roots and characteristic vectors of a square matrix, properties of characteristic roots and Eigen vectors of different types of matrices such as symmetric matrix, orthogonal matrix, Hermitian matrix, Skew-Hermitian matrix; Cayley Hamilton theorem (without proof) and its application; Similarity of matrices, Functions of a square matrix, Minimal polynomial and Derogatory matrix; Quadratic forms: linear transformation of a quadratic form, congruence of a square matrix, reduction to canonical form under

congruent transformations, orthogonal transformation, determining the nature of a quadratic form, Application of Eigen values and Eigen Vectors.

Module 02: Vector calculus

Brief revision of Scalar and vector point functions, Gradient, divergence and curl, Irrotational vectors, scalar potential, solenoidal vectors, Directional derivatives; Line integrals, Circulation, Green's theorem (without proof) for plane regions and properties of line integrals; Surface integrals, Stokes theorem (without proof); Volume integrals, Gauss divergence theorem (without proof) related identities and deductions. (No verification problems on Stoke's Theorem and Gauss Divergence Theorem).

Module 03: Linear Programming

Types of solutions to linear programming problems, standard form of L.P.P. Simplex method to solve L.P.P.; Big M method (Penalty method) to solve L.P.P, Duality, Dual simplex method and Revised simplex method to solve L.P.P.

Module 04: Non Linear Programming

Unconstrained optimization, problems with equality constraints, Lagrange's Multiplier method, Problem with inequality constraints Kuhn-Tucker conditions.

Module 05: Probability Distributions

Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance; Probability distributions: Binomial, Poisson, Normal and exponential Distributions.

Module 06: Sampling theory

Sampling distribution, Test of Hypothesis, Level of significance, critical region, One tailed and two tailed tests, Interval Estimation of population parameters; Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples; Test of significance of small samples:-Student's t-distribution and its properties. Test for significance of the difference between sample mean and population mean, Test for significance of the difference between the means of two Samples, paired t-test; Chi square test, Test of goodness of fit and independence of attributes, Contingency table and Yate's correction; Analysis of Variance (F-Test): One way classification, Two-way classification (short-cut method).

Text/Reference Books

1. Higher Engineering Mathematics. Ramana B.V. 1st Ed. Tata McGraw-Hill Education.
2. Higher Engineering Mathematics. Dass H. K. 3rd Ed. S Chand & Co Ltd. 2014.
3. Higher Engineering Mathematics. Grewal B.S. 42nd Ed. Khanna Publishers. 2012.
4. Advanced Engineering Mathematics. Kreyszig E. 10th Ed. Wiley Eastern. 2012.
5. Advanced Engineering Mathematics. Jain R. K. & Iyengar S. R. K. 3rd Ed. Narosa Publishing House. 2010.
6. Fundamentals of Mathematical Statistics. Gupta S.C. & Kapoor V. K. 11th Ed. S. Chand & Sons. 2002.
7. Operations Research. Gupta P.K. & Hira D.S. 7th Ed. S. Chand & Sons. 2014.
8. Probability statistics and random processes. Veerarajan T. 3rd Ed. Tata McGraw-Hill Education. 2008.

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Semester - IV

(Departmental Core Subject)

CE-2009	L-T-P-C
Surveying - II	3-0-0-3
Pre-requisite	Surveying - I

Objective: *The objective of this is to understand operation of Total Station, EDM, Electronic Theodolite for desired accuracy in surveying and to learn how to establish survey control of determined accuracy using GPS, GIS and Remote sensing. This course will help students to Study various types of curves by linear and angular methods and to prepare different layout from surveying data.*

Course Outcome: *On completion of the course, the learners will be able to: Operate Total Station & GPS for desired accuracy in surveying and establish survey control of determined accuracy using Total Station, GPS, GIS and remote sensing; set out various types of curves by linear and angular methods; compute setting out data from survey and design information; Generate and manipulate field survey data and incorporate design data using specialized software's and appreciate the role of various governmental authorities in maintaining cadastral survey records.*

Course Content

Module 01: Curves-Horizontal

Definitions of different terms, necessity of curves and types of curves

Simple circular curves and compound curves, office and field work, linear methods of setting out curves,

Angular methods of setting out curves, two theodolites and Rankine deflection angle method.

Reverse and transition curves, their properties and advantages, design of transition curves, shift, spiral angle. Composite curves office and field level. Setting out of curves by angular method, composite curves problems.

Difficulties in setting out curves and solution for the same.

Module 02: Curves-Vertical

Sight distance on a vertical curve, Tangent correction and chord gradient methods, Sight distance on a vertical curve

Module 03: Setting out works

General horizontal and vertical control, setting out of foundation plan for load bearing and framed structure, batter board, slope and grade stakes, setting out with theodolite, setting out a foundation plans for building, sewer line, culvert, and use of laser for works; Setting out centre line for tunnel, transfer of levels for underground works. Project/route survey for bridge, dam and canal; Checking verticality of high-rise structures.

Module 04: Special Survey Instruments

Electronic Theodolite, Total Station: Principles, Types, Applications, Topographical Survey and Stake-out, Transferring data to and from other software's for further processing, advantages and limitations. Introduction to Site square, Penta Graph, Auto-set Level, Transit level, Special Compasses, Brunton Universal Pocket Transit, Mountain Compass Transit

Module 05: Modern Methods of Surveying

Global Positioning System (GPS): Basic principles, GPS segments, receivers, computations of coordinates, Applications in surveying,

Remote Sensing: Definition, basic concepts, electromagnetic radiation and spectrum, energy source and its characteristics, image acquisition and image interpretation. Application of remote sensing.

Global Information System (GIS): Geographical concepts and terminology, advantages, basic components of GIS, data types, GIS analysis, Applications of GIS.

Field Astronomy: Introduction, purposes, astronomical terms, determination of azimuth, latitude, longitude and time corrections to the observations.

Aerial photogrammetry: Introduction, Principle, Uses, Aerial camera, Aerial photographs, Definitions, Scale of vertical and tilted photograph, Ground Co-ordinates, Displacements and errors, Ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar

Hydrographic Survey: Introduction, Organizations, National and International Maritime Hydrography, Hydrographic survey Methods, Lead lines, sounding poles, and single-beam, echo sounders.

Module 06: Cadastral Surveying

Interpreting and advising on boundary locations, on the status of land ownership and on the rights, restrictions and interests in property. Legal requirements relating to property boundary surveys in India. Role of revenue department in maintaining survey records, introduction to local survey terminologies like tehsildar, 7/12, utara, namuna8, etc. Introduction to Survey of India Department; Department of Registration and Stamps of any state of India.

Text/Reference Books

1. Surveying & Leveling. Vol. I & Vol. II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. 1972.
2. Surveying. Vol. I & Vol. II. Punmia B.C. & Jain A.K. Laxmi Publication Pvt. 1996.
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. 1994.

Digital Material

1. https://nptel.ac.in/courses/105107122/1

Detailed Syllabus for B. Tech. Degree Programme
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Semester - IV

(Departmental Core Subject)

CE-2010	L-T-P-C
Surveying - II Laboratory	0-0-2-2
Pre-requisite	Surveying - I

Laboratory Outcome: *Students must be able to conduct laboratory and field experiments to collect, analyze, interpret and present the various data related to curve setting, traversing, etc. They should also be able use different instruments like Total Station, GPS, etc. along with CAD and Survey software.*

Description: *The Surveying Laboratory has a wide variety of basic and modern surveying equipment, such as GPS-based surveying equipment, total stations, Digital theodolites, and automatic levels for basic instructional and research purposes. Undergraduate students use above resources to obtain any topographic information that can help their capstone design projects, such as highway design and land development.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	To set out circular curve by linear methods.	01
2.	To set out circular curve by angular methods.	01
3.	Determination of horizontal and vertical distances, bearings and area using Total Station.	04
4.	Determination of co-ordinates of a traverse, length of traverse lines using GPS	05

5.	Post-processing of data obtained in Total Station & GPS practical using software like AutoCAD and print out the sheets.	05
6.	Analysis of survey projects conducted using computer by applying various software like MS excel.	05
7.	Setting out a simple foundation plan in the field.	03

Text/Reference Books

1. Surveying & Leveling, Vol-I &Vol-II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. 1972.
2. Surveying Vol-I &Vol-II. Punmia B.C. & Jain A.K. Laxmi Publication Pvt. 1996.
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. 1994.

Digital Material

1. https://nptel.ac.in/courses/105107122/1
2. http://vlabcivil-iitr.co.in

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - IV

(Departmental Core Subject)

CE-2011	L-T-P-C
Structural Analysis - I	4-1-0-5
Pre-requisite	Engineering Mechanics

Objective: *The objective of this course is to: analyze the statically determinate simple portal frame (both- rigid jointed and having an internal hinges); study the methods and evaluating rotation and displacement parameters in respect of beams and frames using various methods; analyze the three hinged arches; and cables, suspension bridges and three hinged stiffening girder; study the buckling behavior of the axially and transversely loaded beam-columns and its analyses; understand the concept and behavior of the beam and trusses under rolling loads and subsequently, to obtain the absolute maximum bending moment and understand the concept of unsymmetrical bending and shear center and its application in solving the problems of structural mechanics.*

Course Outcome: *On completion of this course, the students will be able to: understand the behavior of various statically determinate structures including compound structures having an internal hinge for various loadings; analyze these structures to find out the internal forces such as axial force, shear force, bending moment, twisting moments, etc.; evaluate the displacements / deflections in beams and frames under the action of loads. They will be able to obtain the response of the beams under the action of moving loads; analyze the structures such as arches and suspension bridges and study the behavior of*

eccentrically loaded columns; analyze the section with respect to unsymmetrical bending and shear center.

Course Content

Module 01: Axial force, shear force and bending moment

Concept of statically determinate structures; Axial force, shear force and bending moment diagrams for statically determinate frames with and without internal hinges.

General theorems and its application to simple structures

General theorems and principles related to elastic structures, types of strain energy in elastic structures, complementary energy, principle of virtual work, Betti's and Maxwell's reciprocal theorems, Castigliano's first theorem, principle of superposition. Application of Energy Approach to evaluate deflection in simple structures such as simple beams, portal frame, bent and arch type structures, etc.

Module 02: Deflection of Statically Determinate Structures Using Geometrical Methods

Deflection of cantilever, simply supported and overhanging beams for different types of loadings Using-Integration Approach including Double Integration method and Macaulay's Method, Geometrical Methods including Moment area method and Conjugate beam method.

Module 03: Deflection of Statically Determinate Structures Using Methods Based on Energy Principle

Application of Unit Load Method (Virtual Work Method/ Dummy Load Method) for finding out slope and deflection in beams. Application of Strain Energy Concept and Castigliano's Theorem for finding out deflection in such structures.

Application of Unit Load Method (Virtual Work Method) for finding out deflection of rigid jointed frames. Application of Strain Energy Concept and Castigliano's Theorem for finding out deflection in such frames.

Application of Unit Load Method (Virtual Work Method/ Dummy Load Method) for finding out deflection in pin jointed frames (trusses). Application of Strain Energy Concept and Castigliano's Theorem for finding out deflection in trusses.

Module 04: Rolling Load and Influence Lines for Statically Determinate Structures

Influence lines for cantilever, simply supported, overhanging beams and pin jointed truss including warren truss, criteria for maximum shear force and bending moment, absolute maximum shear force and bending moment under moving loads (UDL and Series of point loads) for simply supported girder.

Three Hinged Elastic Arches

Determination of normal thrust, radial shear and bending moment for parabolic and circular (semi and segmental) three hinged arches, Influence lines for normal thrust, radial shear and bending moment for three hinged parabolic arches.

Module 05: Cables, Suspension bridges and Three Hinged Stiffening Girder

Simple suspension cable, different geometries of cables, minimum and maximum tension in the cable supported at same/different levels, anchor cable, suspension cable with three hinged stiffening girder.

Module 06: Columns and Struts

Columns and struts subjected to eccentric loads, Secant formula, Perry's formula, struts with initial curvature.

Unsymmetrical bending

Product of inertia, principal moment of inertia, flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.

Shear Centre

Shear centre for thin walled sections such as channel, tee, angle section and I- section.

Text/Reference Books

1. Basic Structural Analysis. Reddy C.S. 2nd Ed. Tata McGraw Hill. 2006.
2. Structural Analysis. Hibbeler R.C. Sixth Ed. Pearson Education. 2009.
3. Structural Analysis. Negi L.S. & Jangid R.S. Tata McGraw Hill, New Delhi. 1997.
4. Mechanics of Structures: Vol-I. Junnarkar S. B. & Shah H.J. Charotar Publishers Anand.
5. Strength of Materials. Ramamrutham S. Dhanpatrai and Publishers Delhi.
6. Theory of Structures. Ramamrutham S. Dhanpatrai and Sons Delhi.

Digital Material

1. https://nptel.ac.in/downloads/105101085/

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Semester - IV

(Departmental Core Subject)

CE-2012	L-T-P-C
Building Design & Drawing	2-0-0-2
Pre-requisite	Engineering Drawing

Objective: *The objective of this course is to: remember and recall the intricate details of building design and drawing; gain an understanding of the basic concepts of building design and drawing; learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices; identify, analyse, research literate and solve complex building design and drawing problems; design new solutions for complex building design and drawing problems and effectively communicate ideas related to building design and drawing, both orally as well as in written format like reports & drawings.*

Course Outcome: *Students will be able to: list down the types of structures and its various components (for eg. doors, windows, staircase, foundations etc.); explain various concepts pertaining to building design and drawing (for eg, principles of planning, architectural planning, green buildings etc.); apply principles of planning, architectural planning and building bye laws while designing and preparing building drawings; calculate and analyze various technical details of a building (for eg. carpet area, FSI etc.) from its drawings; design various components of buildings (for eg. staircases etc.) as well as buildings, given the requirements of the building owner and local D.C. laws; Students will be able to prepare drawings (for eg. plans, elevation, perspective views etc.) of the designed components of buildings as well as buildings as a whole.*

Course Content

Module 01: Principles and Codes of Practices for Planning and Designing of Buildings (Residential and Public buildings)

Study of IS 962: 1989 – Code of Practice for Architectural and Building Drawings

Principles of planning for residential buildings

Classification of buildings:

Residential –Bungalows, Apartments/Flats etc.

Public – Education, Health, Offices/Commercial, Hotels, Hostels.

Study of building Bye-laws and documents / permissions required from commencement to completion of the building according to National Building Code (N.B.C.) of India and local Development Control (D.C.) rules

Study of sun path diagram, wind rose diagram and sun shading devices

Calculation of setback distances, carpet area, built-up area and floor space index (FSI)

Principles of planning for public buildings:

i) Building for education: schools, colleges, institutions, libraries, etc.

ii) Buildings for health: hospitals, primary health centres, etc.

iii) Office buildings: banks, post offices, commercial complexes, etc.

iv) Building for public residence: hostels, boarding houses, etc.

Module 02: Components and Services of a Building

Staircase (dog legged & open newel in details),

Foundations: stepped footing, isolated sloped footing and combined footing

Openings: doors and windows

Types of pitched roof and their suitability (plan and section)

Building services: Water supply, sanitary and electrical layouts

Module 03: Perspective Drawing

One-point perspective

Two-point perspective

Module 04: Town Planning, Architectural Planning & Built Environment

Objectives and principles (road systems, zoning, green belt etc.)

Master plan and slum rehabilitation

Architectural Planning: introduction and principles

Built Environment: introduction and principles

Module 05: Green Buildings

Introduction and overview

Certification methods (LEED and TERI)

Module 06: Computer Aided Drawing (CAD)

Advantages of CAD

Overview of the CAD software prevailing in the market (AutoCAD)

Text/Reference Books

1. Building Drawing with an Integrated Approach to Built Environment. Shah M.G. Kale C.M. & Patki S.Y. Tata McGraw-Hill Education.
2. Building Planning. Singh G. Standard Publishers & Distributors New Delhi.
3. Building Construction. Varghese P.C. PHI Learning Pvt. Ltd. 2008.
4. Building Construction. Punmia B.C. & Jain A.J. Laxmi Publications. 2005.
5. Building Drawing & Detailing. Balagopal T.S. Prabhu K. Paul V. & Vijayan C. Spades Publishers Calicut. 1987.

Digital Material

1. https://nptel.ac.in/courses/105102088/
2. https://nptel.ac.in/courses/112103019/41

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Semester - IV

(Departmental Core Subject)

CE-2013 L-T-P-C
Building Design and Drawing Laboratory 0-0-2-2
Pre-requisite Engineering Drawing

Laboratory Outcome: *Students must be able to remember and recall the intricate details of building design and drawing; gain an understanding of the basic concepts of building design and drawing.*

Description: *Students will be able to prepare drawings (for eg. plans, elevation, perspective views etc.) of the designed components of buildings as well as buildings as a whole.*

List of Experiments/Drawings

S. No.	Title of the Experiment	Module
1.	Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, site plan, schedule of opening and construction notes of a residential building (bungalow or apartment) to be constructed as a (G+1) R.C.C. framed structure	01
2.	Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, site plan, schedule of opening and construction notes of a public building (school or hostel or hospital or bank) be constructed as a (G+1) R.C.C. framed structure	01

3.	Roof plan, foundation plan (with section of a typical foundation), plan and section of staircase, one typical door and one typical window of either one of the two above drawings	02
4.	One point and two-point perspective	03
5.	CAD sheet of either one of the first two drawings	06

Text/Reference Books

1. Building Drawing with an Integrated Approach to Built Environment. Shah M.G. Kale C.M. & Patki S.Y. Tata McGraw-Hill Education.
2. Building Planning. Singh G. Standard Publishers & Distributors New Delhi.
3. Building Construction. Varghese P.C. PHI Learning Pvt. Ltd. 2008.
4. Building Construction. Punmia B.C. & Jain A.J. Laxmi Publications. 2005.
5. Building Drawing & Detailing. Balagopal T.S. Prabhu K. Paul V. & Vijayan C. Spades Publishers Calicut. 1987.

Digital Material

1. https://nptel.ac.in/courses/112103019/41

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - IV

(Departmental Core Subject)

CE-2014 L-T-P-C
Building Materials & Construction Technology 4-0-0-4

Objective: *The objective of this course is to: study the manufacturing process, properties, and use of different types of building materials like cement, lime, mortar, concrete, stone, brick, timber, including materials such as paints and varnishes used for treatment of the surfaces so as to achieve good knowledge about the building materials; enable the students to identify various components of building masonry, roof and floor, staircase etc., their functions and methods of construction so as to achieve good knowledge about building construction; study the properties such as workability, durability and porosity of fresh and hardened concrete; understand the concept and optimization of mix design for different environmental conditions.*

Course Outcome: *On completion of the course, the students will be able to: Identify and list the various building materials, their properties and symbols; identify the properties of ingredients of concrete, interpret and design concrete mix for various grades; explain and interpret manufacturing process of basic construction materials and understand various masonry construction and finishes and perform tests on various materials.*

Course Content

Module 01: Introduction

Classification of materials, building materials symbols and requirements of building materials and products: functional, aesthetical and economical

Module 02: Manufacturing Process and Properties of Basic Construction Materials

Rocks (Stone) quarrying, milling and surface finishing, preservative treatments. Aggregate-Properties of coarse and fine aggregates and their influence on properties of concrete, properties of crushed aggregates.

Structural clay products -bricks, roofing tiles, ceramic tiles, raw materials and manufacturing process.

Concrete blocks, flooring tiles, paver blocks- raw materials and manufacturing process.

Binder material: lime, cement: Manufacturing process and physical properties, plaster of Paris - properties and uses.

Mortar - Ingredients, preparation and uses.

Damp - proofing and water proofing materials

Module 03: Concrete

Grades of concrete, Manufacturing process, Properties of fresh and hardened concrete.

Durability: Factors affecting durability, Relation between durability and permeability, laboratory tests on durability such as Permeability test, Rapid chloride penetration test.

Admixtures: Plasticizers, Super-plasticizers, Retarders, Accelerators, Mineral admixtures and other admixtures, test on admixtures, chemistry and compatibility with concrete.

Module 04: Glass & Timber

Types and uses. Introduction to glass fibre reinforced plastic. Timber: Varieties, defects in timber, preservative treatments and wood composites.

Module 05: Concrete mix design

Types of mix, Mix design for compressive strength by I.S. method, Mix design for flexural strength, Method of determining compressive strength of accelerated - cured concrete test specimens as per IS:9013-2004 (revised code)

Ready mix concrete: Advantages of RMC, components of RMC plant, distribution and transport, handling and placing, mix design of RMC,Mass Concerting, Vaccum Concerting and Concreting Equipments

Module 06: Masonry Construction and Masonry Finishes: Classification and bonding of stone, brick and concrete blocks Masonry finishes -pointing, plastering and painting Formwork: Materials used, design considerations, shuttering, centering and staging, scaffolding. Types of form work: Slip form work, Cantilever and other modern form work. Floor and roof: Different types and its suitability. Type of roofs, wooden and steel trusses and roof covering Different types of cladding.

Text/Reference Books

1. Building Construction. Bindra S.P. & Arora S.P. Dhanpat Rai & Sons Delhi.
2. Engineering Materials. Rangwala S.R. Charotar Publications Anand.
3. Building Construction. Rangwala S.R. Charotar Publications Anand.
4. Concrete Technology: Theory and Practice: Shetty M.S. S. Chand New Delhi.
5. Concrete Technology. Gambhir M.L. Tata McGraw Hill New Delhi.
6. Concrete Technology: Neville A.M. & Brooks. J. J. ELBS-Longman.
7. Indian Standard of Concrete mix proportioning-guidelines (IS:10262-2009). BIS New Delhi.
8. Concrete Technology. Shanthakumar A.R. Oxford University Press.
9. Engineering Materials: Rangwala S.R. Charotar Publications Anand.
10. Specifications for different materials. BIS Publications New Delhi
11. Relevant I.S. codes. Bureau of Indian standard New Delhi.

Digital Material

1. https://nptel.ac.in/courses/105102088/
2. https://nptel.ac.in/downloads/105106053/

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - IV

(Departmental Core Subject)

CE-2015 L-T-P-C
Building Materials and Construction Technology Lab 0-0-1-1

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of geotechnics and soil mechanics with emphasis on soils laboratory testing, field testing and monitoring.*

List of Experiments (Any eight (08) to be performed)

S. No.	Title of the Experiment	Module
1.	Physical properties of cement: Fineness, consistency, setting time, Soundness, Compressive strength.	02
2.	Water absorption and compressive strength test of bricks.	02
3.	Water absorption and transverse load test on tiles.	02
4.	Compression test on timber (Parallel/ perpendicular to the grains).	04
5.	Effect of w/c ratio on workability, (slump cone, compaction factor, V-B test, flow table) and strength of concrete	03
6.	Effect of w/c ratio on strength of concrete,	03

7.	Study of admixtures and their effect on workability and strength of concrete	03
8.	Secant modulus of elasticity of concrete and indirect tensile test on concrete	03
9.	Nondestructive testing of concrete- some applications (hammer, ultrasonic)	03
10.	Mix design in laboratory.	05

Text/Reference Books

1. Building Construction. Bindra S.P. & Arora S.P. Dhanpat Rai & Sons Delhi.
2. Engineering Materials. Rangwala S.R. Charotar Publications Anand.
3. Building Construction. Rangwala S.R. Charotar Publications Anand.
4. Concrete Technology: Theory and Practice: Shetty M.S. S. Chand.
5. Concrete Technology. Gambhir M.L. Tata McGraw Hill New Delhi.
6. Concrete Technology: Neville A.M. & Brooks. J. J. ELBS-Longman New Delhi.
7. Indian Standard of Concrete mix proportioning-guidelines (IS:10262-2009). BIS New Delhi.
8. Concrete Technology. Shanthakumar A.R. Oxford University Press.
9. Engineering Materials: Rangwala S.R. Charotar Publications Anand.
10. Specifications for different materials. BIS Publications New Delhi.
11. Relevant I.S. codes. Bureau of Indian standard New Delhi.

Digital Material

1. http://civ02.vlabs.ac.in/exp10/index.html
2. http://www.vlab.co.in/broad-area-civil-engineering

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - IV

(Departmental Core Subject)

CE-2016 L-T-P-C
Fluid Mechanics - II 3-0-0-3

Objective: *The objective of this course is to understand and study: understand the Pipe flow problems, losses incurred during transmission of power through pipe and nozzle; hardy cross method and water hammer phenomenon; the pipe network which will help to design water supply schemes; laminar, turbulent flows and its significance; compressible flow and understand boundary layer theory.*

Course Outcome: *On completion of this course the student will be able to: Interpret different pipe fittings and evaluate the fluid velocity considering major and minor losses; Solve pipe network problems by Hardy cross method; Distinguish the types of compressible flow and understand concept of boundary layer theory; Evaluate pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe; Establish Prandtl's mixing theory and solve turbulent flow problems.*

Course Content

Module 01: Flow through pipes

Loss of head through pipes, Darcy-Weisbach equation, minor and major losses. Hydraulic gradient line and energy gradient line, pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flow through branched pipes, three reservoir problem, siphon.

Pipe network and water hammer: Hardy cross method, water hammer in Pipes-Gradual

closure and instantaneous closure of valve control measures.

Module 02: Flow through nozzles

Power transmitted through nozzle, condition for maximum power transmitted, diameter of nozzle for maximum transmission of power.

Module 03: Compressible flow

Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties

Module 04: Boundary layer theory

Development of boundary layer over flat surfaces. Boundary layer thickness, energy thickness and momentum thickness, Boundary layer separation and control. Introduction to flow around submerges body, drag and lift, terminal velocity of body.

Module 05: Laminar Flow

Reynolds experiment, critical velocity, laminar flow through circular pipes, flow between two parallel plates: stationary and moving. kinetic energy correction factor, and momentum correction factor. Dash pot mechanism.

Module 6: Turbulent Flow

Causes of turbulence, shear stress in turbulent flow, Prandtl's mixing length Theory, Hydro dynamically smooth and rough pipes, velocity distribution in smooth and rough pipes, Karman-Prandtl velocity distribution equation, Resistance to flow in smooth and rough pipes, resistance equation and Moody's diagram.

Text/Reference Books

1. Hydraulics & Fluid Mechanics. Modi P.N. & Seth S.M. Standard Book House. 1998.
2. Fluid Mechanics. Streeter V.L. & Wylie E.B. McGraw Hill USA.1997.
3. Fluid Mechanics. B.F. White. McGraw Hill USA.1994.
4. Fluid Mechanics: Bansal R.K. Laxmi Publications (P) Ltd New Delhi. 2010.

Digital Material

1. https://nptel.ac.in/courses/105101082/
2. https://nptel.ac.in/courses/105106114/

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - IV

(Departmental Core Subject)

CE-2017 L-T-P-C
Fluid Mechanics – II Lab 0-0-1-1

Laboratory Outcome: *The objective of this course is to understand and study: understand the Pipe flow problems, losses incurred during transmission of power through pipe and nozzle Students must be able to conduct laboratory experiments related to Reynold's experiments, pipe flow, etc. and collect, analyze, interpret and present the results.*

Description: *On completion of this course the student will be able to: Interpret different pipe fittings and evaluate the fluid velocity considering major and minor losses.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Reynold's Experiment	05
2.	Determination of viscosity of fluid	01
3.	Friction loss through pipes	01
4.	Minor losses through pipes	01
5.	Laminar flow through pipes	01
6.	Velocity distribution in circular pipes	01
7.	Turbulent flow through pipe	06

8.	Water Hammer phenomenon	01

Text/Reference Books

1. Hydraulics & Fluid Mechanics. Modi P.N. & Seth S.M. Standard Book House. 1998.
2. Fluid Mechanics. Streeter V.L. & Wylie E.B. McGraw Hill USA. 1997.
3. Fluid Mechanics. B.F. White. McGraw Hill USA.1994.
4. Fluid Mechanics. Bansal R.K. Laxmi Publications (P) Ltd. New Delhi. 2010.

Digital Material

1. https://eerc03-iiith.vlabs.ac.in/
2. http://fm-nitk.vlabs.ac.in/
3. http://www.vlab.co.in/broad-area-civil-engineering

Detailed Syllabus for B. Tech. Degree Programme

EP-1999/EP-2999/EP-3999/EP-4999 L-T-P-C
Endeavour Project (Beyond the Syllabus) 0-0-0-3

Our University is continuously looking at innovative ways to deliver knowledge to our students, making learning & delivery mechanism innovative, interesting & easy with truly 'out of the box' teaching-learning process. This beyond the syllabus initiative uses all working second Saturdays as class days.

Endeavour is a compulsory interdisciplinary project for all students of the University. Respective Heads of the Department shall select students & form groups. Each project shall be supervised by a faculty member.

The faculty of SPSU will select a contemporary topic, which is preferably industry relevant & associate a company or professional who can provide application-oriented perspective. The topic chosen may be from wide range of subjects. For example: - Biodiversity, Social subjects, Media & advertisement, Environment, Scientific, Technical, Management, Architecture, Tourism or any other subject or their combination.

The project is evaluated in two phases: Internal Evaluation & External Evaluation. This ensures descriptive assessment of the projects performance & challenges faced during the implementation of the project. The project will be spread over two semesters beginning from the odd semester (July to November) & ending in the even semester (December to May) every year. The grade obtained in this course may be used to improve the student's semester grade point average.

The final report should include the reasons for the choice of the title, the concept, the structure, the results with working models/drawings etc. & its practicality. The role & responsibility of every individual of the group should be indicated clearly. The report should be written in the prescribed format/guidelines, certified by the faculty member & presented as a seminar.

The project is evaluated as per the approved procedure & marks obtained are computed in the even semester.

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3001	L-T-P-C
Structural Analysis-II	4-0-0-4
Pre-requisite	Structural Analysis-I

Objective: *This course will impart the fundamental concepts of the structures studied in the course Structural Analysis-I and analyze the statically determinate structures with reference to the variation in the temperature. Understand the concept of static and kinematic indeterminacy (degrees of freedom) of the structures such as beams & rigid pin jointed frames, methods involved in the analysis of indeterminate structures and apply various methods for analyzing the indeterminate structures to evaluate the response of such structures in the form of bending moment, shear force, axial force etc.*

Course Outcome: *Students must be able to understand the behavior of various statically indeterminate structures subjected to static loads and variation in temperature. Analyze the structures using displacement parameters to find out the internal forces such as axial force, shear force, bending moment, twisting moments, etc. for beams, 2D portal frames with various loads and boundary conditions. Contrast between the concept of force and displacement methods of analysis of indeterminate structures. Also, the elastic curve in beams and frames under the action of loads. Understand the concept of plastic hinge, plastic moment carrying capacity, shape factor and collapse load for single and multiple span beams.*

Course Content

Module 01: General

Types of structures occurring in practice, their classification. Stable and unstable structures, static and kinematic determinacy and indeterminacy of structure. Symmetric structures, symmetrical & anti-symmetrical loads, distinction between linear and non-linear behaviors of material and geometric non- linearity. Two hinged arches: Introduction, classification and structural behavior (no numerical).

Module 02: Deflection of statically determinate structures

Introduction to the concept of complimentary energy, absolute & relative deflection caused by loads, temperature changes settlement of supports, application to beams, pin jointed frames, rigid jointed frames.

Module 03: Analysis of indeterminate structures by Force Method

Application of the Clapeyron's Theorem of Three Moments. Flexibility coefficients and their use in formulation of compatibility equations. Application to propped cantilevers, fixed beams, continuous beam and rigid jointed frames. Application of flexibility method to simple pin jointed frames including effect of lack of fit for members.

Module 04: Analysis of indeterminate structures by Displacement Methods

Direct stiffness method: Stiffness coefficients for prismatic members, their use for formulation of equilibrium equations. Application to indeterminate beams rigid jointed frames with inclined member but having only one translation degree of freedom. Slope deflection method: Development of slope deflection equation, their use for formulation of equilibrium equations. Application to indeterminate beams & simple rigid jointed frames with inclined member but having only one translation degree of freedom including the effect of settlement of supports. Moment distribution method: Stiffness factor, distribution factor, Application to indeterminate beams & simple rigid jointed frames, having only one translation degree of freedom including the effect of settlement of supports. Kani's Method: Fundamental equation of Kani's Method, application to simple beams and frames with single storey having two bays.

Module 05: Plastic analysis of Steel structures

Introduction to plastic analysis, Concept of plastic hinge, plastic moment carrying capacity, shape factor. Determination of collapse load for single and multiple span beams.

Module 06: Approximate Method for Analysis of Building Frames

Approximate method for gravity loads: Substitute frame method and equivalent frames. Approximate method for lateral loads: Portal and cantilever method.

Text/Reference Books

1. Structural Analysis. Hibbler. Pentice Hall International USA. 2008.
2. Structural Analysis. Chajes. ElBS London. 1990.
3. Theory of Structures. Timoshenko & Young. Tata McGraw Hill New Delhi.
4. Element of Structural Analysis. Norries & Wilbur. McGraw Hill.
5. Structural Analysis. Laursen H.I. McGraw Hill Publishing Co.
6. Structural theorem and their application. Neal B.G. Pergaman Press.
7. Structural Analysis. Kassimali. TWS Publications.
8. Fundamentals of Structural analysis. Leet K.M. Uang C.M. & Gilbert A.M. Tata McGraw Hill New Delhi.
9. Elementary theory of Structures. Heish. Prentice Hall.

Digital Material

1. Concept in Civil Engineering NPTEL. (https://nptel.ac.in/downloads/105105109/)

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3002	L-T-P-C
Structural Analysis– II Lab	0-0-1-1
Pre-requisite	Structural Analysis-I

Term Work

The term work shall comprise of neatly written report based on tutorials and assignments. The term work shall cover the entire syllabus in such a way that the students would attempt at least four problems on each sub-modules and contents thereof. At least twenty solved problem have to be validated by using available computer software. Or at least ten solved problem (validated by using available computer software) and Analysis of (G+2) portal frame with minimum three bays.

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3003	L-T-P-C
Geotechnical Engineering-I	3-0-1-4

Objective: *The course is designed to study the types of soil and relationships involving the weight, volume, index properties and classify the soil based on different classification systems, study the concept of total stress, neutral stress & effective stress in soil, deformation concept through compaction process, soil exploration, assessing the subsoil conditions.*

Course Outcome: *Students must be able to Understand the soil types, index and engineering properties, relationship between various parameters. Classify the soil with a view towards assessing the suitability of a given soil for use; either to use if to support a structure (e.g. embankment) or to construct a structure therein (e.g. foundation), understand the use of geosynthetics in soil to improve soil properties.*

Course Content

Module 01: Introduction to Geotechnical Engineering, Basic Definitions & Relationships

Definitions: Rocks, Soil, origin & mode of formation and type of soil obtained, soil mechanics, rock mechanics, soil engineering, geotechnical engineering. Scope of soil engineering: Importance of field exploration and characterization. Cohesionless & cohesive soils. Soil as three-phase & two-phase system in terms of weight, volume, void ratio, porosity. Weight-volume relationship: water content, void ratio, porosity, degree of

saturation, air voids, air content, different unit weights, specific gravity of solids, and mass, absolute specific gravity. Relationship between: different unit weights with void ratio, degree of saturation, specific gravity; different unit weights with porosity, void ratio, water content; different unit weights with water content, unit weights air voids. Mention different methods to find water content, specific gravity, unit weight of soil (Detailed description to be covered during practical)

Module 02: Plasticity Characteristics of soils

Plasticity of soil: Definition of plasticity of soil, reason of plasticity, consistency of soil, explanation about idea set by Atterberg in defining the three states of soil, definition & determination of liquid limit, plastic limit, shrinkage limit. Definitions of shrinkage parameters; plasticity index, shrinkage index, liquidity index, consistency index, flow index, toughness index, activity, sensitivity and thixotropy of soils. Use of consistency limits. Explanation about clay minerals e.g. montmorillonite, alite, and kaolinite; their formation and role in producing the plastic behavior in soil.

Module 03: Classification of soils

Necessity of soil classification, Indian standard particle size classification, Indian standard soil classification system as per IS: 1498, boundary classification. Mechanical sieve analysis: wet & dry sieve analysis, combined sieve & sedimentation analysis, Stokes's law, hydrometer method of analysis, relation between percent finer and hydrometer reading. Limitation of sedimentation analysis, particle size distribution curve/gradation curve and its use. Relative density

Module 04: Permeability of soils & seepage analysis

Introduction about ground water flow: water table, types of aquifers, types of soil water, explanation of surface tension with capillary rise in small diameter tubes, capillary rise in soils. Definition of hydraulic head, hydraulic gradient, Darcy's law, laminar flow through soil, validity of Darcy's law. Definition of permeability of soil, numerical values for different types of soils, determination of coefficient of permeability of soil in lab using constant head and variable head methods. Determination of in-situ permeability with pumping out and pumping in test. Permeability from indirect methods e.g. empirical equation & from consolidation data. Permeability of stratified soil deposits. Definition of seepage and its importance for the study of analysis & design of hydraulic structures. Derivation of

Laplace equation for two- dimensional flow, its analytical solution representation by stream & potential function; Graphical representation by flow net, definition of flow line, equipotential lines, flow channel, field, characteristics of flow net, use of flow net. Solution of Laplace equation by other methods e. g. numerical methods

Module 05: Effective stress principle

Definition of geostatic stresses, vertical stress/total stress, neutral stress/pore water pressure, effective stress. Effect of water table fluctuations, surcharge, capillary action, seepage pressure on effective stress; quick sand condition.

Module 06: Compaction of soils & soil exploration

Theory of compaction, determination of Optimum Moisture Content (OMC) & Maximum Dry Density (MDD) in laboratory by conducting the light and heavy compaction test. Factors affecting the compaction, effect of compaction on properties of soil, relative compaction. Necessity of soil exploration, methods of investigation, methods of boring, types of soil samples, soil samples sampling, number and spacing of bore holes, depth of bore holes. Penetrometers tests: SPT, SCPT, and DCPT. Representation of data with borehole logs.

Text/Reference Books

1. Soil Engineering in Theory and Practice; Alam Singh, CBS Publishers Distributors New Delhi.
2. Soil Mechanics and Foundation Engineering: V. N. S. Murthy; Saitech Publications.
3. Soil Mechanics and Foundation Engineering: K. R. Arora; Standard Publishers and Distributors New Delhi.

Digital Material

1. Concept in Civil Engineering NPTEL. (https://nptel.ac.in/courses/105106142/)

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3004 L-T-P-C
Geotechnical Engineering– I Lab 0-0-1-1

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of geotechnics and soil mechanics with emphasis on soils laboratory testing, field testing and monitoring.*

List of Experiments (At least 8 to be performed)

S. No.	Title of the Experiment	Module
1.	Determination of natural moisture content using oven drying method.	01
2.	Specific gravity of soil grains by density bottle method or pycnometer method.	01
3.	Field density using core cutter method.	06
4.	Field density using sand replacement method	06
5.	Field identification of fine grained soils	01
6.	Grain size distribution by sieve analysis	03

7.	Grain size distribution by hydrometer analysis	03
8.	Determination of liquid & plastic limit	02
9.	Determination of shrinkage limit	02
10.	Liquid limit by cone penetrometer method	02
11.	Permeability using constant head method	04
12.	Permeability using falling head method	04
13.	Compaction test, IS light compaction test/ Standard Proctor test	06
14.	Compaction test, IS heavy compaction test/ Modified Proctor test	06
15.	Relative density test	06

Text/Reference Books

1. Soil Mechanics and Foundation Engineering. Arora K. R. Standard Publishers and Distributors, New Delhi.
2. Geotechnical Engineering. Ramaiah C.V. New Age International.
3. Relevant Indian Standard Specifications Codes. BIS Publications New Delhi.

Digital Material

1. Soil Mechanics Lab. Virtual Labs. (http://smfe-iiith.vlabs.ac.in/Introduction.html)
2. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3005 L-T-P-C
Applied Hydraulics 3-0-0-3
Pre-requisite Fluid Mechanics-I

Objective: *The course is designed to introduce the concept of dynamics of fluid flow and dimensional analysis, study hydraulic machines like centrifugal pumps, reciprocating pumps and turbines. Also to impart the dynamic behavior of the fluid flow analyzed by the Newton's second law of motion, understand the uniform and non-uniform flow through open channels and to study design of open channel and understand concept of surface profile with hydraulic jump.*

Course Outcome: *Students must be able to apply the concepts of fluid dynamics to solve pipe bend and sprinkler problems, analyze dimensional problems and explain model laws. Explain the working and functions of Francis, Kaplan and Pelton wheel turbines and basic concepts of open channel hydraulics and measure discharge through open channels.*

Course Content

Module 01: Dynamics of Fluid Flow

Momentum principle (applications: pipe bends), moment of momentum equation (applications: sprinkler).

Module 02: Dimensional Analysis

Dimensional homogeneity, Buckingham's π theorem, Reyleigh's method, dimensionless numbers and their significance, Model (or similarity) laws, application of model laws: Reynold's model law, Froude's model law, scale effect in models.

Module 03: Impact of Jets

Introduction, force exerted on stationary flat plate: held normal to jet, held inclined to jet, hinged plates, curved plate: Stationary and Moving, symmetrical and unsymmetrical (Jet striking at Centre and jet striking tangentially at one end).

Module 04: Hydraulic Turbines

General layout of hydro-electric plant, heads, efficiencies of turbine, classification, working of Pelton Wheel Turbine, Reaction Turbine, Francis Turbine, Kaplan Turbine and draft tube theory, specific speed, unit quantities, Characteristic curves, Cavitation.

Module 05: Centrifugal pumps

Work done, heads, efficiencies, Minimum speed: series parallel operation, Multistage pumps, specific speed, model testing, priming, characteristic curves, cavitations. Brief introduction to reciprocating pump.

Module 06: Flow through open channels

Uniform Flow: Flow through open channel: Definition, types of channels, Types of flows in channels, Prismatic, non-prismatic channels, Uniform flow: steady flow and unsteady flow, laminar and turbulent flow, subcritical flow, supercritical flow, Chezy's formula, Manning's formula, hydraulically efficient channel cross-section (most economical section). Non-Uniform Flow: Specific energy and specific energy curve, Specific force, Hydraulic jump and standing wave. Gradually varied flow, equation for gradually varied flow, back water curve and afflux, Introduction to surface profiles.

Text/Reference Books

1. Hydraulics and Fluid mechanics: Modi P.N. & Seth S.M. Standard Book House Delhi.
2. Theory and Application of Fluid Mechanics. Subramanya K. Tata McGraw hill publishing company New Delhi.
3. Fluid Mechanics. Jain A.K. Khanna Publishers.
4. Fluid Mechanics and Hydraulics. Ukarande S.K. Ane's Books Pvt. Ltd. 2012.
5. Fluid Mechanics and Fluid Pressure Engineering. Kumar D.S. Kataria and Sons.
6. Fluid Mechanics. Bansal R.K. Laxmi Publications (P) Ltd.

7. Flow in Open Channels. Subramanya K. Tata Mc-Graw Hill Publishing House Pvt. Ltd.
8. Irrigation and Water Power Engineering. Punmia B. C. Standard Publishers New Delhi.

Digital Material

1. Concept of Civil Engineering NPTEL. (https://nptel.ac.in/courses/105107059/)

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3006 L-T-P-C
Applied Hydraulics Lab 0-0-1-1
Pre-requisite Fluid Mechanics-I

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of fluid dynamics with emphasis on fluid testing and monitoring.*

List of Experiments (Any Six)

S. No.	Title of the Experiment	Module
1	Impact of jet on flat plate/inclined plate/curved plate.	03
2	Performance of Pelton wheel- full gate opening.	04
3	Performance of Centrifugal pumps.	05
4	Performance of Kaplan turbine.	04
5	Performance of Francis turbine.	04
6	Determination of Chezy's roughness factor.	06
7	Study of gradually varied flow	06
8	Study of hydraulic jump and its characteristics	06

9	Calibration of Venturi-flume/Standing wave flume	06

Text/Reference Books

1. Soil Mechanics and Foundation Engineering. Arora K. R. Standard Publishers and Distributors, New Delhi.
2. Geotechnical Engineering. Ramaiah C.V. New Age International.
3. Relevant Indian Standard Specifications Codes. BIS Publications. New Delhi.

Digital Material

1. Fluid Mechanics Virtual Lab. (http://fm-nitk.vlabs.ac.in/)

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - V

(Departmental Core Subject)

CE-3007 L-T-P-C
Environmental Engineering-I 3-0-0-3
Pre-requisite Environmental Studies

Objective: *The course is designed to prepare students who can accomplish planning, design and construction of water systems and related infrastructural facilities, provide the necessary knowledge on quality of water, concepts in the field of water supply and treatment, impart necessary skill for the design and operation of water treatment plants and to introduce new developments in the field of water treatment and to inculcate the students with sound theoretical knowledge in engineering sciences as well as in research consultancy skills.*

Course Outcome: *Students must be able to understand the water supply system, its components and water demand by various consumers, analyze the quality of water and will be able to conduct the quality control test on samples, different processes in the water treatment facility, Design the different units of treatment for water treatment plants, storage and rain water harvesting, problems of air and noise pollution and solutions to environmental problems in our society.*

Course Content

Module 01: Water Supply and Distribution of Water

Water resources, Water supply systems, distribution systems of water, types of intake structure, water demand.

Module 02: Quality of Water

Wholesomeness and palatability, physical, chemical, Biological standards, Treatment of water, drinking water standards, environmental chemistry, Eutrophication, Primary, Secondary and Tertiary treatment of water. Typical water treatment flow diagram.

Module 03: Aeration Sedimentation Coagulation flocculation and Filtration

Aeration, Types of Aeration systems, Theory and factors affecting efficiency of sedimentation, design of sedimentation tank and tube settler Coagulation and flocculation: Mechanisms, common coagulations, rapid mixing and flocculating devices, Jar test, coagulant aids – PAC. Filtration: Classification, slow and rapid sand filters, dual media filters, under drainage system, mode of action, cleaning, limitations, operational difficulties, performance, basic design consideration, head loss in filters and numerical on head loss, pressure filters: construction and operation. Water Softening: Lime soda and base exchange methods, Principle reactions, design considerations, sludge disposal. Disinfection: Chlorination, chemistry of chlorination, kinetics of disinfection, chlorine demand, free and combined chlorine, break point chlorination, super chlorination, de-chlorination, chlorine residual, uses of iodine, ozone, ultra violet rays and chlorine dioxide as disinfectants, well water disinfection. Advanced and Miscellaneous Treatments: Reverse Osmosis, Activated carbon, Membrane filtration, Removal of Iron and Manganese, taste, odour and colour, principles and methods, de-fluoridation.

Module 04: Building Water supply

Introduction – Per Capita Supply, Determination of storage capacity, Service connection from main, water meter. Sanitary Fixtures and fittings: Introduction, classification of fixtures, soil fixtures, bathroom accessories, special accessories, fittings.

Module 05: Rainwater Harvesting

Need for rainwater harvesting, Annual potential, Collection of rain water for direct use or ground water recharge, Roof-top rain water harvesting.

Module 06: Air Pollution & Noise

Air-Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution-automobile pollution, Air quality standards, Control measures for Air pollution, construction and limitations. Noise: Basic concept, measurement and various control methods. Thermal pollution.

Text/Reference Books

1. Water Supply and Sanitary Engineering. S.K. Hussain, Oxford & IBH Publication New Delhi.
2. 2. Manual on Water Supply and Treatment. Ministry of Urban Development New Delhi.
3. Plumbing Engineering Theory and Practice. Patil S.M. Seema Publication Mumbai.
4. Water Supply and Sewage. Steel E.W. McGraw Hill New York.
5. Water Supply and Sewage: McGhee T.J. McGraw Hill New York.
6. CPHEEO Manual on Water Supply and Treatment.
7. Water Supply Engineering. Modi P.N. Rajsons Publication.
8. Water Supply Engineering. Garg S. K. Khanna Publication.
9. Environmental Engineering (Vol. II) Sewage Disposal and Air Pollution Engineering. Garg S. K. Khanna Publication.
10. Introduction to Environmental Engineering. Vesilind, PWS Publishing company.
11. Water supply and pollution control. Clark J.W. Veisman W. & Hammer M.J. International textbook company.
12. Relevant Indian standard specifications.
13. Environmental Pollution. Gilbert Masters.
14. Basic Environmental Engineering. Nathanson J.A. Prentice Hall of India.
15. Environmental Engineering. Sincero & Sincero.
16. Air pollution. Rao M.N. Tata Mc Graw Hill. New Delhi.

Digital Material

1. Concept of Civil Engineering NPTEL. https://nptel.ac.in/courses/105106119/

Detailed Syllabus for B. Tech. Degree Programme
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Semester - V

(Departmental Core Subject)

CE-3008 L-T-P-C
Environmental Engineering-I Lab 0-0-1-1
Pre-requisite Environmental Studies

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of environmental engineering with emphasis on water and wastewater laboratory testing.*

List of Experiments (Any eight to be performed)

S. No.	Title of the Experiment	Module
1.	Determination of pH of water.	02
2.	Determination of Alkalinity of water	02
3.	Determination of Hardness of water.	02
4.	Determination of Turbidity of water.	02
5.	Determination of Optimum dose of coagulant by using Jar Test Apparatus	03
6.	Determination of Dissolved Oxygen of Water	03
7.	Determination of Residual chlorine in water	02
8.	Determination of chlorides in water	03

9.	Most Probable Number	02
10.	High Volume Sampler.	06
11.	Determination of Level Equivalent of Noise	04

Text/Reference Books

1. Soil Mechanics and Foundation Engineering. Arora K. R. Standard Publishers.
2. Manual on Water Supply and Treatment. Ministry of Urban Development New Delhi.
3. CPHEEO Manual on Water Supply and Treatment.
4. Water supply and pollution control Clark J.W. Veisman W. Hammer M.J. International textbook company.

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Semester - V

(Departmental Core Subject)

CE-3009 L-T-P-C
Transportation Engineering – I 3-0-0-3

Objective: *The objective of this course is to give insight of the development in the field of highway engineering, right from inception up to construction and maintenance and to familiarize the students with different surveys required to be carried out for the implementation of the highway project, enable the students to understand the phase of engineering which deals with the planning and geometrics design of streets, highways, abutting land and with traffic operations thereon w.r.t. safe, convenient and economic transportation of people and goods, understand the properties of the different materials, principle of soil stabilization along with its significance, classification and behaviour of different types of pavements.*

Course Outcome: *Having completed this course the students get an insight of the development in all the fields of highway engineering and familiarized with different surveys required to be carried out for the implementation of the highway project; to understand the phase of engineering which deals with the planning and geometrics design of streets, highways and abutting land in the context of safe and convenient traffic operations thereon, know the required properties of the different materials to be used in the construction of highways and other allied structures, understand characterization of the materials and to evaluate their suitability; understand the principle of soil stabilization, utilization of geosynthetics in the construction of highway and allied structure,*

classification of different types of pavements, factors to be considered in the design of pavements, approaches for designing the different types of pavements

Course Content

Module 01: Highway Planning and Development/ Highway Alignment and Surveys

Classification of roads based on the different criteria; brief history of road developments in India; present status of roads development programme in India, including different programmes being executed by various agencies. Highway alignment, basic requirement of ideal alignment, factors governing highway alignment. Different types of surveys for Highway location survey, map study, reconnaissance, topographic surveys, highway alignment in hilly area, drawing report preparation.

Module 02: Geometric Design of Highway

Terrain classification, vehicular characteristics, highway cross section elements, salient dimensions, clearances, width of carriage way, shoulders, medians, width of road way, right of way, camber along with its profile (IRC Standards). Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance. Horizontal curves: design of super elevation, its provisions, minimum radius of horizontal curves, widening of pavement, transition curves. Gradients: Different types of gradients (maximum, minimum, ruling, exceptional) grade compensation in curves, vertical curves: design factors, comfort sight distance, summit curve, valley curve.

Module 03: Traffic Engineering

Different Traffic Studies: Speed Studies (Spot Speed, Speed and Delay Studies), Traffic Volume, Parking Studies, Significance/ applications of these studies; different methods of conducting traffic studies, Methods of the presentation of data. Introduction to relationship between Speed, density and volume; Capacity: Different types and factors affecting the capacity, concept of Passenger Car Units (PCU) and Level of Service (LoS). Introduction to different types of Traffic Control Devices: Traffic signs, signals (no design), road marking. Different types of intersections: At grade and grade separated; grade separated interchanges; rotary intersections.

Module 04: Highway Materials

Subgrade materials: desirable properties, modulus of elasticity, modulus of subgrade reaction, classification of subgrade soils, different strengths, various tests to be conducted to evaluate the suitability of the soil as the highway material. Sub-base material: desirable properties, different tests to be conducted on aggregate, requirement of aggregate for different types of pavements. Bituminous materials: types of bituminous material, test on bituminous material, desirable properties, grade of bitumen. Soil Stabilization: Significance; principle of soil stabilization; different methods of soil stabilization, use of Geosynthetics in highways and allied structures.

Module 05: Highway Pavement Design

Types of pavements: Flexible, Rigid, Semi-Rigid and composite; comparison between them vis-à-vis based on the structural behavior and other parameters; Factors affecting design of pavements including traffic factors (Design wheel load, equivalent single wheel load, equivalent wheel load factor/VDF). Flexible pavement: Various approaches of designing the pavement and methods falling under each category (theoretical, semi-theoretical or semi-empirical, empirical, mechanistic empirical and methods based on road performance); Overview of the method prescribed by IRC along with the modifications incorporated therein time to time (IRC: 37- 1970, 1984, 2001 and 2012); Design of the pavement using IRC: 37- 2001 and IRC: 37- 2012 with a more emphasis on latest IRC Code); Introduction to the design of low volume flexible pavement (IRC: SP 72- 2007/2015 and IRC: 77-2008). Rigid Pavements: Introduction to the different types of rigid pavements (plain jointed, plain jointed reinforce, continuous reinforced, fiber reinforced, roller compacted concrete); Analysis of the stresses to be developed in the pavement (wheel load, warping and frictional); critical combination of the loading; Overview of the various approaches (Analytical, Empirical and Mechanistic empirical) of designing the pavements and methods falling under the respective category; overview of the methods prescribed by IRC along with modifications incorporated therein time to time (IRC: 58-1974, 58-1988; 58-2002 and 58-2015); Design of plain jointed rigid pavements (IRC: 58- 2002 and IRC: 58- IRC: 58- 2015 with more emphasis on IRC: 58-2015) including design of joints; Introduction to the design of low volume rigid pavement using (IRC: SP- 62-2004 and IRC: SP- 62-2014)

Module 06: Highway Construction/ Drainage/ Rehabilitation and maintenance

Construction of different types of roads: Introduction to the water bound macadam (WBM), wet mix macadam (WMM), bituminous pavements, plain jointed cement concrete pavements and along with various joints (as per IRC/ MORTH specifications), jointed reinforced, continuously reinforced; fiber reinforced, roller compacted concrete pavements. Pavement failure: Classification of distresses in pavements (functional and structural); different types of distresses in flexible and rigid pavements along with the causes and remedial measures; various types of maintenance pavements; evaluation of pavements: functional and non-destructive evaluation of pavement, various equipment used in evaluation of pavements along with their principles (Profilometer, bump integrator, Benkelman beam, lacroixdeflectograph, falling weight deflectometer) and utility in the evaluation. Strengthening of existing pavement: Objective of strengthening, different types of overlay, design of flexible overlays on flexible pavement using effective thickness approach, and deflection approach resorting to Benkelman Beam method (IRC: 81-1981) and Mechanistic Empirical approach using deflection (IRC: 81-1997); Introduction to the design of other types of overlays. Highway drainage: Necessity/ Significance, mode of ingress of water in highway structure, Different methods of drainage- surface and subsurface drainage inkling for the roads in hilly areas.

Text/Reference Books

1. Highway Engineering. Khanna S.K. Justo C.E.G. & Veeraraghavan A. Nem Chand and Bros. Roorkee.
2. Principles and Practice of Highway Engineering. Kadiyali L.R. Khanna Publishers Delhi.
3. A Textbook of Highway and Traffic Engineering. Saxena & Chandra S. CBS Publishers and Distributors. 2014.
4. Textbook of Highway Engineering. Sriniwasakumar R. University Press Hyderabad Reprinted. 2013.
5. Transportation Engineering (Vol.-I) Highway Engineering. Venkatramaiah C. University Press Hyderabad. 2016.
6. Principles of Transportation and Highway Engineering. Rao G.V. Tata McGraw Hill Publishing House Pvt. Ltd. New Delhi.
7. Principles, Practice and Design of Highway Engineering (Including Airport Engineering). Sharma S.K. S. Chand and Company Pvt. Ltd. New Delhi.
8. Principles of Transportation Engineering. Chakraborty Partha & Das A. Prentice Hall India Learning Pvt. Ltd. New Delhi. 2013.

Digital Material

1. Concept of Civil Engineering NPTEL. (https://nptel.ac.in/courses/105101087/)

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Semester - V

(Departmental Core Subject)

CE-3010 L-T-P-C
Transportation Engineering-I Lab 0-0-1-1

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of pavement engineering with emphasis on aggregate, bitumen, soils laboratory testing and monitoring.*

List of Experiments (Any eight to be performed)

S. No.	Title of the Experiment	Module
1.	Impact test on aggregates	04
2.	Abrasion test on aggregates	04
3.	Crushing test on aggregates	04
4.	Shape test on aggregates	04
5.	Soundness test	04
6.	Polished stone value test	04
7.	Stripping value or bitumen adhesion test (water sensitivity)	04
8.	Penetration test on bitumen	04
9.	Ductility test on bitumen	04

10.	Softening point test on bitumen	04
11.	Viscosity test on bitumen	04
12.	Flash point and fire point test on bitumen	04
13.	Marshall stability test on the bituminous mix	04
14.	CBR test on subgrade soil material (Laboratory or Field)	04
15.	Plate bearing test on subgrade soil	04

Text/Reference Books

1. Highway Engineering. Khanna, S.K., Justo, C.E.G. & Veeraraghavan A. Nem Chand and Bros. Roorkee.
2. Principles, Practice and Design of Highway Engineering (Including Airport Engineering). Sharma S.K. S. Chand and Company Pvt. Ltd. New Delhi.
3. Principles of Transportation Engineering. Chakraborty. Partha. & Das A. Prentice Hall India Learning Pvt. Ltd. New Delhi. 2013.

Digital Material

1. https://nptel.ac.in/courses/105101087/

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Semester – V

(Ability Enhancement Course)

HU-3001 L-T-P-C
Business Communication & Ethics 1-1-0-2

Objectives: *To enhance persuasive and professional language in speech and writing and to develop interpersonal skill competencies.*

Course Outcomes: *The student will be able to apply effective communication skills in a variety of public & interpersonal settings; and demonstrate interpersonal communication, business etiquette and relationship building skills.*

Course Content

Module 01: Report Writing

Objectives of report writing, Language and Style in a report, Types of reports, Formats of reports: Memo, letter, project and survey based.

Module 02: Technical Proposals

Objective of technical proposals, Parts of proposal.

Module 03: Introduction to Interpersonal Skills

Emotional Intelligence, Leadership, Team Building, Assertiveness, Conflict Resolution, Negotiation Skills, Motivation, Time Management.

Module 04: Meetings and Documentation

Strategies for conducting effective meetings, Notice, Agenda, Minutes of the meeting.

Module 05: Introduction to Corporate Ethics and etiquette

Business Meeting etiquette, Interview etiquette, Professional and work etiquette, Social skills, Greetings and Art of Conversation, Dressing and Grooming, Dinning etiquette,

Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response the process of making ethical decisions).

Module 06: Employment Skills

Cover letter, Resume, Group Discussion, Presentation Skills, Interview Skills.

List of Assignments

S. No.	Title of the Assignment	Module
1.	Report Writing (Synopsis or the first draft of the Report)	01
2.	Technical Proposal (Group activity, document of the proposal)	02
3.	Interpersonal Skills (Group activity and Role play)	03
4.	Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)	04
5.	Corporate ethics and etiquette (Case study, Role Play)	05
6.	Cover Letter and Resume	06

Text/ Reference Books

1. Organizational Behavior. Luthans F. Mc Graw Hill. 2012.
2. Report Writing for Business. Lesiker R and Petit J. Mc Graw Hill. 1997.
3. Technical Writing and Professional Communication. Huckin T and Olsen L. McGraw Hill. 2013.
4. Personal Development for Life and Work. Wallace H and Masters A. Cengage. 2012.
5. Effective Business Communication. Murphy HA. Mc Graw Hill. 1997.
6. Business Correspondence and Report Writing. Sharma R and Mohan K. Mc Graw Hill. 2010.
7. Managing Soft Skills for Personality Development. Ghosh BN. Tata McGraw Hill. Lehman. 2004.
8. BCOM. Dufrene D, Sinha M. Cengage Learning, 2nd Edition. 2016.
9. Management Communication. Bell A. Smith D. Wiley India Edition. 3rd Edition. 2009.
10. Soft Skills: Know Yourself and Know The World. Alex K. S Chand and Company. 2009.
11. Professional Ethics. Subramaniam R. Oxford University Press. 2013.

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Semester - VI

(Departmental Core Subject)

CE-3011 L-T-P-C
Geotechnical Engineering – II 3-0-0-3
Pre-requisite Geotechnical Engineering – I

Objective: *This course is design to understand the importance of earth pressure theory in design & analysis of retaining walls, sheet piles & bulk heads. The course will also be useful in understanding the concepts of bearing capacity, pile foundation & analysis of the pile & pile group under various soil conditions.*

Course Outcome: *Students will be able to evaluate the consolidation parameters for the soil. Students will be able to calculate the shear strength parameters for the soil. Students will be able to calculate the factors of safety of different types of slopes under various soil conditions, analyze the stability of slopes, calculate lateral earth pressures and analyse the stability of retaining walls. Lastly Students will be able to calculate bearing capacity of shallow foundations using theoretical and field methods, calculate load bearing capacity of individual as well as group of pile foundations and their settlement using theoretical and field method*

Course Content

Module 01: Consolidation of soils

Compressibility & settlement, comparison between compaction & consolidation, concept of excess pore water pressure, initial, primary secondary consolidation, spring analogy for primary consolidation, consolidation test results, coefficient of compressibility, coefficient of volume change, compression, expansion recompression indices, normally

over consolidated soils. Terzhaghi's theory of consolidation- assumptions, coefficient of vertical consolidation, distribution of hydrostatic excess pore water pressure with depth & time, time factor, relationship between time factor degree of consolidation, determination of coefficient of vertical consolidation, pre- consolidation pressure. Final settlements of a soil deposit in the field, time settlement curve, field consolidation curve.

Module 02: Shear strength

Three dimensional state of stress in soil mass, principal stresses in soil, shear failure in soils- frictional cohesive strength, general shear stress-strain curves in soil definition of failure, graphical method of determination of stresses on a plane inclined to the principal planes through Mohr's circle, important characteristics of Mohr's circle. Mohr-Coulomb theory- shear strength parameters; Mohr-Coulomb failure criterion- relation between major minor principle stresses, total & effective stress analysis. Different types of shear tests drainage conditions; Direct shear test, Triaxial compression test (UU, CU CD), Unconfined compression test, Vane shear test; comparison between direct & triaxial tests, interpretation of test results of direct shear & triaxial shear tests stress-strain curves Mohr failure envelopes. Determination of shear strength of soil with geosynthetics- pull out test: ASTM procedure for finding shear strength of soil-geosynthetic system.

Module 03: Stability of Slopes

Introduction: Types of slopes, types of slope failures, factors of safety. Stability analysis of infinite slopes in i) cohesionless soil and ii) cohesive soil under a) dry condition, b) submerged condition and c) steady seepage along the slope. Stability analysis of finite slopes: i) Culmann's method, ii) Swedish slip circle method, iii) friction circle method and iv) Taylor's stability number.

Module 04: Lateral Earth Pressure Theories and Stability of Retaining Walls

Introduction to Lateral Earth Pressure Theories: Concept of lateral earth pressure based on vertical and horizontal stresses, different types of lateral earth pressure. Rankine's earth pressure theory: i) assumptions, ii) active and passive states in cohesionless soil: effect of submergence, effect of uniform surcharge, effect of inclined surcharge iii) active and passive states in cohesive soil. Coulomb's wedge theory: i) assumptions, ii) active and passive states in cohesionless soil, iii) active and passive states in cohesive soil. Rehbann's Graphical Method (no proof). Culmann's Graphical Method (no proof).

Introduction to retaining walls: types of retaining walls, stability checks for retaining walls. Stability analysis of gravity retaining walls. Stability analysis of cantilever retaining walls

Module 05: Shallow Foundations

Introduction: types of shallow foundations, definitions of different bearing capacities. Theoretical methods of determining bearing capacity of shallow foundations: i) Terzaghi's theory: assumptions, zones of failure, modes of failure, ultimate bearing capacity equations for general and local shear failure, factors influencing bearing capacity: shape of footing and water table, limitations of Terzaghi's theory, ii) Vesic's theory: bearing capacity equation iii) I.S. Code Method: bearing capacity equation. Field methods of determining bearing capacity of shallow foundations: i) standard penetration test and ii) plate load test

Module 06: Pile Foundations

Introduction to pile foundations: types of pile foundations, necessity of pile foundations. Theoretical methods of determining load carrying capacity of pile foundations: i) static formulae and ii) dynamic formulae. Field method of determining load capacity of pile foundations: pile load test. Group action of piles, settlement of pile groups, negative skin friction.

Text/Reference Books:

1. Soil Mechanics and Foundations. Punmia B.C. Jain A.K. & Jain A.K. Laxmi Publications.
2. Soil Mechanics and Foundation Engineering. Arora K.R. Standard Publishers and Distributors.
3. Soil Mechanics and Foundation Engineering. Murthy V.N.S. Saitech Publications.
4. Geotechnical Engineering. Venkatramaiah C. New Age International.
5. Soil Engineering in Theory and Practice. Singh A. CBS Publishers Distributors.
6. Designing with Geosynthetics. Koerner R.M. Prentice Hall New Jersey.
7. An Introduction to Soil Reinforcement Geosynthetics. Babu G.L.S. Universities Press.
8. Theoretical Soil Mechanics. Terzaghi K. John Wiley and Sons.

Digital Material

1. Advanced Geotechnical Engineering, Prof. Dr. B.V.S. Viswanadham IIT Bombay NPTEL. (https://nptel.ac.in/courses/105101001/)

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Semester - VI

(Departmental Core Subject)

CE-3012 L-T-P-C
Geotechnical Engineering – II Lab 0-0-1-1
Pre-requisite Geotechnical Engineering – I

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of Geotechnical engineering.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Determination of pre-consolidated pressure coefficient of consolidation from one dimensional consolidation test.	01
2.	Determination of shear parameters from unconsolidated undrained tri-axial compression test	02
3.	Determination of shear parameters from direct shear test.	02
4.	Determination of CBR value from CBR test	02
5.	Determination of shear strength of soft clays from vane shear test	02

Text/Reference Books

1. Soil Mechanics and Foundations. Punmia B.C. Jain A.K. & Jain A.K. Laxmi Publications.
2. Soil Mechanics and Foundation Engineering. Arora K.R. Standard Publishers and Distributors.
3. Soil Mechanics and Foundation Engineering. Murthy V.N.S. Saitech Publications.

Digital Material

1. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)

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Semester - VI

(Departmental Core Subject)

CE-3013	L-T-P-C
Design and Drawing of Steel Structures	4-0-0-4
Pre-requisite	Strength of Materials

Objective: *To learn IS 800-2007 code of practice for the design of compression, tension & flexural members using various cross-sections; to study the behaviour & design of compression & tension members using simple & built-up sections.*

Course Outcome: *On completion of this course, the students will be able to: Explain the Limit State Design philosophy as applied to steel structures, Predict the behaviour and design members subjected to axial compression, tension and their connection, Predict the behaviour and design members subjected to bending, shear and their connection Calculate loading for a truss and design the complete truss, Demonstrate ability to follow IS codes, design tables and aids in analysis and design steel structure,. Analyze and design the commercial steel structures and prepare drawing with complete detailing.*

Course Content

Module 01: Introduction

Types of steel structures, Properties of Structural Steel, Indian Standard Specifications and Sections, Design Requirements & Design Process, Advantages and limitations of WSM, Introduction to Limit State Design, partial safety factors for load and resistance, design load combinations, section classification such as plastic, compact, semi-compact and slender.

Module 02: Design of tension members

Introduction, types of tension members, net area calculation. Design strength due to yielding, rupture and block shear. Design of tension members with welded and bolted end connection using single angle section & double angle section.

Module 03: Design of compression members and column bases

Introduction, types of compression members, classification of cross sections, types of buckling, effective length of column and slenderness ratio, buckling curves, design of compression members as struts using single angle sections & double angle section. Design of axially loaded column using rolled steel sections, design of built up column, laced and battened columns. Design of slab bases & gusseted base.

Module 04: Design of beams and welded plate girder

Design strength in bending, effective length, Lateral torsion buckling behavior of unrestrained beams, design of single rolled section with or without flange plates, design strength of laterally supported beams, low and high shear, design strength of laterally unsupported beams, web buckling, web crippling, shear lag effect and deflection. Design of angle section purlin. Design of welded plate girder: proportioning of web and flanges, flange plate curtailment, stiffeners and connections

Module 05: Design of connections

Design of bolted and welded beam to beam and beam to column connections. Framed, stiffened and unstiffened seat, bracket connections.

Module 06: Design of truss

Design of determinate truss. Calculation of dead load, live load and wind load acting on truss. Load combinations and calculation of internal forces. Design and detailing of members. Support detailing.

Text/Reference Books

1. Design of Steel Structure. Subramanian N. Oxford University Press New Delhi.
2. Limit state design of steel structures Duggal S.K. McGraw Hill Education (India) Pvt. Limited New Delhi.
3. Design of steel structure by Limit State Method as per IS: 800- 2007. Bhavikatti S. S. International Publishing House New Delhi.
4. Design of Steel Structures. Sai Ram K.S. Pearson Education New Delhi.

Digital Material

1. Design of Steel Structure, Prof. Damodar Maity, IIT Guwahati NPTEL. (https://nptel.ac.in/courses/105105162/)

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Semester - VI

(Departmental Core Subject)

CE-3014 L-T-P-C
Design and Drawing of Steel Structures Lab. 0-0-1-1
Pre-requisite Strength of Materials

Term Work

The Term work shall consist of following:

1. Design Report including detail drawings on any of the two projects as listed below:
   a) Design of truss (internal forces to be calculated by analytical method/graphical method/using any software)
   b) Flooring system including beam, column, column base and connections.
   c) Welded plate girder.

The drawing should be drawn in pencil only on minimum of A-1(imperial) size drawing sheets.

2. Neatly drawn minimum 15 sketches showing structural detailing based on entire syllabus (in sketchbook).
3. Neatly written assignments covering the syllabus. (At least four problems on each modules and contents thereof)
4. One site visit report (The report should contain structural details with sketches).viz. Industrial structure, Railway Structures, Workshops etc.

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Semester - VI

(Departmental Core Subject)

CE-3015	L-T-P-C
Transportation Engineering-II	3-0-0-3
Pre-requisite	Transportation Engineering-I

Objective: *This course is aimed at understanding the traffic characteristics, design of intersections & other Traffic facilities. The course will also be useful for planning & components of airport, railways and harbours.*

Course Outcome: *On successful completion of this course, the students shall be able to: Understand the various systems of railway, airport, water transportation and the components of p-way and its construction, yards, modernization of railway track, Apply the concept of geometric design of railway track and railway traffic control. Understand airport planning, obstructions and orientation of runway, Apply the concept of geometric design of runway, taxiway, etc. and the knowledge of various signalling system for air traffic control, Understand the system of water transportation, types of breakwater, harbours and port facilities equipment Understand the basic idea about the bridge engineering.*

Course Content

Module 01: Railway Engineering

Railways for urban transportation-Engineering surveys for track alignment-Obligatory Points-Conventional and modern methods (e.g. Remote sensing, GIS) Permanent way-track components their functions, sleeper – functions types, sleeper density, ballast functions different ballast materials. Rails: coning of wheels, tilting of rails, rail cross

sections, wear, creep of rails, rail fastenings. Yards: details of different types of railway yards their functions. Construction and maintenance of railway track, methods of construction, material requirements, maintenance of tracks, traffic operations. Modernization of track and railway station for high speed trains, Mono rails and Metro rails. Permanent way-track components their functions, sleeper – functions types, sleeper density, ballast functions, different ballast materials.

Module 02: Geometric Design of Railway and Traffic Control

Geometrics: gradients, transition curves, widening of gauge on curves, Cant deficiency Points crossing: design of turnouts, description of track junctions, different types of track junctions. Signaling interlocking: classification of signals, interlocking of signals points, control of train movement.

Module 03: Airport Engineering

Aircraft component, their functions, aircraft characteristics and their influence on airport planning. Airport planning: topographical geographical features, existing airport invicinity, air traffic characteristics, development of new airports, factors affecting airport site selection. Airport obstruction: zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones. Airport layout: runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, geometric design, airport capacity, runway configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers parking. Airport marking and lighting marking, lighting of runways, taxiway, approach other areas. Terminal area & airport layout: terminal area, planning of terminal buildings, apron: size of gate position, number of gate position, aircraft parking system, hanger, general planning considerations, blast considerations. Air Traffic Control: Air traffic control aids, en-route aids, landing aids. Airport drainage: requirement of airport drainage, design data, surface drainage design. Airport airside capacity delay: runway capacity delays, practical hourly capacity, practical annual capacity, computation of runway system, runway gate capacity, taxiway capacity, Air traffic forecasting in aviation: forecasting methods, forecasting requirement applications.

Module 04: Water Transportation

Introduction of water transportation system, harbours docks, port facilities.

Module 05: Bridge Engineering

Bridge Engineering: Importance, Investigations, Site Selection, Different terms related with Bridges; Waterway, Afflux, Economic span, Scour depth, Different types of bridges: Superstructures and sub-structures, Different loadings for design of bridges, Design requirements for high speed trains.

Text/Reference Books

1. A Course of Railway Engineering. Saxena S. C. & Arora S. P. Dhanpat Rai Sons New Delhi.
2. Airport Planning Design. Khanna S.K. Arora M.G. & Jain J.J. Nemchand Bros. Roorkee.
3. Docks and Harbour Engineering. Bindra S. P. Dhanpat Rai and Sons New Delhi.
4. Principles and Practice of Bridge Engineering. Bindra S.P. Dhanpat Rai and Sons New Delhi.
5. Harbour, Dock and Tunnel Engineering: Shrinivas R. Charotar Publishing House Anand.
6. A Textbook on Highway Engineering Airports. Sehgal S.E. & Bhanot K. L. S. Chand and Co. Ltd. New Delhi
7. Airport Engineering. Rao G. V. Tata Mc-Graw Hill India Publishing House New Delhi.
8. Indian Railway Track. Agarwal M. M. Suchdeva Press New Delhi.
9. Planning Design of Airport. Horonjeff M. Tata Mc-Graw Hill India Publishing House New Delhi.
10. Design and Construction of Ports and Marine Structures. Quinn A. D. Tata Mc-Graw Hill India Publishing House.
11. Bridge Engineering. Victor D. J. Tata Mc-Graw Hill Publishing House Pvt. Ltd. New Delhi.
12. Bridge Engineering. Bindra S. P. Dhanpatrai and Sons New Delhi.

Digital Material

1. Transportation Engineering-II, Prof. Rajat Rastogi IIT Roorkee. NPTEL (https://nptel.ac.in/courses/105107123/)

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Semester - VI

(Departmental Core Subject)

CE-3016	L-T-P-C
Transportation Engineering-II Lab	0-0-1-1
Pre-requisite	Transportation Engineering-I

Term Work

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-module content thereof further. There shall be theory questions as well.

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Semester - VI

(Departmental Core Subject)

CE-3017 L-T-P-C
Environmental Engineering – II 3-0-0-3
Pre-requisite Environmental Engineering – I

Objective: *The objective of this course is to understand and explain the role of sanitation in the urban water cycle and its relation to public health and environment. The course is designed to understand the relevant physical, chemical and biological processes and their mutual relationships within various sanitation components. It aims to develop rational approaches towards sustainable wastewater management via pollution prevention.*

Course Outcome: *Having completed this course the students shall ensure the safe handling and treatment of wastewater and sewage. The students shall be able to conduct quality control tests on samples obtained from sewer water, soil, nearby rivers and groundwater. Further, the students shall be able to design the treatment facilities and assess the guidelines for disposing of waste. Lastly, they shall be able to formulate approaches to treat waste water in most effective manner.*

Course Content

Module 01: Introduction

Need for sewerage system, Domestic sewage, Industrial waste and Storm Water-Quantification and design. Definitions: sewage, sullage, sewerage, Conservancy and water carriage system Systems of sewerage and their layout: Separate, Combined and partially combined system, Merits and demerits ,Patterns of sewerage layout, Quantity of sewage, dry weather flow.

Module 02: Conveyance of sewage

Sewer: Shapes and materials of sewers, open drains, Design of sewers: SEWER SIZE, Determination of velocity of flow using empirical formulae, limiting velocities. Laying and testing of sewers Sewer joints, Sewer appurtenances, Ventilation of sewers. Construction and Maintenance of sewers. Pumping of sewage: Types, selection of pumps, Pumping station

Module 03: Primary Treatment of sewage

Need for Analysis, Characteristics of sewage: Composition, Biochemical characteristics, aerobic decomposition, anaerobic decomposition, Sampling of sewage, Analysis of sewage. Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Screens, Grit chamber, Primary and secondary clarifier. Design of primary treatment units.

Module 04: Secondary treatment methods

Principles, Trickling filter, Activated sludge process, recirculation, hydraulic design of trickling filter and activated sludge process, Sludge volume index, Operational problems in trickling filter and activated sludge process, Aerated lagoons, Rotating Biological contractors, Stabilization Ponds, UASB . Design of secondary treatment units. Sludge treatment and disposal: Sludge Digestion: Principles of anaerobic digestion, quantity and characterization of sludge, design of sludge digestion tanks, disposal of digested sludge, drying beds. Sewage disposal: Discharge of Raw and treated sewage on land and water, standards for disposal. Self-purification of natural water bodies: Oxygen economy, Numerical on BOD, Sewage farming. Disposal of treated effluent.

Module 05: Reclamation and Reuse of Waste water

Tertiary treatment for removal of residual organics, removal of nutrients, recycling and reuse of wastewater.

Module 06: House drainage and Environmental sanitation

Plumbing**:** Basic principles, Plumbing regulations, preliminary data for design, Preparation and submission of plans, Plumbing fixtures , materials used for plumbing system, systems of plumbing, antisiphonic and vent pipes. Low cost sanitation**:** Septic tanks, Inhoff tanks- Principles, Operation and suitability, Design.

Module 07: Environmental Pollution

Air-Composition and properties of air, Quantification of air pollutants,Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations, Noise-Basic concept, measurement and various control methods. Thermal pollution.

Text/Reference Books

1. Environmental Engineering (Vol. II). Garg S.K. Khanna Publishers New Delhi.
2. Water supply and Sanitary Engineering Hussain S. K. Oxford and IBH Publication New Delhi.
3. Plumbing Engineering, Theory and Practice: Patil, S. M. Seema Publications, Mumbai.
4. Environmental Engineering. Punmia B. C. Laxmi Publications New Delhi.
5. Air pollution. Rao M. N. Tata Mc-Graw Hill Publishers New Delhi.
6. Environmental Engineering. Peavy H. S. Rowe D. R. & Tchobanoglous G. Tata-Mcgraw Hill. 1991.
7. Wastewater Engineering Treatment, Disposal, Refuse. Metcalf & Eddy Tata McGraw Hill Publishers New Delhi. 1995.
8. Water Supply and Sewerage. Steel E.W.
9. Introduction to Environmental Engineering. Aarne P.V. PWS Publishing Company. 2000.
10. Introduction to Environmental Engineering. Aarne P.V.& Morgan S.M. Thompson /Brooks/Cole Second Edition. 2008.
11. Manual on Wastewater Treatment. CPH and Env. Engg. Organization (3rd Ed.) Ministry of Urban Development Govt. of India New Delhi. 1991.
12. CPHEEO Manual on Sewage and Treatment.
13. Relevant Indian Standard Specifications.

Digital Material

1. Wastewater Engineering. Prof. M.M. Ghangrekar. NPTEL (https://nptel.ac.in/courses/105105048/).

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Semester - VI

(Departmental Core Subject)

CE-3018 L-T-P-C
Environmental Engineering – II Lab. 0-0-1-1
Pre-requisite Environmental Engineering – I

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of Environmental engineering with emphasis on water and wastewater laboratory testing.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Determination of chlorides	01
2.	Determination of pH of sewage	01
3.	Determination of Total Solids, suspended solids, dissolved solids, volatile solids	02
4.	Determination of Dissolved oxygen	03
5.	Determination of Bio chemical Oxygen Demand of sewage sample	03
6.	Determination of Chemical Oxygen Demand of sewage sample	03

7.	To find Sludge Volume Index (SVI) of sewage sample.	03
8.	Plumbing demonstration of accessories, fittings and fixtures.	05

Text/Reference Books

1. Environmental Engineering (Vol. II). Garg S.K. Khanna Publishers New Delhi.
2. Water supply and Sanitary Engineering Hussain S. K. Oxford and IBH Publication New Delhi.
3. Plumbing Engineering, Theory and Practice: Patil S. M. Seema Publications Mumbai.
4. Environmental Engineering. Punmia B. C. Laxmi Publications New Delhi.

Digital Material

1. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)

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Civil Engineering

Semester - VI

(Departmental Core Subject)

CE-3019	L-T-P-C
Water Resources Engineering-I	3-0-0-3
Pre-requisite	Fluid Mechanics

Objective: *This course will help the students to understand the necessity & importance of irrigation, factors affecting frequency & efficiency of irrigation, Also to understand the hydrological parameters, its impact on the design of hydraulic structures, modelling of hydrological phenomenon's & creates the background for the study of the design of hydraulic structures.*

Course Outcome: *On completion of this course the student will be able to: Classify various types of irrigation projects Explain different irrigation methods and effective use of water resources, Calculate the crop water requirements and irrigation requirement, Derive hydrographs and calculate runoff of a catchment area, Explain the steady state and unsteady state conditions of any aquifer and design water wells, Estimate the capacity of a reservoir for different purposes.*

Course Content

Module 01: Introduction

Definition of irrigation, water resources in India, development of irrigation in India, need of irrigation in India, Benefits of irrigation, ill effects of irrigation, irrigation systems: major, medium and minor irrigation projects, command area development, impact of irrigation on environment, national water policy.

Module 02: Irrigation methods and management

Types of irrigation: surface irrigation, subsurface irrigation; lift irrigation, bandhara irrigation, percolation tanks. Techniques of water distribution: free flooding, border flooding, check flooding, basin flooding, furrow irrigation method, micro irrigation, sprinkler irrigation, drip irrigation. Irrigation scheduling, participatory irrigation management. Introduction, types of tension members, net area calculation. Design strength due to yielding, rupture and block shear. Design of tension members with welded and bolted end connection using single angle section & double angle section.

Module 03: Water requirement of crops

Crops and crop seasons in India, cropping pattern, duty and delta, quality of irrigation water, soil water relationship, soil characteristics significance from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation, water requirement and capacity of canal and reservoir, assessment of irrigation water, water conservation, rain water harvesting.

Module 04: Hydrology

Hydrologic cycle, Precipitation: Types of precipitations, measurement of rainfall by rain gauges, stream flow measurement, runoff, factors affecting runoff, computation of runoff, yield of the catchment runoff hydrograph, runoff computations, flood discharge and calculations, unit hydrograph, application of unit hydrograph, methods of deriving unit hydrograph, S-hydrograph, complex hydrograph.

Module 05: Ground water and well hydraulics

Ground water resources, occurrence of ground water, well irrigation. Well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifer, aquifer tests, design of water wells.

Module 06: Investigation and reservoir planning

Selection of site for reservoir, zones of storage reservoir, capacity elevation and area elevation curve of reservoir site, control levels, fixation of control levels, reservoir sedimentation, methods of control of sedimentation, evaporation loss, estimation and controlling methods of evaporation.

Text/Reference Books

1. Irrigation and Waterpower Engineering. Punmia B.C. Pande B.B. & A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi.
2. Irrigation Water Resources and Waterpower Engineering. Modi P.N. Standard Book House Delhi. ISBN 978-81-87401-29-0.
3. Irrigation Engineering and Hydraulic Structures. Ukarande S.K. Ane Books Pvt. Ltd.
4. Irrigation Engineering and Hydraulics Structures. Garg S.K. Khanna Publishers Delhi.
5. Design of Irrigation Structures. Sharma S.K. S. Chand and Co.
6. Theory and Design of Irrigation Structures. Varshney R.S. & Gupta R.C. Nem Chand.
7. Engineering for Dams Vol. I to III. Justin C. & Hinds. John Wiley.
8. Design of Small Dams. USBR.
9. Hydro Power Structures. Varshney R.S. Nem Chand and Bros.
10. Concrete Dam. Varshney R.S. Oxford and IBH Publishing Co.

Digital Material

1. Water Resource Engineering, Prof. Rajesh Srivastava IIT Kanpur and Dr. Pranab K Mohapatra IIT Kanpur. NPTEL (https://nptel.ac.in/courses/105104103/)

Detailed Syllabus for B. Tech. Degree Programme
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Semester - VI

(Departmental Core Subject)

CE-3020	L-T-P-C
Water Resources Engineering-I Lab	0-0-1-1
Pre-requisite	Fluid Mechanics

Term Work

The term work shall comprise of the neatly written assignment/tutorials based on above modules. The assignment shall be covering the entire syllabus in such way that the student would attempt at-least three questions including numerical if any, on each module.

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Semester - VI

(Departmental Core Subject)

CE-3021 L-T-P-C
Software Applications in Civil Engineering 0-0-1-1

Objective: *This course will help the students will able to: learn all kinds of software packages available in various fields of civil engineering.*

Course Outcome: *The students will be able to: Use the software in various disciplines of Civil Engineering, apply the software in to provide solutions to field problems.*

Course Content

Module 01: General

Importance and need of software for modelling, analysis and design in Civil Engineering field, Advantages and limitations of software, causes for errors, validation of software results. Failures due to errors in modelling, data entry and interpretation of software results.

Module 02: Software application in various disciplines of Civil Engineering

Drafting and drawing: AutoCAD.

Building Information Modelling

Numerical Analysis and Mathematical operations

Structural Analysis and Design: STAAD Pro.

Finite Element Analysis

Project Management

Geotechnical Engineering

Quantity Surveying

Environmental Engineering

Remote Sensing and Geographical Information System

Transportation Engineering

Hydraulics and Water Resources

MS Excel: Conduct concrete mix design for M40 grade concrete. or any exercise of Civil Engineering domain.

Text/Reference Books

1. Software manuals.
2. Refereed Journal papers on Software applications.
3. MATLAB programming for numerical computation. Kaisare N. IIT Madras.

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Semester - VII

(Departmental Core Subject)

CE-4001 L-T-P-C
Quantity Survey Estimation and Valuation 4-0-0-4

Objective: *The course is designed to read, understand and interpret plans, sections, detailed drawings and specifications for a construction project. Moreover it also aims to cover the various methods of detailed and approximate estimates. This course will impart the fundamental concepts of the relevant IS: 1200- 1964 codes and relevant Indian Standard specifications, taking out quantities from the given requirements of the work, and drafting specifications. The course covers the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.*

Course Outcome: *Students must be able to Read, understand and interpret plans, sections, detailed drawings and specifications for a construction project. Student will learn to Prepare approximate and detailed estimates based on the quantity survey of the available general and detailed drawings. Also, the student will have knowledge about the current market rates for labor and material required for construction, perform rate analysis and compare with DSR.*

Course Content

Module 01: Estimates

Various types, their relative importance, factors to be considered, 14 complete set of Estimate. Approximate estimates: importance, purpose, different methods. Use of CBRI

Equations for the same. Methods of preparation of estimates for projects such as: Building R.C.C., Load bearing, Road, Cross drainage work, Factory shed including steel truss.

Module 02: Material survey

Approximate estimates of requirement of various materials for building works, percentage breakup of the cost, cost sensitive index, market survey of basic materials.

Module 03: Specifications

Types, requirements and importance, detailing of specifications for various items.

Module 04: Rate analysis

Purpose, importance and necessity of the same, factors affecting, task work.

Module 05: Tender

Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and items, penalty and liquidated charges, Settlement of disputes, R.A. Bill and Final Bill, Payment of advance, insurance, claims, price variation, etc.

Module 06: Valuation

Different terms used the role of a valuer, purpose and necessity of the same. Capitalized Value, Years purchase, sinking fund, depreciation, types of values, Purpose of valuation. Different methods of valuation for open plots, open plots with existing residential and commercial structures lease hold properties.

Text/Reference Books

1. Estimating, Costing Specifications and Valuation. Chakraborty M. Kolkata.
2. Building and Engineering Contracts. Patil B.S. University Press Hyderabad.
3. Estimating and Costing. Datta B. N. UBS Publications.
4. Relevant Indian Standard Specifications. BIS Publications.

Digital Material

1. Construction Planning and Management Unit 7-8. Prof. A.K.Singh. NPTEL (https://nptel.ac.in/syllabus/105103093/)

Detailed Syllabus for B. Tech. Degree Programme

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Civil Engineering

Semester - VII

(Departmental Core Subject)

CE-4002 L-T-P-C
Quantity Survey Estimation and Valuation Lab 0-0-1-1

Term Work

The term work shall consist of the following:

1. An approximate estimate of a multistoried building by approximate method.
2. Detailed estimate of any four of the following with the required material survey for the same.
    a) a single storeyed building (RCC)
    b) a bridge with minimum 2spans
    c) a factory building
    d) a road work
    e) a cross drainage work
    f) a load bearing structure
3. Valuation report in a standard format of the Government/ Private company/Firm.
4. Assignments on rate analysis, market survey, specifications and simple estimates.
5. Detailed estimate of a minor structure.
6. Bar bending schedule.

The use of quantity survey software and the use of worksheets / databases while solving some of the afore-mentioned assignments is desirable.

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Semester - VII

(Departmental Core Subject)

CE-4003	L-T-P-C
Theory of Reinforced Concrete Structure	4-0-0-4
Pre-requisite	Strength of Materials

Objective: *This course will impart the fundamental concepts of the design of reinforced concrete structure using ULM and LSM. The course covers the various clauses of IS: 456-2000 and its significance in the RCC design. The course is designed to understand the importance of ULM in the analysis and design of beams. Moreover it also aims to cover the concepts of LSM in the analysis and design of beams, slabs, columns and footings.*

Course Outcome: *Students must be able to understand the various clauses specified in IS: 456-2000 for designing structural members with the safety and economy. They must understand the application and effectiveness of the LSM to the considerable extent along with the application of ULM in the limited extent.*

Course Content

Module 01: Ultimate Load Method

Brief introduction to fundamentals of ultimate strength theory: curved stress distribution, compressive stress block, simplified rectangular stress block as per Whitney's approach, ultimate moment of resistance of singly reinforced section and doubly reinforced sections.

Module 02: Limit State Method

Introduction to limit state method of design as per IS 456 (latest edition): concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to various limit states.

Module 03: Limit State of Collapse – Flexure

Limit state of collapse in flexure, shear and Limit state of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of beam subjected to bending and torsion.

Module 04: Design of Slabs

Design of one way and two-way slabs

Module 05: Limit State of Collapse – Compression

Limit state of collapse compression for short and slender column. Members subjected to combined axial and uni-axial as well as biaxial bending. Development of interactive curves and their use in column design.

Module 06: Design of Foundations:

Isolated square and rectangular footings subjected to axial load and moments. Design of combined rectangular pad footings, slab beam type footing and strap footing.

Text/Reference Books

1. Design of Reinforced Concrete Structures. Dayaratnam P. Oxford and IBH.
2. Limit State Design – Reinforced Concrete. Jain A. K. Nemchand and Bros. Roorkee.
3. Limit State Design – Reinforced Concrete. Shah & Karve. Structure Publications Pune.
4. Ultimate Strength Design for Structural Concrete. Arthur P.D. & Ramakrishnan V. Wheeler and Co. Pvt. Ltd.
5. Limit State Theory of Reinforced Concrete Design. Huges B. & Pitman P.
6. Reinforced Concrete. Warner R. F. Rangan B. C.& Hall A. S. Pitman.
7. Reinforced Concrete. Shah H.J. Charotar Publishers Anand.
8. Fundamentals of Reinforced Concrete. Sinha & Roy S. Chand and Co. Ltd.
9. Illustrated Reinforced Concrete Design. Shah V.L. & Karve S.R. Structure Publications Pune.
10. Reinforced Concrete Design. Wang, C. K. Salmon, C. G. & Pincheira J.A.
11. 7th Edition John Wiley. 2007.
12. Reinforced Concrete Fundamentals. Ferguson, P. M. Breen J. E., and Jirsa, J. O. 5th Edition John Wiley and Sons. 1988.
13. RCC Design (WSM and LSM). Punmia B.C. Jain A. K. & Jain A.K. Laxmi Publications.

14. Limit State Design of Reinforced Concrete (as per IS: 456-2000). Punmia B.C. Jain A.K. and Jain A. K. Laxmi Publications.
15. Design and RCC structural Elements (RCC Vol-I). Bhavikatti S.S. New Age International Publications.

Digital Material

1. Design of Reinforced Concrete Structures. Prof. N. Dhang. NPTEL (https://nptel.ac.in/courses/105105105/)
2. Design of RC Structures. Weekly Assignments NPTEL (https://nptel.ac.in/downloads/105105105/)

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Semester - VII

(Departmental Core Subject)

CE-4004	L-T-P-C
Theory of Reinforced Concrete Structure Lab	0-0-1-1
Pre-requisite	Strength of Materials

Term Work

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/ or questions on each modules/ sub-modules or contents thereof, further.

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Semester - VII

(Departmental Core Subject)

CE-4005 L-T-P-C
Water Resources Engineering-II 3-0-0-3
Pre-requisite Water Resources Engineering-I

Objective: *This course will help the students to design methods of erodible and non-erodible canals, know the principles of design of hydraulic structures on permeable foundations, know the concepts for analysis and design principles of storage and diversion head works and to learn design principles of canal structures.*

Course Outcome: *On completion of this course the student will be able to: plan an irrigation system, design irrigation canal structures, plan and design diversion head works, analyze stability of gravity and earth dams, design ogee spillways and energy dissipation works.*

Course Content

Module 01: Canals

Classification, design of non-erodible canals – methods of economic section and maximum permissible velocity, economics of canal lining, design of erodible canals - Kennedy's silt theory and Lacey's regime theory, balancing depth of cutting. Canal Falls: Types and location

Module 02: Diversion Head Works

Types of diversion head works, weirs and barrages, layout of diversion head works, components. causes and failures of weirs on permeable foundations, Bligh's creep theory, Khosla's theory, design of impervious floors for subsurface flow, exit gradient.

Module 03: Gravity Dams and Reservoir Planning

Investigations, site selection, zones of storage, yield and storage capacity of reservoir, reservoir sedimentation. Dams: Types of dams, selection of type of dam, selection of site for a dam. Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a dam, stability analysis, drainage galleries, grouting.

Module 04: Earthen Dams and Spillways

Earth Dams: Types, causes of failure, criteria for safe design, seepage, measures for control of seepage-filters, stability analysis-stability of downstream slope during steady seepage and upstream slope during sudden drawdown conditions. Spillways: Types, design principles of Ogee spillways, types of spillways crest gates. Energy dissipation below spillways-stilling basin and its appurtenances.

Text/Reference Books

1. Irrigation Engineering and Hydraulic Structures. Garg S.K. Khanna publishers.
2. Irrigation and Waterpower Engineering. Punmia. Lal Laxmi publication Pvt. Ltd. New Delhi.
3. Irrigation and Water Resources Engineering. Asawan G.L. New Age International Publishers.
4. Theory and Design of Hydraulic structures. Varshney. Gupta & Gupta.
5. Irrigation engineering. Arora K.R.
6. Irrigation engineering. Sharma R.K. & Sharma T.K. S. Chand Publishers.
7. Engineering Hydrology. Ojha C.S.P. Berndtsson R. & Bhunya P. Oxford University Press.

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Civil Engineering

Semester - VII

(Departmental Core Subject)

CE-4006	L-T-P-C
Water Resource Engineering - II Lab	0-0-1-1
Pre-requisite	Water Resource Engineering-I

Term Work

The term work shall comprise of the neatly written assignment/tutorials based on above modules. The assignment shall be covering the entire syllabus in such way that the student would attempt at-least three questions including numerical if any, on each module.

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Semester - VII

(Departmental Core Subject)

CE-4100	L-T-P-C
Minor Project	0-0-3-3

The Project shall be based on thrust areas in Civil Engineering (Construction Engineering and Management; Structural Engineering, Geotechnical Engineering including Geology, Transportation Engineering, Hydraulics Engineering, Environmental Engineering, Remote Sensing, etc.) or interface problem of any of the diversified fields of the Civil Engineering Branch.

For this purpose, the students shall form a group of minimum two students and maximum four students. Further, each faculty shall be permitted to guide maximum four groups.

Guidelines for Minor Project:

- Student should carry out the preliminary literature survey and subsequently, identify the problem in broad terms for the project and finalize/ settle it in consultation with Guide/ Supervisor.
- Pursuant to this, the student shall refer multiple literatures pertaining to the theme of the problem and understand the problem and define the problem in the precise terms.
- Student should attempt solution to the problem by analytical/simulation/experimental methods. The solution shall be validated with proper justification. The students shall compile the report in standard format.

- The work to be pursued as a part of the project shall be divided broadly in two parts, namely- Minor Project and Major Project.
- The topic of the project should be such that it is a value addition for the existing knowledge in the field and has some worthwhile outcomes.

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Semester - VII

(Departmental Core Subject)

CE-4200	L-T-P-C
Summer Internship	0-0-3-3

Summer Internships offer students personal & real world spirits & exposes to an actual working life, an experiential foundation to their career choices & the chance to build valuable business networks. Under this programme each student undergoes training in an Industry for a minimum period of six weeks during the summer vacation after VI Semester. Through the internship students are exposed with the various processes involved at any typical industrial unit such as, operating procedure, construction processes, management procedures etc.; have the opportunity to relate with the knowledge they acquired in the classroom. Students execute a small project based on any of the above-mentioned aspects under the supervision of competent personnel in the industry; a faculty member of the university. After completion of the Internship, students are required to prepare a report, based on the activities performed during the internship, as per the prescribed format/ guidelines. The report should be certified by the Supervisors; presented in the form of a seminar in the VII Semester. Evaluation of the Summer Internship will be done as per the approved procedure.

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Semester - VIII

(Departmental Core Subject)

CE-4007	L-T-P-C
Design and Drawing of Reinforced Concrete Structures	4-1-0-5
Pre-requisite	Reinforced Cement Concrete

Objective: *To understand the complete analysis and design of residential and industrial buildings using relevant IS codes. To understand the complete analysis and design of different types of water tanks using relevant IS codes by working stress method. To understand the complete analysis and design of different types of retaining walls. To develop the students well versed with concepts of civil engineering techniques and ability to use it in practice.*

Course Outcome: *The student shall be able to independently or as a member of the team design the structures using structural analysis and design knowledge for safety, serviceability and economy. The student shall be able to design different types of water tank, retaining wall by limit state method. The student shall be able to design a residential and industrial buildings by relevant IS code.*

Course Content

Module 01: Design of Foundation

Design of simple raft subjected to symmetrical loading using limit state method.

Module 02: Design of Staircase

Design of dog legged and open well type staircase using limit state method.

Module 03: Comprehensive Design of the Building

Complete design of residential, commercial or Industrial building including staircase and foundations using limit state method; Introduction to ductile design and detailing of structures

Module 04: Design of Retaining Walls

Design of cantilever and counter fort type retaining wall using limit state method.

Module 05: Effective stress principle

Definition of geostatic stresses, vertical stress/total stress, neutral, stress/pore water pressure, effective stress. Effect of water table fluctuations, surcharge, capillary action, seepage, pressure on effective stress; quick sand condition.

Module 06: Design of Water Tanks

Circular and rectangular, at ground level, underground and overhead water tank both by IS coefficient and - approximate methods, including supporting structure for overhead water tanks using working stress method.

Term Work

Design report of (G+3) industrial or residential building using relevant IS codes. Design report of counter fort retaining wall. Design report of rectangular or circular underground water tank or overhead water tank using relevant IS codes by working stress method.

Text/Reference Books

1. Limit State Theory for Reinforced Concrete Design. Huges B. P. Pitman
2. Limit State Design - Reinforced Concrete. Jain A. K. New Chand, India
3. Reinforced Concrete. Warener R. F. & Rangan B.C. & Hall A. S.
4. Illustrated Design of G+3 Building. Shah & Karve, Structures Publishers.
5. Reinforced Concrete. Sinha S.N. TMH, New Delhi.
6. Reinforced Concrete. Shah H.J. Charotar Publisher.
7. Relevant I.S. codes and Design Aids. BIS Publications.
8. Reinforced Concrete Fundamentals. Ferguson P.M. Breen J.E. & Jirsa J.O. 5th Edition John Wiley and Sons. 1988.
9. Illustrated Reinforced Concrete Design. Shah V.L. & Karve S.R. Structures Publishers.
10. Earthquake Resistant Design of Structures. Duggal S. K. Oxford University. Press, New Delhi
11. Earthquake Resistant Design of Structures. Agrawal P. and Shrikhande M. PHI Learning Pvt. Ltd.

Digital Material

1. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)
2. Virtual Labs.(http://smfe-iiith.vlabs.ac.in/Introduction.html)

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Semester - VIII

(Departmental Core Subject)

CE-4008 L-T-P-C
Construction Management 4-1-0-5

Objective: *To understand the basic principles and functions of construction management. To learn scheduling techniques such as CPM and PERT. To gain the knowledge of time-cost optimization and effective utilization of resources on construction sites. To understand allocating the resources and project monitoring. To know about safety and quality aspect of construction works.*

Course Outcome: *On successful completion of the course the students will be able to understand and apply the knowledge of management functions like planning, scheduling, executing and controlling to construction projects. The students will be able to demonstrate their capability for preparing the project networks to work out best possible time for completing the project. The students will be able to understand and exercise the time- cost relationship in practices. The students will be able to implement the safety as well as quality aspects during the execution of civil engineering project. The course will inculcate the managerial skills among the students.*

Course Content

Module 01: Introduction to Construction Management

Concept of Management, Principles of management, contribution by eminent personalities towards growth of management thoughts. Significance of construction,

management, objectives and functions of construction management Resources required for construction.

Module 02: Construction Projects

Unique features of construction industry. Construction projects- classification, characteristics life cycle concept of project etc. Roles and responsibilities of various agencies associated with a Construction project. Pre-requisites of commencing construction work sanctions, approvals to be sought, and feasibility studies. Site layout, organizing and mobilizing the site

Module 03: Construction Project Planning and Scheduling

Stages of planning in the view of owner/Department as well as contractor. W.B.S, Bar Charts. Network-Terminology, Network Rules, Fulkerson's rule, skip numbering, Precedence network etc. C.P.M - Activity and event with their types, activity times, event times, critical path, forward pass, backward pass, float and its types. P.E.R.T- Assumption underlying PERT analysis time estimates, slack and its types, probability of completing the project etc.

Module 04: Resources Management and Allocation

Material Management- Importance, objectives, functions of material management, inventory control, A-B-C analysis, E.O.Q etc. Human Resource Management- Manpower planning, recruitment, Selection training, performance evaluation of worker etc. Financial Management- accounting and Accounting principles, source of finance, cash flows associated with project, time value of money, economic appraisal criteria's for project. Resources Allocation Methods- Resource leveling resource smoothening. Introduction to project Management softwares.

Module 05: Project Monitoring and Cost Control

Supervision, record keeping, Periodic progress reports etc. Updating- Purpose of frequency of updating method of updating a network etc. Time cost optimization in construction projects compression and decompression of network etc. Common causes of time over run and cost overrun and Corrective measures.

Module 06: Safety and Health on Construction Sites

Common causes of accidents on construction sites, costs of accident, precautionary measures to avoid accidents, Occupational health hazards in construction industry. Safety and Health Campaign. O.S.H.A

Module 07: Quality Control

Concept of Quality, quality control check list in quality control etc. Role of inspection in quality control, Quality manual, Quality assurance statistical quality control 7.4 ISO 14000

Module 08: Construction Labors and Legislation

Need for legislation Acts applicable to Indian construction labors such as payment of wages act, min wages act, workmen's compensation act, factories act etc.

Term Work

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/ or questions on each modules/ sub-modules and contents thereof, further. In addition to this, the students will carry out the mini project based on the application of software's. This project will form a part of the term work.

Text/Reference Books

1. Construction Engineering and Management. Seetaraman S.
2. Construction Planning and Management. Shrivastava. U. K.
3. Professional Construction Management. Barrie D.S. & Paulson B.C. McGraw Hill.
4. Construction Project Management. Chitkara K. K. Tata McGraw Hill.
5. Handbook of Construction Management. Joy P.K. Macmillan India.
6. Critical Path Methods in Construction Practice. Antill J.M. & Woodhead R.W. Wiley.
7. Construction Hazard and Safety Handbook. King & Hudson Butterworths.

Digital Material

1. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)
2. Virtual Labs.(http://smfe-iiith.vlabs.ac.in/Introduction.html)

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Semester - VIII

(Departmental Core Subject)

CE-4300 L-T-P-C
Major Project 0-0-4-4

After completion of the work at the end of Semester VIII, the student shall compile the report in a standard format and written in the systematic manner and chapter wise. The student shall adhere to the following scheme of chaptalization while compiling the final report in general. The Guide/ Supervisor shall ensure the student has written the Dissertation Report in appropriate language (grammatically correct).

Course Content

Module 01: Introduction

The student shall give the introduction to the theme of the subject chosen as a Project/ Dissertation, give further current state of art related to the theme (i.e., brief review of literature), broad problem definition and scope of the work. The student shall also state at the end of this chapter the scheme of chaptalization included in his/ her Dissertation

Module 02: Theoretical Aspects/ Review of Literature

The student is expected to highlight the various theoretical aspects pertaining to the topic chosen, literature (updated) available related to the various aspects of the topic chosen citing the research work carried out by the earlier researchers and summarize the findings of the literature. The student may state the precise the problem definition. If felt necessary, these two aspects, i.e., theoretical aspects and review of literature can be compiled as separate chapters.

Module 03: Formulation/ Methodology/ Experimental Work

In this chapter, the student is expected to explain the methodology for pursuing their work. In case of analytical work, students may give the formulation along with validation for assessment of accuracy of the numerical procedure being used/ proposed by them. In respect of experimental work, the students may outline the experimental set up/ procedure. In case of the work in which either approach is involved, the students may appropriately provide the methodology to cover either approach. This chapter may be supported by the Data Collection if the work involves the Collection of the Data and its subsequent processing.

Module 04: Analysis/ Results and Discussion

The students are expected to present the results emerging from the analytical/ theoretical/ experimental study/ studies being pursued by them. The results shall be discussed properly. The results may be compared with the results published by the earlier researchers if the work being pursued by the students warrants the same. The students may indicate the broad conclusions/ inferences at the end

Module 05: Summary and Conclusions

Based on the results discussed in the previous chapter, the students shall give in the systematic manner the conclusions/ inferences emerged from the study and summarize it properly. The students shall indicate the scope of the future work which can be extended by any other students in the future. The students may point out the limitation/s left out in the work pursued by them while carrying out the work contained in the Dissertation.

Module 06: References

The students shall at the end give the list of the references in the appropriate manner. This part should not be treated as a Chapter. For referencing style, student may refer any standard journal of national and international repute.

Module 07: Publication/s

The student shall give the list of the technical/ research papers published/ accepted for publication in the referred journal/ conference proceedings. This part should not be treated as a Chapter.

Project Stage- II should be assessed based on following points:

1. Quality of Literature survey and Novelty in the problem
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization or current Research / Industrial trends Clarity of objective and scope
4. Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)
5. Quality of work attempted
6. Presentation of the results along with the validation of results or part thereof.
7. Quality of Written Report and Oral Presentation
8. Publication of the technical/ research paper by the student in a conference of National/ International repute. Publication of paper in a referred/ peer reviewed journal is highly preferred.

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Semester - V

(Departmental Level Optional Course -I)

CE-3106	L-T-P-C
Advanced Surveying	3-0-0-3
Pre-requisite	Surveying

Objective: *The objective of this course is to enable the students to use Total Station & GPS for desired requirements in surveying, Establish surveying control to determine required accuracy, Stake out the designed data by using modern high precision surveying instruments, Generate and utilize field surveying data and incorporate design data using specialized software, Apply GIS for solving civil engineering problems*

Course Outcome: *Having completed this course the students shall be able to select appropriate methods and instruments in surveying, based on accuracy and precision required, sophistication, availability of resources, economics and duration of project, employ modern surveying methods, for solving complex surveying problems, collect and manipulate data using GIS for simplifying data management and also reducing labour and knowledge of limits of accuracy will be obtained by making measurements with various surveying equipment employed in practice*

Course Content

Module 01: Modern Surveying Equipment

Introduction., Electronic Distance Measuring Instrument (EDMI), Surveying Use of lasers in surveying. Electronic Theodolite, Total Station and Scan Station

Module 02: Global Positioning System

Basics of GPS, Positioning using satellites, GPS receivers, GPS principles, GPS errors and accuracy Error sources in GPS observations Satellite geometry and accuracy measures, GPS measurements techniques, GPS algorithms/Navigational solutions Other satellite navigation systems and GPS modernization**,** Civil engineering application of GPS.

Module 03: Photogrammetry

Introduction to geometry of vertical photographs, Geometry of tilted photographs, photogrammetric terms; Applications; Type of photographs; perspective geometry of vertical and tilted photographs, heights and tilt distortions; Flight planning: Stereoscopy, base lining, floating marks, parallax equation and stereo measurements for height determination, Developments photogrammetry: analogue, analytical and digital methods, photogrammetric instruments. Civil engineering application of photogrammetry

Module 04: Remote Sensing

Physical basis of remote sensing- Electro-magnetic radiation (EMR)- nature, nomenclature and radiation laws; Interaction in atmospheric nature, its effects in various wavelength regions, atmospheric windows, interaction at ground surface- soils and rocks, vegetation, water, etc.; Physical basis of remote sensing (Radiometry), Geometric basis of interaction, Platform and sensors, Terrestrial, aerial and space platforms; Orbital characteristics of space platforms, sun and geo-synchronous; Sensor systems radiometers, optomechanical and push broom sensor; Resolution- spectral, spatial, radiometric and temporal; Data products from various air and spaceborne sensors- aerial photographs, LiDAR, Landsat, SPOT, IRS, ERS, IKONOS, etc. Image interpretation- Elements of interpretation; Manual and digital interpretation; Field verification, Remote sensing: Image Interpretation, Introduction to image processing techniques, Image enhancement, Information extraction, Civil engineering application of Remote Sensing

Module 05: Geographical Information System

Introduction to GIS, its hardware and software components Geographical data in computer: Data structures for GIS, Components of GIS- data acquisition, spatial and attribute data, pre-processing, storage and management; Data structures- raster and vector data; GIS analysis functions; Errors and corrections; Data presentation and

generation of thematic maps. Introduction to a software, GIS manipulation, query running, analysis and modelling, Errors and corrections Civil Engineering Application of GIS.

Module 06: Hydrographic Survey

Introduction, Organizations, National and International Maritime Hydrography, Hydrographic survey Methods, Lead lines, sounding poles, and single-beam, echo sounders, Civil Engineering Application of Hydrographic Survey.

Text/Reference Books

1. Higher surveying. Chandra A.M. New Age International publishers.
2. Higher surveying. Punimia B.C. Jain A.K. & Jain A.K. Laxmi Publications(P) Ltd.
3. Geographic Information System and Science. Longley Paul A. Michael F. G. Maguuire D.J. & Rhind D.W. John Wiley and Sons New York. 2005.
4. Modeling Our World The ESRI Guide to Geodata base Design Zeiler, M. ESRI Press Redlands California. 1999.
5. GIS, Spatial Analysis, and Modeling. Maguire D. Batty M. & Goodchild M. 2005.
6. Global Positioning System. Signals, Measurements, and Performance. Misra P. 2006.
7. Remote Sensing Principles and Interpretation. Floyd F. Sabins & Freeman and Co. San Franscisco. 1978.
8. A Remote Sensing Perspective: Introductory Digital Image Processing. John, R. Jensen Prentice Hall.
9. Imaging Radar for Resource Survey: Remote Sensing Applications. Travelt W. Chapman and Hall.
10. Remote Sensing and GIS. Bhatia B. Oxford University Press New Delhi.
11. Remote sensing and Image interpretation. Lilles T.M. Kiefer R.W. & Chipman J.W. 5th edition John Wiley and Sons India.
12. Concepts and Techniques of Geographic Information Systems. Lo C.P. & Yeung A.K.W. Prentice Hall of India New Delhi. 2002
13. Remote Sensing and Geographical Information Systems. Reddy M.A. B.S. Publications Hyderabad 2001.

Digital Material

1. http://nptel.ac.in/courses/105104100/1
2. http://www.surveyofindia.gov.in

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Semester - V

(Departmental Level Optional Course -I)

CE-3107	L-T-P-C
Advance Surveying Lab	0-0-1-1
Pre-requisite	Surveying

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of advanced surveying on field survey and monitoring.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Determination of co-ordinates of profile by GPS and length of profile.	02
2.	Profile Leveling (Open Traverse) by Total Station and print output by using any software interface	02
3.	Navigation of existing co-ordinates by GPS	02
4.	Digitization work by any GIS software.	05
5.	Setting out a foundation plan of RC structure in the field using Total Station	01
6.	Mini Project on GIS using various software	05

Text/Reference Books

1. Higher surveying. Chandra A.M. New Age International publishers.
2. Higher surveying. Punimia B.C. Jain A.K. & Jain A.K. Laxmi Publications(P) Ltd.
3. Geographic Information System and Science. Longley Paul A. Michael F. G. Maguuire D.J. & Rhind D.W. John Wiley and Sons New York. 2005.
4. Modeling Our World The ESRI Guide to Geodata base Design Zeiler M. ESRI Press Redlands California. 1999.
5. GIS, Spatial Analysis, and Modeling. Maguire D. Batty M. & Goodchild M. 2005.

Digital Material

1. http://nptel.ac.in/courses/105104100/1
2. http://www.surveyofindia.gov.in/
3. http://www.iism.nic.in/
4. http://bhuvan.nrsc.gov.in/bhuvan_links.php
5. http://igrmaharashtra.gov.in/#

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Semester - V

(Departmental Level Optional Course -I)

CE-3108	L-T-P-C
Advanced Concrete Technology	3-0-0-3
Pre-requisite	Building Material & Construction Technology

Objective: *The objective of this course is to develop the knowledge about properties/ design and testing of advanced cement concrete, various materials and properties in concrete, concept of durability and cracking in concrete.*

Course Outcome: *Having completed this course the students shall know various materials and properties in concrete, Mix design by different methods, various properties of special concrete, knowledge of Fibre Reinforced Concrete, different procedures for testing concrete*

Course Content

Module 01: Properties of Concrete

Cement and its types: general, hydration of cement, water requirement for hydration, alkali aggregate reaction. Aggregate: grading curves of aggregates. Concrete: properties of fresh concrete, w/c ratio, w/b ratio, gel space ratio, maturity concept, aggregate cement bond strength, curing and its method.

Module 02: Special Concrete

Light weight concrete, ultra-light weight concrete, vacuum concrete, mass concrete, waste material-based concrete, shotcreting, guniting, sulphur concrete and sulphur infiltrated concrete, jet cement concrete (ultra-rapid hardening), gap graded concrete, no fines concrete, high strength concrete, high performance concrete.

Module 03: Concrete Mix Design

Design of concrete mixes by IS code method - ACI method - Road Note No: 4 methods. Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly-ash cement concrete mixes, design of high-density concrete mixes.

Module 04: Fibre Reinforced Concrete

Historical development of fibre reinforced concrete, properties of metallic fibre, polymeric fibres, carbon fibres, glass fibres and naturally occurring fibres. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending.

Module 05: Testing of Concrete

Properties of hardened FRC, behaviors under compression, tension and flexure of steel fibres and polymeric fibres. Advanced non-destructive testing methods: ground penetration radar, probe penetration, pull out test, break off maturity method, stress wave propagation method, electrical/ magnetic methods, nuclear methods and infrared thermography, core test.

Module 06: Durability of Concrete

Durability, Transport mechanism of fluids and gases in concrete, cracking in concrete corrosion and carbonation induced cracking, Alkali Aggregate Reaction, degradation by freeze and thaw, chloride attack, sulphate and sea water attack (marine conditions). Hot and cold weather concreting.

Text/Reference Books

1. Concrete Technology. Shanthakumar A.R. Oxford University Press New Delhi. 2007.
2. Concrete Technology Theory and Practice. Shetty M.S. S. Chand.
3. Properties of concrete. Isaac N. Pitman. London.
4. Relevant I.S. codes. Bureau of Indian standard.
5. Special Publication of ACI on Polymer concrete and FRC.
6. Proceedings of International Conferences on Polymer Concrete and FRC.
7. Concrete Technology. Gambhir M.L. Tata McGraw Hill. New Delhi.
8. Concrete Technology. Neville A.M. & Brooks. J. J. ELBS-Longman Pearson Education Ltd.
9. Chemistry of Cement and Concrete. Lue F.M. 3rd Edition Edward Arnold. 1970.
10. Concrete Technology. Orchardi D.F. Wiley. 1962.
11. Tentative Guidelines for cement concrete mix design for pavements (IRC: 44-1976): Indian Road Congress New Delhi.

12. Concrete mix proportioning-guidelines (IS 10262:2009).
13. Concrete- Microstructures, Properties and Materials. Mehta P.K. and Paulo J. M. Monteiro, Indian Edition, Indian Concrete Institute Chennai, 1999.
14. Concrete Mixture Proportioning- A Scientific Approach. De Larrard F. E&FN Spon London 1999.
15. Fibre Reinforced Cementitious Composites Bentur A. & Mindess S. Modern Concrete Technology Series Tylor and Francis.

Digital Material

1. www.theconcreteportal.com
2. www.concrete.org

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Semester - V

(Departmental Level Optional Course -I)

CE-3109 L-T-P-C
Advance Concrete Technology Lab 0-0-1-1
Pre-requisite Building Material & Construction Technology

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of concrete technology with emphasis on concrete laboratory testing, field testing and monitoring.*

List of Experiments (Any Eight to be performed)

S. No.	Title of the Experiment	Module
1.	Mix design in laboratory by ACI Method.	03
2.	Mix design in laboratory by Road Note 4.	03
3.	Chemical Admixture (Superplasticiser) optimization by Mini Slump and Marsh cone.	05
4.	Concrete- Slump, Slump retention by Slump cone.	05
5.	Split and Modulus of rupture of concrete	05
6.	Permeability test on concrete	05
7.	Rapid chloride penetration test	05
8.	Tests on polymer modified concrete/mortar	04
9.	Tests on fiber-reinforced concrete	04

10.	Nondestructive testing of concrete- some applications (hammer, ultrasonic etc.).	05
11.	Carbonation test on concrete	06

Text/Reference Books

1. Relevant I.S. codes: Bureau of Indian standard.
2. Concrete mix proportioning-guidelines (IS 10262:2009).
3. Concrete Mixture Proportioning- A Scientific Approach. De Larrard F. E&FN Spon London. 1999.
4. Concrete Technology Theory and Practice. Shetty M.S. S. Chand.
5. Concrete Technology. Gambhir M.L. Tata McGraw Hill New Delhi.

Digital Material

1. www.theconcreteportal.com
2. www.concrete.org

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Semester - V

(Departmental Level Optional Course -I)

CE-3110	L-T-P-C
Building Services and Repairs	3-0-0-3
Pre-requisite	Building Design & Drawing

Objective: *The objective of this course is to understand and explain the role of sanitation in the urban water cycle and its relation to public health and environment. The course is designed to understand the relevant physical, chemical and biological processes and their mutual relationships within various sanitation components. It aims to develop rational approaches towards sustainable wastewater management via pollution prevention.*

Course Outcome: *Having completed this course the students shall enable to understand the importance & installation of utility services, drawbacks of all the service lines are not installed properly or if materials used are faulty, choose appropriate systems & integrate the same into the building construction projects, assess the structural health of the buildings & infrastructural works and also Inspect & evaluate the damaged structures, implement the techniques for repairing the concrete structures and also decide whether or not the structure should be dismantled, if it is deteriorated beyond repair and understand the damage caused by fire & exercise due care for fire safety.*

Course Content

Module 01: Machineries

Lifts & Escalators- Special features required for physically handicapped & elderly, Conveyors, Vibrators, Concrete mixers, DC/AC motors, Generators, Laboratory services, Gas, Water, air & electricity, Hot water boilers and pumps

Module 02: Plumbing Systems & Fire safety in Building

Plumbing Services: Water Distribution system, Material for service pipes, Service connection, Size of service pipe, Water meter, valves and storage tanks. Drainage system: Pipe and traps, system of plumbing, House drainage plans, septic tanks and soak pit. Fire Safety Installation: Causes of fire in building - safety regulation - NBC - Planning considerations in building like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. system. Special features required for physically handicapped and elderly in building types - Heat and smoke detectors - Fire alarm system, snorkel Ladder - Fire Lighting pump and water storage - Dry and wet riser - Automatic sprinklers

Module 03: Electrical systems & Illumination Design in Buildings

Electrical systems in buildings: Basics of electricity - Single / Three phase supply, Protective devices in electrical installations, earthing for safety, Types of Earthing, ISI specifications, Types of wires, wiring systems &their choice, Planning electrical wiring for building, Main &distribution boards, Transformers & switch gears, Layout of Substations. Principles of Illumination Design: Visual task, Factors affecting visual task, Modern theory of light & colour, Synthesis of Light, Additive &

Subtractive synthesis of colour, Luminous flux, candela, solid angle illumination, utilization factor, Depreciation factor, MSCP, MHCP, Lens of illumination, Classification of lighting, Artificial lights sources, spectral energy distribution, Luminous efficiency, colour temperature, colour rendering. Design of Modern lighting: Lighting for stores, offices, school, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

Module 04: Deterioration of Concrete Structures

Causes of deterioration of concrete structures, effects of climate, moisture, temperature, chemical, wear, erosion & loading on serviceability & durability. Design& construction errors. Causes of seepage & leakage in concrete structures. Formation of cracks including those due to corrosion.

Module 05: Condition Survey, Evaluation & Damage Assessment

Diagnostic methods & analysis. Destructive, semi-destructive and non-destructive methods: core test, carbonation test, chloride test, petrography, corrosion analysis,

cover meter test, rebound hammer test, ultrasonic pulse velocity test, and crack measurement techniques, Concrete endoscopy & thermal imaging, pull- off test & pull-out test.

Module 06: Materials & Repair Methodologies, Protection of Concrete Structures & Rebar Corrosion Protection

Repair analysis & design. Repair materials and their desired properties. Methodologies for crack and patch repair: polymer modified mortar, polymer modified concrete, polymer concrete. Injection grouting, shotcrete, joints and sealants, rebar corrosion crack repair Protective materials and their properties for moisture barrier systems. Above grade and below grade water-proofing of concrete structures. Systems like integral, crystalline, coatings, membranes, etc. Thermal protection coatings. Methods of corrosion protection, corrosion inhibitors. Corrosion resistant steels, cathodic protection. Pre-packed zinc sacrificial anode, Snap-on zinc mesh anode CP system.

Text/Reference Books

1. Heat Pumps and Electric Heating. Ambrose E.R. John and Wiley and Sons Inc. New York. 1968.
2. Handbook for Building Engineers in Metric Systems. NBC New Delhi. 1968.
3. Philips Lighting in Architectural Design, McGraw-Hill, New York, 1964.
4. The Lighting of Buildings. Hopkinson R. G. & Kay J. D. Faber and Faber London 1969.
5. National Building Code.
6. Building Construction. Punmia B.C. Jain A.K. & Jain A.K.
7. Construction Engineering and Management: Seetharaman S. Umesh Publications, Delhi.
8. Water supply and Sanitory Installations. Panchdhari A.C. New Age International Publication Delhi.
9. Concrete Repair and Maintenance. Emmons P.H. and Sabnis G.H. Galgotia Publication.
10. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
11. Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
12. CPWD handbook on Repairs and Rehabilitation of RCC buildings published by DG(Works), CPWD, Government of India (Nirman Bhawan), http://www.cpwd.gov.in/handbook.pdf.
13. Guide to Concrete Repair. Smoak G. US Department of the Interior Bureau of Reclamation, Technical Service Center, http://books.google.co.in.
14. Management of Deteriorating Concrete Structures Somerville G. Taylor and Francis Publication.

15. Concrete Building Pathology. Macdonald S. Blackwell Publishing.
16. Testing of Concrete in Structures. Bungey J.H. Millard S.G. & Grantham M.G. Taylor and Francis Publication.
17. Durability of concrete and Cement Composites. Page C.L. & Page M.M. Woodhead Publishers.
18. Fire Safety in Building. Jain V. K. New Age International Publication Delhi.

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Semester - V

(Departmental Level Optional Course -I)

CE-3111 L-T-P-C
Building Service and Repairs Lab 0-0-1-1
Pre-requisite Building Design & Drawing

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of building design with emphasis on building service and monitoring.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Carbonation test by spraying phenolphthalein.	05
2.	Non -destructive testing of concrete structures by Rebound hammer	05
3.	Non -destructive testing of concrete structures by UPV meter	05
4.	Outdoor exposure test to measure weathering of coating	06
5.	Test for flexibility of coating by applying on a tin sheet	06
6.	Test for effectiveness by measuring water absorption of coating applied on a card board	06

Text/Reference Books

1. Relevant I.S. codes: Bureau of Indian standard.

2. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
3. Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
4. CPWD handbook on Repairs and Rehabilitation of RCC buildings published by DG(Works), CPWD, Government of India (Nirman Bhawan) http://www.cpwd.gov.in/handbook.pdf.
5. Building Construction. Punmia B.C. Jain A.K. & Jain A.K.

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Semester - V

(Departmental Level Optional Course -I)

CE-3112	L-T-P-C
Advanced Structural Mechanics	3-0-0-3
Pre-requisite	Structural Analysis

Objective: *The objective of this course is to understand the damage caused by fire & exercise due care for fire safety, behavior of beams resting on elastic foundation, concept of different theories of failure in regards of materials, behavior of deep beams using different theories available for the analysis of different sections.*

Course Outcome: *Having completed this course the students shall be able to understand the concept of shear centre for thin walled open sections, study the behavior of beam resting on elastic foundation with various loading conditions, analyses the beam curved in plan for different support conditions and concept of different theories of failure in different sections.*

Course Content

Module 01: Shear centre

Shear Centre for symmetrical & unsymmetrical (about both axes) thin walled open sections.

Module 02: Bending of beams with large initial curvature

Bending of beams with large initial curvature, loaded in their plane of curvature. Application to analysis of hooks, circular closed rings, chain links with straight length & semi-circular ends.

Module 03: Beams on elastic foundation

Analysis of beams of infinite length subjected to concentrated force/moment & semi-infinite length subjected to concentrated load/moment at one end. Semi-infinite beam hinged at one end (origin) & subjected to UDL throughout.

Module 04: Beams curved in plan

Analysis of beams loaded perpendicular to their own plane. Simply supported, fixed & continuous beams.

Module 05: Theories of Failure

Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory. Maximum total strain energy theory.

Module 06: Analysis of deep beams

Determination of deflection. Determination of shear correction factor for various sections: rectangular solid & hollow section, circular solid & hollow section & I-section. Stress concentration, stress concentration factor.

Text/Reference Books

1. Mechanics of Materials. Popov E.P. Prentice Hall of India Pvt. Ltd.
2. Mechanics of Materials. James G. M. Thomson Brooks.
3. Mechanics of Materials Beer F.P. Jhonston E.R. and DeWolf J.T. TMH New Delhi.
4. Advanced Mechanics of Materials. Boresi A.P. & Sidebottom O.M. Wiley and Sons.
5. Advanced Mechanics of Materials. Boresi A.P. & Schmidt R. John Wiley and sons.
6. Strength of Material Part I and Part II. Timoshenko McGraw Hill New York.
7. Mechanics of Solids. Shames, I & Pitarresi, J. M. Prentice Hall New Delhi.
8. Beams on Elastic Foundation. Heteny M.
9. Strength of Materials. Subramanian. Oxford University Press.

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Semester - V

(Departmental Level Optional Course -I)

CE-3113	L-T-P-C
Advanced Structural Mechanics Lab	0-0-1-1
Pre-requisite	Structural Analysis

Term Work

The term-work shall comprise of the neatly written report based on the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/ or questions on each modules/ sub-modules and contents thereof further.

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Semester - VI

(Departmental Level Optional Course -II)

CE-3114 L-T-P-C
Advanced Construction Equipment 3-0-0-3
Pre-requisite Building Materials & Construction Technology

Objective: *This course will help the students to select appropriate equipment and techniques in construction for large and heavy engineering projects on the basis of suitability, availability, productivity, output, initial and operation cost, savings in time and other resources etc.*

Course Outcome: *On successful completion of this course, students shall be able to: Understand the use/applications of various conventional construction equipment and select the best out of them for a particular site requirement, Compare conventional and modern methods of formwork on the basis of productivity, reuse value, ease of erection and dismantling, flexibility offered and overall cost, Understand the techniques involved and the equipment required thereof for construction of various transporting facilities, Select proper equipment for construction of transporting facilities based on requirements.*

Course Content

Module 01: Introduction

Study of Different categories of construction equipment used conventionally with reference to available types and their capacities, operations and factors affecting their performance. Earthmoving and other hauling equipment Drilling and blasting equipment. Pile driving equipment. Pumping equipment (for water as well as concrete), Applications

of Air compressor. Dewatering techniques for trenches, tunnels. Stone crushing equipment.

Module 02: Equipment for Underground and Underwater tunneling.

Various purposes for which tunneling may be carried out, Basic terms related to tunneling, Conventional methods of carrying out tunneling in different types of soils/rocks. Modern methods of tunneling and detailed study of following equipment/techniques in this regard: Jumbo – used for drilling and blasting. Vertical shaft sinking machine (VSM). Tunnel Boring machine (TBM), Micro tunneling. New Austrian tunneling method (NATM). Cut & cover method, Top to bottom construction. Tunnel lining trolley.

Module 03: Modern formwork systems

Difference in conventional and modern systems of formwork Mivan Doka shuttering along with their advantages and disadvantages. Modular shuttering, Slip and jump form, Tower cranes and the benefits they offer for high rise construction. Prefabricated housing systems, Difficulties faced in the installation and operation of all these systems.

Module 04: Equipment for construction of underground utilities, road construction bridges/flyovers

Pipeline insertion system, use of ground penetrating radar (GPR) for locating underground utilities. Construction of roads using paver machines. Methods of construction for bridges/flyovers and the processes/equipment required thereof, Incremental launching method and balanced cantilever method with reference to the recent infrastructure developed in the local and global context.

Module 05: Equipment/ techniques for setting up of power generation structures.

Hydropower station. Thermal power station. Solar power station. Atomic power generation. Installation and operation of wind mills. Installation and operation of underground power transmission lines as well as overhead transmission towers.

Module 06: Equipment for construction of transporting facilities

Construction of railway lines using track laying machine. Methods, techniques and equipment involved in the construction of Metro, mono and maglev trains. Special requirements of the permanent way in each case. Equipment required for construction and operation of an airport and seaport.

Text/Reference Books

1. Construction Equipment & Planning. Purifoy R.L & Ledbetter. McGraw Hill.
2. Construction Equipment & it's Management. Sharma S.C. Khanna Publishers.
3. Tunnel Engineering Handbook. Kuesel T.R. King E.H. & John O. Springer.
4. Practical tunnel construction. Gary B. Hemphill Wiley Publishers.
5. Construction Technology for Tall Buildings. Chew M.Y.L. World Scientific.
6. The prefabricated home. Davies C. Reaktion Books.
7. Literature/specifications/downloadable videos available on Doka & Mivan shuttering websites.
8. Accelerated Bridge Construction: Best Practices and Techniques. Khan M.A. BH Elsevier.
9. Design and Construction of Nuclear Power Plants. Meiswinkel R. Meyer J. Jürgen Schnell Wiley Publishers.

Digital Material

1. Compendium of Construction Equipments. Ministry of Railways, Government of India (https://rdso.indianrailways.gov.in/works/uploads/File/WKS-R-1.pdf)

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Semester - VI

(Departmental Level Optional Course -II)

CE-3115	L-T-P-C
Advanced Construction Equipment Lab	0-0-1-1
Pre-requisite	Building Materials & Construction Technology

Term Work

The term work shall comprise of the neatly written report based on assignments (One for each module) and site visits (minimum 2). The assignments shall be given covering the entire syllabus and preferably different questions can be given to different group of students so that they themselves will create the question bank and answers for the same. This course should be taught through maximum site visits and demonstration of the working processes and equipment through animations/videos to make the delivery most effective. The difference between conventional and modern method of carrying out a construction process should be clearly known to the students. Site visits to various ongoing infra projects especially in Mumbai Metropolitan region (MMR) can be of great help to the students. The site visits should be planned in such a way so that maximum equipment/techniques can be seen actually by the students. The report on site visit shall also form a part of the term work.

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Semester - VI

(Departmental Level Optional Course -II)

CE-3116 L-T-P-C
Traffic Engineering and Management 3-0-0-3
Pre-requisite Transportation Engineering

Objective: *This course will help the to understand the concepts of traffic characteristics, traffic surveys to be conducted for planning any transportation network or judging the adequacy of the existing one, further the concept of highway capacity and such other components such as Passenger Car Unit and Level of Service affecting the Capacity; and Speed- Flow- Density Relationship and various theories describing these relationships.*

Course Outcome: *After successful completion of the course the students shall be able to: Understand different characteristics of the road users and vehicles from their consideration and view point in the traffic engineering and transportation planning, Conduct different traffic surveys, analyzing the data collected as a part of such studies and interpreting it with the help of the different statistical models, Explain the concepts of PCU and LoS, their implication in determination of the capacity using Speed-Flow-Density relationships.*

Course Content

Module 01: Traffic Engineering

Introduction to the Road User and the Vehicle; Road Users' (Human) Characteristics affecting their behaviour; Vehicular Characteristics; Power performance of vehicles. Introduction to Spot Speed (space and time mean speed); Speed and Delay Studies (different types of delays, overall/ journey speed, running speed, journey time, running

time); Traffic Volume Studies; Vehicle Occupancy Studies; Parking Studies; Accident Studies. Significance/ Objectives/ Necessity/ Application of the afore-mentioned studies; Methods of conducting these studies along with pros and cons (merits and drawbacks) of each of methods; Analysis Methodologies; Different methods of the Interpretation / Presentations of the Results. Different Statistical Methods; Basic Concepts of the Terminologies pertaining to statistical methods; Poisson's, Binomial and Normal Distribution, Sampling theory and Significance Testing, Regression (Linear and Multiple) and Correlation

Module 02: Highway Geometrics and Parking System

Different Terms involved in Highway Geometrics; Types Intersections (At grade and grade separated) and its further bifurcations/ classification along with merits and drawbacks; Conflict points and Conflict Area at Intersections; Flaring of Intersections; Principles behind designing the intersections. Channelization: Significance, Different types of islands within the layout of the road network and intersection or junctions. Speed Change Lanes; Rotary intersection: Merits and Demerits; Necessity; Different Types; Design Principle; Design of the Rotary. Traffic and parking problems; different types of parking facilities (on street and off street along with further bifurcations therein); Truck Terminals; Long distance Bus Terminals.

Module 03: Highway Capacity and Introduction to Theory of Traffic Flow

Capacity; Difference between Capacity and Volume; Passenger Car Unit (PCU); Concept of Level of Service; Different Types of Capacities and Factors affecting the Capacity. Speed- flow-Density Relationships; Introduction to the Lighthill and Whitham's Theory; Car Following Theory and Queuing Theory

Module 04: Highway Safety/ Traffic System Management/ Lighting

Factors responsible for the accident; Preventive Measures; Traffic Management Measures and its implications on traffic flow and accident prevention Brief Introduction to the Highway Lighting: Importance; Principle of Visibility at Night; Factors influencing Night Visibility; Design Factors; Important Definitions; Law of Illumination; Discernment by Artificial Lighting; Mounting Height; Spacing; Lantern Arrangements; Types of Lamps; Lighting of Some Important Highway Structures; Design of Highway Lighting Systems. Significance; Advantages and Drawbacks; Principles of TCDs; Different Traffic

Signs; Different Types of Traffic Signals; Terms involved in Signals; Co-ordinated Control of Signals and Types of Co-ordinated Signal System; Various Approaches of Designing the Signals (determination of optimal cycle time and signal setting for an intersection with fixed time signals); Area Traffic Control and Delay at Signalized Intersections.

Module 05: Transportation Planning

Introduction to the process of urban transport planning. Trip Generation: Introduction; Factors affecting Traffic Generation and Attraction Rates; Multiple Regression Analysis, Category Analysis Trip Distribution: Importance; Different Methods of Trip Distribution, Uniform and Average Factor Method, Fratar Method, Furness Method,

Gravity model, Opportunities Model. Traffic Assignment: Purpose; General Principles; Assignment Techniques (All or Nothing Assignment, Multiple Route Assignment, Capacity restraint assignment, Diversion Curves). Modal Split: General Considerations; Factors affecting Modal Split; Modal Split in the Transportation Planning Process Land Use Transport Models: Introduction; Selection of Land Use Transport Models; Lowry Derivative Models; Garin Lowery Model

Module 06: Transport Economics

Economic Evaluation of Transportation Projects; Necessity; Cost and Benefits of Transportation Projects, Basic Principles of Economic Evaluation, Interest Rate; Costs (Vehicle Operating; Time; Accident); Benefits (Direct and Indirect); Different Methods of Economic Evaluation (Benefit- Cost Ratio Method, First Year Rate of Return Method; Net present Value Method; Internal rate of Return Method); Comparison of the Various Methods of Evaluation vis-a-vis.

Text/Reference Books

1. Traffic Engineering and Transportation Planning. Kadiyali L. R. Khanna Publishers Delhi.
2. Principles of Traffic Engineering. Pignataro G. J. McGraw-Hill.
3. Traffic System Analysis for Engineering and Planners. Wohl & Martin. Mc-Graw Hill
4. Highway Engineering. Khanna S.K. Justo C.E.G. & Veeraraghavan A. Nemchand and Bros. 10th Revised Edition. Roorkee
5. Principles of Transportation Engineering. Chakroborty P. & Das A. Prentice Hall India.

6. Highway Engineering and Traffic Engineering. Saxena & Subhash C. C.B.S. Publishers.
7. Transportation Engineering (Vol.-I). Venkatramaiah C. University Press Hyderabad
8. Principles, Practice and Design of Highway Engineering. Sharma S.K. S Chand and Co. Pvt. Ltd. Delhi.
9. Highway Engineering. Sriniwaskumar R. University Press Hyderabad
10. Traffic Flow Theory and Control. Drew D. R. Mc-GrawHill New York
11. Transportation Engineering and Planning. Papacostas C. S. Prevedouros P. D. PHI Learning Pvt. Ltd.
12. Transportation Engineering. Khisty C.J. & Lall K.B. PHI Learning Pvt. Ltd.
13. Introduction to Urban Transport Systems, Planning. Hutchinson B.G. McGraw-Hill.
14. Economics of Transportation. Fair & Williams. Harper and Brothers Publishers New York.
15. Highway Capacity Manual. Transportation Research Board National Research Council Washington D.C.
16. Relevant IRC Codes amended time to time.

Digital Material

1. Traffic Engineering and Management, Dr. Tom V Mathew, IIT Bombay. NPTEL (https://nptel.ac.in/courses/105101008/)

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Semester - VI

(Departmental Level Optional Course -II)

CE-3117	L-T-P-C
Traffic Engineering and Management Lab	0-0-1-1
Pre-requisite	Transportation Engineering

Term Work

The term work shall comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems/questions on each sub-modules and contents thereof further. Apart from this, the students shall conduct at least three traffic surveys and shall prepare a detailed report of the analysis of these surveys. This report shall also form a part of the term work.

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Semester - VI

(Departmental Level Optional Course -II)

CE-3118	L-T-P-C
Ground Improvement Techniques	3-0-0-3
Pre-requisite	Geotechnical Engineering

Objective: *This course will help the students to identify problematic soils and their associated issues; to make the student understand for different ground improvement methods adopted for improving the properties of in-situ and remoulded soils; to make the student learn the concepts, purpose, methods and effects of soil stabilization; to make the student learn the concepts, purpose and effects of grouting; to provide the concepts of the reinforced earth and soil nailing to the students in conventional retaining walls.*

Course Outcome: *After successful completion of the course students will be able to: Identify problematic soils and their associated issues, Study the various ground improvement techniques and propose suitable remedial techniques and design, Select appropriate soil improvement technique based on the soil type and application, Design grouting for various engineering applications in the field.*

Course Content

Module 01: Introduction

Need for Ground Improvement, Different types of problematic soils, classification of ground improvement techniques, Emerging trends in ground Improvement techniques, economic considerations and suitability.

Module 02: Compaction and Consolidation

Methods of compaction, Shallow compaction, Deep compaction techniques: Vibro-floatation, Blasting, Dynamic consolidation, pre-compression; accelerated consolidation by sand drains, free strain and equal strain cases, design of sand drain layout.

Module 03: Stabilization of Soil

Methods of stabilization, mechanical stabilization: lime, cement, lime, fly-ash, bitumen, chemicals and polymer stabilization, stabilization by electro- osmosis.

Module 04: Grouting

Grouting technology, Grout materials, physical and chemical properties, strength, Rheological aspects of coarse and fine grouts, penetrability and performance aspect of coarse and fine grouts, Various application of grouting.

Module 05: Stone Columns

Application, layout feature, procedures of installation, vibro float and rammed stone column, unit cell concept, load transfer mechanism, settlement in stone column, methods of improving the effectiveness of stone column, Design for stone column layout.

Module 06: Reinforced Earth and Anchors

Necessity of reinforced earth, theory of reinforced earth, materials and method, application, design of reinforced earth, characteristics of reinforced earth masses; introduction to soil nailing and ground anchors; Capacity of shallow horizontal and vertical strip anchors by using Mononobe-Okabe method.

Text/Reference Books

1. Ground Improvement Techniques. Raj P.P. Prentice Hall of India. 2005.
2. Engineering Principles of Ground Modification. Housmann M.R. McGraw Hill. 1990.
3. Foundation Engineering Manual. Nayak N. V. 2015.
4. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards New Delhi. 2003.
5. Ground Improvement Techniques. Patro N.R. Vikas Publishing House (P) Limited. 2012.
6. Geotechnical Earthquake Engineering. Kramer S. L. Pearson. 2013.
7. Earth Anchors. Das B. M. Elsevier. 2012.

Digital Material

1. Ground Improvement Technique, Dr. G.L. Sivakumar Babu IISc Bangalore. NPTEL (https://nptel.ac.in/courses/105108075/).

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Semester - VI

(Departmental Level Optional Course -II)

CE-3119	L-T-P-C
Ground Improvement Techniques Lab	0-0-1-1
Pre-requisite	Geotechnical Engineering

Term Work

The term work shall comprise of neatly written report based on assignments. The term work shall cover the entire syllabus in such a way that the students would attempt conceptual theory part from each module. Further, groups of students (having maximum four students) shall be formed who shall analyze and design any **three** with different data from the following:

1. Design of sand layout in soft compressible clay deposit for required (accelerated) rate of consolidation.
2. Analysis of Horizontal or Vertical strip anchor by using Mononobe-Okabe Method to find the seismic capacity.
3. Design of a reinforced earth retaining wall.

Analysis and design of skirted stone columns.

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Semester - VI

(Departmental Level Optional Course -II)

CE-3120	L-T-P-C
Advanced Structural Analysis	3-0-0-3
Pre-requisite	Structural Analysis

Objective: *This course will help the students to to analyze the statically indeterminate portal frame; to study the methods and evaluating rotation and displacement parameters in complete frame using various methods; to analyze the symmetrical frame with symmetrical and anti-symmetrical loading; to understand the concept of Influence lines for statically indeterminate beams.*

Course Outcome: *The students will be able to: Understand the Stiffness Matrix method and will be able to analyze various types of structures by this method understand the conventional methods of analysis, Understand the methodology involved in commercially available computer software for analysis which are based on stiffness matrix method, Obtain the response of the indeterminate beams under the action of moving loads, Understand the concepts of the finite element method toward solving the problem, different elements and shape functions (displacement functions) to extend the application to the short problems.*

Course Content

Module 01: Introduction to Stiffness Method in Matrix form

Basic concepts of stiffness coefficients, member stiffness matrix for beam, member stiffness matrix for plane truss, member stiffness matrix for rigid jointed plane frame, member stiffness matrix for plane grid and of space frame. Properties of stiffness matrix,

co-ordinate transformation matrix, stiffness matrix in local and global co-ordinate axes system, assemblage of structural stiffness matrix and application of boundary conditions. Joint loads, Equivalent joint loads, method of solution for displacements and computation of internal forces in members. Application of stiffness method to beams, pin jointed trusses, rigid jointed plane frames and simple plane grid structures.

Module 02: Conventional Form of Stiffness Method, Modified Moment Distribution Method

Symmetrical structure, Symmetric and anti-symmetric loads, Modification of stiffness and carryover factors for symmetric and anti-symmetric loads both for sway and non-sway cases for frames with different support conditions. Application to frames involving side sways.

Module 03: Flexibility Method in Matrix form

Review of concepts of flexibility coefficients, Flexibility member matrix for beam, member flexibility matrix for plane truss, member flexibility matrix for rigid jointed plane frame, member flexibility matrix for plane grid and of space frame. Selection of primary structure, concepts of flexibility matrix, compatibility equation, solution for redundant forces, computational of internal forces, and joint displacement. Application to pin jointed trusses and rigid jointed plane frames for different loading including the effect of settlement of support, temperature changes and elastic supports.

Module 04: Conventional Form of Flexibility Method

Elastic Centre Method and its application to rectangular box, and rigid jointed portal frames. Column Analogy Method and its application to analysis of non-prismatic beams, simple rectangular frames, determination of stiffness coefficients and carry over factors for non-prismatic beam members.

Module 05: Influence Line Diagrams for Indeterminate Structures

Muller Breslau's Principle for drawing influence line diagrams for statically indeterminate structures. Influence Lines Diagrams for propped cantilevers, fixed beams and continuous beams.

Module 06: Introduction to Finite Element Method

Brief History of the Development; Advantages & Disadvantages of Finite Element Method. Different elements (1-D, 2-D, 3-D, CST Elements); Shape Functions & Interpolation

Polynomials for two nodded bar and beam elements; Stiffness Matrix for the basic Bar & Beam Element, Solution Methodology.

Text/Reference Books

1. Basic Structural Analysis. Reddy C. S. Tata McGraw hill.
2. Analysis of Framed Structures. Gere & Weaver, East-West Press.
3. Analytical Methods in Structural Analysis. Raz S. A., New Age Int Publishers.
4. Modern Method in Structural Analysis. Thadani B. N. & Desai J. P. Weinall Book Corporation.
5. Structural Analysis. Negi L. S. & Jangid R. S. Tata McGraw hill.
6. Structural Analysis Vol. I and Vol. II. Pandit & Gupta. Tata McGraw hill.
7. Analysis of Structures. Vazirani V.N. & Ratwani M.M. Khanna Publishers.
8. Finite Element Analysis. Bhavikatti S.S. New Age International Publication.

Digital Material

1. Advanced Structural Analysis, Prof. Devdas Menon IIT Madras. NPTEL (https://nptel.ac.in/courses/105106050/)

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Semester - VI

(Departmental Level Optional Course -II)

CE-3121	L-T-P-C
Advanced Structural Analysis Lab	0-0-1-1
Pre-requisite	Structural Analysis

Term Work

The term work shall comprise of neatly written report based on tutorials and assignments. The term work shall cover the entire syllabus in such a way that the students would attempt at least four problems on each sub-modules and contents thereof.

At least twenty solved problem have to be validated by using available computer software.

Or

At least ten solved problem (validated by using available computer software) and analysis of (G+2) portal frame with minimum three bays.

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Semester - VII

(Department Level Optional Course - III)

CE-4106	L-T-P-C
Pre-stressed Concrete	3-0-0-3
Pre-requisite	Reinforced Cement Concrete

Objective: *The course is designed to bring the students to such a level so as to enable them to take the appropriate decision in respect of choice of prestressed section over R. C. C. as a civil engineer. Moreover, it also aims to make the student to be aware of such a highly mechanized technology in civil engineering construction.*

Course Outcome: *On successful completion of the course, the students shall be able: to understand the concept of pre-stressing, behavior of the pre-stressed structures vis- à-vis that of the RCC structure, to take the decision with respect to the choice of pre-stressed section over RCC, to understand the application of these techniques in civil engineering construction, especially in mass housing, railway sleepers, transmission of poles, bridges, etc., to analyze the various pre-stressed components of the structures and design the same.*

Course Content

Module 01: Introduction to Prestressed Concrete

Basic concept and general principles, materials used and their properties, methods, techniques and systems of prestressing.

Module 02: Analysis of Prestressed concrete sections

Loading stages and computation of section properties, critical section under working load for pre tensioned and post tensioned members, stress method, load balancing method

and internal resisting couple method, kern points, choice and efficiency of sections, cable profiles.

Module 03: Loss of Prestress

Loss of stresses doe to elastic deformation of concrete, creep in concrete, creep in steel, shrinkage in concrete, relaxation in steel, anchorage slip and friction.

Module 04: Deflections of Prestressed Concrete Members

Short time and long time deflection, deflection of uncracked sections, Uni-linear and bi-linear methods for cracked sections.

Module 05: Design of Prestressed Concrete Sections for Flexure in Working Stress and Limit State Method

General philosophy of design, permissible stresses in concrete and steel, suitability of section, safe cable zone, design of simply supported pretension and post tension slabs and beams using limit state method

Module 06: Design for shear

Calculation of principle tension under working load, permissible principle tension, shear strength calculation under limit state of collapse for both sections cracked and uncracked in flexure.

Module 07: End zone stresses in prestressed concrete members

Pretension transfer bond, transmission length, end block of post- tensioned members.

Module 08: Application of prestressing to continuous members

Introduction to application of prestressing to continuous beams and slabs, linear transformation and concordancy of cables.

Text/Reference Books

1. Prestressed Concrete. Krishna Raju N. McGraw Hill New York.
2. Prestressed Concrete. Rajgopalan N. Narosa Publishing House.
3. Fundamentals of Prestressed Concrete. Sinha N.C. & Roy S.K. S.C. Chand and Company.
4. Prestressed Concrete Structures. Dayaratnam, P. Oxford & IBH
5. Design of Prestressed Concrete Structures. Lin T.Y. & Burns N.H. John Willey New York.
6. Design of Prestressed Concrete. Nilson A. McGraw Hill Book Company.
7. Prestressed Concrete Vol—I. Guyon I.Y. Contractors Record, London.
8. Prestressed Concrete. Ramamurtham. S. Dhanpat Rai & Son's.
9. Relevant latest IS codes.

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Semester - VII

(Department Level Optional Course - III)

CE-4107	L-T-P-C
Pre-stressed Concrete Lab	0-0-1-1
Pre-requisite	Reinforced Cement Concrete

Term Work

The term work shall consist of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems/ questions on each modules/ sub-modules and contents thereof further. The report of the field visit/ site visit shall also form a part of the term work.

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Semester - VII

(Department Level Optional Course - III)

CE-4108	L-T-P-C
Solid Waste Management	3-0-0-3

Objective: *The course is designed to understand the implications of the production, resource management and environmental impact of solid waste management, to understand the components of solid waste management infrastructure systems to minimize the above effects, to be aware of the significance of recycling, reuse and reclamation of solid wastes, to be familiar with relationships between inappropriate waste management practices and impacts on water, soil and sediment quality, to fully appreciate the current practices available and implement the systems available in solid waste management.*

Course Outcome: *On completion of this course, the students shall be able to understand the various methods of disposal of solid waste. They shall have the better understanding of the nature and characteristics of solid waste and regulatory requirements regarding solid waste management and further they shall have an ability to plan waste minimization. Besides, they shall be prepared to contribute practical solutions to environmental problems in our society.*

Course Content

Module 01: Introducing Municipal Solid Waste Management Overview

problems and issues of solid waste management - Need for solid waste management- Functional elements such as waste generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.

Module 02: Generation and Characteristics of Waste

Sources, Types, composition, quantity, sampling and characteristics of waste, factors affecting generation of solid wastes.

Module 03: Waste Collection, Storage and Transport

Collection and storage of municipal solid waste; Methods of collection - House to House collection - Type of vehicles-Manpower requirement- collection routes; on site storage methods-materials used for containers- Reduction of solid waste at source-on site segregation of solid waste- Recycling and Reuse Need for transfer and transport; transfer station- selection of location, operation and maintenance; transportation Methods-manual, Mechanical methods with or without compaction, economy in transportation of waste optimization of transportation routes

Module 04: Waste Processing Techniques

Processing techniques-biological and chemical conversion technologies –
composting and its methods, vermicomposting, mechanical composting, In vessel composting, incineration, pyrolysis, gasification.

Module 05: Disposal of Solid Waste

Segregation, reduction at source, recovery and recycle; dumping of solid waste-sanitary waste- sanitary landfills-site selection-design and operation of sanitary landfill-secure landfills-landfill bioreactors-leachate and landfill gas management-landfill closure and environmental monitoring-landfill remediation; Municipal solid waste in Indian conditions, legal aspects of solid waste disposal.

Module 06: Industrial Solid Waste

Waste products during manufacturing and packing, operation of pollution control facilities, generation, minimization at source, recycling, disposal

Module 07: Hazardous Waste

Definition, sources, hazardous characteristics, management, Treatment and disposal, mutagenesis, carcinogenesis, Toxicity testing.

Module 08: Biomedical Waste

Definition, sources, classification, collection, segregation, treatment and disposal.

Module 09: Electronic Waste

Waste characteristics, generation, collection, transport and disposal.

Text/Reference Books

1. Integrated Solid Waste Management. Techobanglous. Thisen. & Vigil. McGraw Hill International.
2. Hazardous Waste Management. Lagrega. Buckingham. & Evans. McGraw Hill International.
3. Solid Waste Management in Developing Countries. Bhide A. D. Nagpur publications.
4. Environmental Pollution Control Engineering. Rao. C. S. Wiley Eastern. Manual of solid waste of management. CPHEEO.
5. E-Waste Implications Regulations and Management in India and Current Global Best Practices. Rakesh Johri. The Energy and Resources Institute.
6. Biomedical Waste Management in India. Kishore J. & Ingle G. K. Century Publications.

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Semester - VII

(Department Level Optional Course - III)

CE-4109	L-T-P-C
Solid Waste Management Lab	0-0-1-1

Term Work

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems and/ or questions on each modules/ sub-modules and contents thereof further. A detailed report prepared on the site visit as mentioned in the afore- mentioned section will also be submitted along with the assignments.

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Semester - VII

(Department Level Optional Course - III)

CE-4110	L-T-P-C
Structural Dynamics	3-0-0-3

Objective: *The course is designed to expose the students to understand the basic theory of structural dynamics, structural behavior under vibratory load and the effect of damping, to study the difference between static load and different types of dynamic loads, to study the free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system subjected to different dynamic loads, to study the dynamic degrees of freedom and calculation of the frequencies and mode shapes for lumped mass for discrete MDOF systems, to study the modal analysis of MDOF systems and analysis of systems with distributed mass for continuous system.*

Course Outcome: *The students are expected to understand the difference between static and dynamic loads and analysis. They are expected to evaluate the response of SDOF and MDOF systems to different types of dynamic loads including ground motions. They are also expected to understand the basics of random vibrations and the application of this concept to analyze Linear SDOF systems.*

Course Content

Module 01: Introduction

Introduction to structural dynamics, definition of basic problem in dynamics, static v/s dynamic loads, different types of dynamic load

Module 02: Single Degree of Freedom (SDOF) Systems

Undamped vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement. Forced vibration, response to harmonic forces, periodic loading, dynamic load factors, response of structure subjected to general dynamic load, Duhamel's integral, numerical evaluation of dynamics response of SDOF systems subjected to different types of dynamic loads. Introduction to frequency domain analysis, response of structure in frequency domain subjected to general periodic and non-periodic / impulsive forces of short duration, use of complex frequency response function. Use of Fourier Series for periodic forces, introduction to vibration isolation. Distributed mass system idealized as SDOF system, use of Rayleigh's method, response of SDOF system subjected to ground motion.

Module 03: Generalized Single-Degree of Freedom System

Generalized properties, assemblages of rigid bodies, systems with distributed mass and elasticity, expressions for generalized system properties.

Module 04: Lumped Mass Multi Degree of Freedom (MDOF) system

Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes- vector iteration methods, energy methods and use of Lagrange's method in writing equations of motions. Decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness, forced vibration of MDOF system, modal analysis, and application to multi storey rigid frames subjected to lateral dynamic loads.

Module 05: Structure with Distributed Mass System

Use of partial differential equation, free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes, forced vibration of single span beams subjected to the action of specified dynamic loads.

Module 06: Random Vibrations

Probability theory: Single random variable, important averages of single random variable, two random variables, important averages of two variables, principal axis of joint

probability density function, Rayleigh's probability density function. Random processes, stationary and ergodic processes, autocorrelation function, power spectral density function, relationship between power spectral and autocorrelation functions, power spectral density and autocorrelation functions for derivatives of processes, superposition of stationary processes, stationary Gaussian processes, stationary white noise, probability distribution for maxima and extreme values

Module 07: Stochastic Response of Linear SDOF Systems

Transfer functions, relationship between input and output autocorrelation functions, relationship between input and output power spectral density functions, response characteristics for narrowband systems

Text/Reference Books

1. Structural Dynamics-An Introduction to Computer Methods. Craig R.R. John Wiley and Sons.
2. Dynamics of Structures. Chopra A.K. Prentice Hall India Pvt. Ltd.
3. Dynamics of Structures. Cloguh & Penzein. Tata Mc-Graw Hill Pvt. Ltd.
4. Structural Dynamics. Biggs J.M. Tata Mc-Graw Hill.

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Semester - VII

(Department Level Optional Course - III)

CE-4111	L-T-P-C
Structural Dynamics Lab	0-0-1-1

Term Work

The term-work shall comprise of the neatly written report based on the practicals/ experiments performed either in the laboratory andthe assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/or questions on each modules/ sub-modules and contents thereof further.

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Semester - VII

(Departmental Level Optional Course - III)

CE-4112	L-T-P-C
Application of GIS and Remote Sensing Lab	3-0-0-3
Pre-requisite	Surveying

Objective: *To introduce the students to the basic concepts and principles of various components of remote sensing. To provide an exposure to GIS and its practical applications in civil engineering.*

Course Outcome: *Students should get the detail knowledge of remote sensing and GIS.*

Course Content

Module 01: EMR and its interaction with atmosphere & earth material

Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil

Module 02: Platforms and sensors

Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and spaceborne TIR and microwave sensors.

Module 03: Image interpretation and analysis

Types of Data Products – types of image interpretation – basic elements of image interpretation – visual interpretation keys – Digital Image Processing – Pre processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.

Module 04: Geographic information system

Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and nonspatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).

Module 05: Data entry, storage and analysis

Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

Text/Reference Books

1. Remote Sensing and Image Interpretation. Lillesand. T.M. Kiefer R.W. & Chipman J.W. John Willey & Sons Asia Pvt. Ltd. New Delhi. 2004.
2. Textbook of Remote Sensing and Geographical Information System. Reddy A.M. BS Publications Hyderabad. 2001.

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Semester - VII

(Departmental Level Optional Course - III)

CE-4113	L-T-P-C
Application of GIS and Remote Sensing Lab	0-0-1-1
Pre-requisite	Surveying

Term Work

The term work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further

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Semester - VII

(Departmental Level Optional Course –III)

CE-4114	L-T-P-C
Foundation Analysis and Design	3-0-0-3
Pre-requisite	Geotechnical Engineering

Objective: *The course is designed to study site investigation techniques and characterization of the soil, also it helps to understand the one and three dimensional consolidation process and their practical applications and to study stress paths and failure criteria. Moreover it helps to study the bearing capacity and settlement of shallow foundations and study the different ground improvement methods*

Course Outcome: *On successful completion of the course, the students will: Able to identify, formulate and solve geotechnical engineering problems, Also able to design a suitable foundation system from economic and safe aspects.*

Course Content

Module 01: Site exploration and characterization

Purpose and scope, influence of soil conditions and type of foundations on exploratory programme, project assessment, phasing of site exploration. Open excavation and boring methods of exploration, types of samplers and their design features. Subsurface soundings-static, dynamic and geophysical methods. Planning of subsurface investigations, type and sequence of operations, lateral extent and depth of exploration, interpretation of field and laboratory data.

Module 02: Consolidation

Terzaghi's one dimensional consolidation- derivation of equation (solution in detail need not be covered) Estimation of C_c and c_v from laboratory tests, estimation of preconsolidation pressure by various methods, field consolidation curves, prediction of field settlement, practical applications. Quasi-preconsolidation and secondary consolidation. Concept of three dimensional consolidation in cylindrical coordinates, theory of sand drain and prefabricated vertical drains.

Module 03: Stress and strain behaviour of soil

Triaxial test – drained and undrained behaviour of sands and clays. Stress path, ideal, plastic and real soil behaviour, shear strength of sands and clays, failure criteria in soils- Mohr-Coulomb's criteria, modified cam clay model.

Module 04: Estimation of stresses

Boussinesq's theory, vertical stress due to concentrated load, horizontal and shear stress due to concentrated load, isobar diagram, vertical stress distribution on horizontal plane, influence diagram, vertical stress distribution on vertical plane. Vertical stress due to line load, vertical stress under strip load, maximum shear stress at points of under strip loads, vertical stress under a circular area, vertical stress under a corner of a rectangular area, Newmark's influence charts. Westergard's theory.

Module 05: Bearing capacity and settlement of shallow foundation

Modes of failure, failure criteria- Terzahi concept, Vesic concept, IS code recommendations. Assumptions in estimation of ultimate loads, effect of shape, embedment of footing, eccentricity in loading, choice factor of safety. Compressibility (including critical rigidity index), settlement of foundations on sand- Schmertmann method. Evaluation of bearing capacity using plate load test and standard penetration test, Housel method.

Module 06: Pile foundations

Estimation of single pile capacity by static and dynamic methods, group capacity in sand and clay deposits, separation of skin friction and end bearing capacity. Settlement of single and group of piles.

Module 07: Ground improvement

Improvement of deep cohesionless soils. Improvement in cohesive soils. Improvement of soil using additives such as fibres, chemicals, sustainable waste materials Concept of

using geosynthetics, soil nailing to stabilize slopes and embankments Instrumentation-pore pressure gauges and settlement gauges and their applications.

Text/Reference Books

1. Soil Mechanics and Foundation Engineering. Murthy V. N. S. Publisher Saitech.
2. Soil Mechanics and Foundation Engineering. Arora K. R. Standard Publishers and Distributors New Delhi.
3. Geotechnical Engineering. Venkatramaiah C. New Age International.
4. Soil mechanics in Engineering Practice. Terzaghi K. & Peck R. B. Wiley international edition.
5. Foundation Engineering Handbook. Winterkorn & Fang. Galgotia publications.
6. Foundation Design Manual. Nayak N. V. Dhanpat Rai publications (P) Ltd.
7. Principles of Foundation Engineering. Das B.M. PWS publishing.
8. Relevant Indian Standard Specifications and Codes. BIS Publications New Delhi.

Digital Material

1. Construction Planning and Management Unit 7-8, Dr. Kousik Deb, IIT Kharagpur NPTEL (https://nptel.ac.in/courses/105105039/)

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Semester - VII

(Departmental Level Optional Course –III)

CE-4115 L-T-P-C
Foundation Analysis and Design Lab 0-0-1-1
Pre-requisite Geotechnical Engineering

Laboratory Outcome: *Students must be able to conduct laboratory experiments to collect, analyze, interpret and present the data.*

Description: *The purpose of the laboratory is to facilitate high-level research and development work within the field of Geotechnical engineering.*

List of Experiments

S. No.	Title of the Experiment	Module
1.	Unconsolidated Undrained, Consolidated Undrained and Consolidated Drained Triaxial Tests.	01
2.	Direct box shear test on c- ϕ soils.	02

Text/Reference Books

1. Soil Mechanics and Foundation Engineering. Murthy V. N. S. Publisher Saitech.
2. Soil Mechanics and Foundation Engineering. Arora K. R. Standard Publishers and Distributors New Delhi.
3. Geotechnical Engineering. Venkatramaiah C. New Age International.

Digital Material

1. Civil Engineering Lab. NITTTR-NCTEL. (http://www.nitttrchd.ac.in/sitenew1/nctel/civil.php)

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Semester - VII

(Departmental Level Optional Course –III)

CE-4116	L-T-P-C
Applied Hydrology and Flood Control	3-0-0-3
Pre-requisite	Water Resource Engineering

Objective: *The course is designed to study the hydrological cycle, rainfall measurement, various water losses, hydrograph, unit hydrograph their applications. Students will also learn flood control methods, estimate design flood, flood routing, concepts of ground water movement, steady and unsteady flow towards fully penetrating wells and well yields.*

Course Outcome: *On successful completion of the course, the students will: be able to understand hydrological cycle, measure rainfall and runoff. They will be able to estimate design flood and apply flood controlling methods on a given problem.*

Course Content

Module 01: Introduction

Hydrological cycle, scope of hydrology, water budget equation, sources of data.

Module 02: Precipitation

Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area - Duration relationship, Intensity-Duration -Frequency relationship,

Probable Maximum Precipitation

Module 03: Abstractions from Precipitation

Evaporation and transpiration, evapotranspiration, interception, depression storage, infiltration and infiltration indices, determination of water losses.

Module 04: Stream Flow Measurement

Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.

Module 05: Runoff

Catchment, watershed and drainage basins, Factors affecting runoff, rainfall-runoff relationship, runoff estimation, droughts

Module 06: Hydrograph Analysis

Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.

Module 07: Floods

Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk-reliability and safety factor.

Module 08: Flood Routing

Reservoir routing, channel routing.

Module 09: Ground Water Hydrology

Yield, transmissibility, Darcy's law, Dupuit's theory of unconfined flow, steady flow towards fully penetrating wells (confined and unconfined).Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.

Text/Reference Books

1. Engineering Hydrology. Subramanya K. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures. Ukarande S. K. Ane's Books Pvt. Ltd. 2015.
3. Hydrology. Raghunath H. M. New Age International Publishers New Delhi.
4. Irrigation and Waterpower Engineering. Punmia B.C. & Pande B.B.L. Laxmi Publications Pvt. Ltd. New Delhi.

5. Irrigation Engineering and Hydraulics Structures. Garg S. K. Khanna Publishers Delhi.
6. Irrigation Water Resources and Waterpower Engineering. Modi P.N. Standard Book House Delhi.
7. Elementary Hydrology. Singh V. P. Prentice Hall.
8. Engineering Hydrology Principles and practice. Ponce V. M. Prentice Hall.

Digital Material

1. Watershed Management, Dr. T.I. Eldho, IIT Bombay NPTEL (https://nptel.ac.in/courses/105101010/)

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Semester - VII

(Departmental Level Optional Course –III)

CE-4117	L-T-P-C
Applied Hydrology and Flood Control Lab	0-0-1-1
Pre-requisite	Water Resource Engineering

Term Work

The term work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and / or questions on each sub-modules and contents thereof further.

Text/Reference Books

1. Engineering Hydrology. Subramanya K. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures. Ukarande S. K. Ane‘s Books Pvt. Ltd. 2015.
3. Irrigation and Waterpower Engineering. Punmia B.C. & Pande B.B.L. Laxmi Publications Pvt. Ltd. New Delhi.
4. Engineering Hydrology Principles and practice. Ponce V. M. Prentice Hall.

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Semester - VII

(Department Level Optional Course - III)

CE-4118	L-T-P-C
Pavement Sub-grade and Materials	3-0-0-3

Objective: *The course is designed to give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards, to study the significance of the soil subgrade along with its functions.to study the soil classification for highway engineering purpose as per different classification system.to understand the concept of stresses in soil, to enable the student to identify the basic deficiencies of various soil deposits and to arrive upon the various ways and means of improving the soil and implementing the techniques of improvement.*

Course Outcome: *On the successful completion of the course, the students shall be able to: Understand the soil classification in accordance with various soil classify the system and evaluate the ability of the soil as a subgrade material. Understand the requirements and desirable properties of the various materials to be used in the construction of pavements. Understand the characterization of different paving materials along with the tests to be conducted on these materials. Know the various ground improvement methods. Know the different methods of drainage in highways and design the drainage systems.*

Course Content

Module 01: Subgrade

Functions, Importance of subgrade soil properties on pavement performance, subgrade soil classification for highway engineering purpose soils as per PRA system, revised PRA system, Bur mister system, Compaction system.

Module 02: Grading

Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials), selection of different grade of bitumen, types of bituminous surfaces, skid qualities, bituminous mix design, Marshall Stability test, design aspect of paving concrete. Experimental characteristics of road aggregate.

Module 03: Soil Survey

Soil Survey Procedure for Highway and Ground Water Investigation. Identification and Significance of soil Characteristics, effect of water in soil Swelling/shrinkage, cohesion, plasticity in soil. Soil Moisture movement- ground water, gravitational water, held water, soil suction.

Module 04: Stress in soil

Theories of elastic and plastic behavior of soils, Methods of reducing settlement, estimation of rate of settlement due to consolidation in foundation of road embankment. Static and cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus. CBR test, effect of lateral confinement on CBR and E value of Subgrade soil. Static and cyclic plate load test, estimation of modulus of subgrade reaction, correction for late size, correction for worst moisture content.

Module 05: Ground Improvement Technique

Different method of soil stabilization, use of geo-textile, geogrid and fibres in highway subgrade. Vertical sand drain: design criteria, construction and uses

Module 06: Storm water Drainage

General principles subsoil Drainage. Frost action soil: Frost susceptible soils, depth of frost penetration, and loss of strength during frost melting. Compaction of soils, field and laboratory method of soil compaction, equipment's used in field compaction. Design of surface and subsurface drainage system, pumping system, water body, holding ponds

Text/Reference Books

1. Principles of Pavement Design. Yoder E.J. John Wiley and Sons Inc. New York. 1975.

2. Concrete Roads: HMSO Road Research Laboratory London.
3. Highway Engineering. Khanna S.K. Justo C.E.G. & Veeraraghavan A. Nemchand and Bros. Roorkee. 2014.
4. Principles and Practices of Highway Engineering. Kadiyali L.R. & Lal N.B. Khanna Publishers New Delhi.
5. Highway Engineering. Sharma S.K. S. Chand Technical Publishers New Delhi. 2013.
6. Principles of Transportation and Highway Engineering. Rao G.V. Tata Mc-Graw Hill Publications New Delhi.

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Semester - VII

(Department Level Optional Course - III)

CE-4119	L-T-P-C
Pavement Sub-grade and Materials Lab	0-0-1-1

Term Work

The term-work shall comprise of the neatly written report comprising of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems/ two questions on each modules/ sub-modules and contents thereof further.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4120	L-T-P-C
Advanced Design of Steel Structures	4-0-0-4
Pre-requisite	Design of Steel Structures

Objective: *To understand the analysis and design concept of round tubular structures. To understand the design concept of different type of steel water tank. To understand the design concept of lattice tower and steel chimney. To understand the design concept of gantry girder. To develop clear understanding of the concepts and practical knowledge of modern Civil Engineering techniques for design of steel structures. Use of various relevant IS codes for designing steel structures.*

Course Outcome: *On completion of this course, the students shall be able to understand the analysis and design of gantry girder by limit state method. They shall be able to analysis and design steel chimney, lattice tower, tubular truss and water tank. The students are expected to be able to independently design steel structures using relevant IS codes.*

Course Content

Module 01: Introduction to Steel Structure

Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM) and Limit state method

Module 02: Moment Resistant Beam End Connections

Design of moment resistant bolted and welded beam end connections by limit state method

Module 03: Round Tubular Structural Members

Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports.

Module 04: Elevated Steel Tanks and Stacks

Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation, design of rectangular steel tanks including design of staging, columns and foundation.

Module 05: Gantry Girder

Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.

Module 06: Lattice Tower

Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower, design of lattice tower including welded or riveted connections for members by limit state method.

Module 07: Steel Chimney

Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.

Text/Reference Books

1. Design of Steel Structures. Subramanian N. Oxford- University Press
2. Design of Steel Structures. Punamia, A. K. Jain & Jain A.K. Laxmi Publication.
3. Design of Steel Structures. Dayaratnam. Wheeler Publication New Delhi.
4. Design of steel structures. Krishnamachar. B.S. & Ajitha S. D.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4121	L-T-P-C
Advanced Design of Steel Structures lab	0-0-1-1
Pre-requisite	Design of Steel Structures

Term Work

The marks of the term-work shall be judiciously awarded for various components depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4122	L-T-P-C
Industrial Waste Treatment	4-0-0-4
Pre-requisite	Environmental Engineering

Objective: *To study different characteristics of liquid waste generated from different industries. To study the effect of disposal of liquid waste into natural water course, municipal sewer and on land. To study general treatment of industrial wastes like neutralization, equalization and segregation. To study the conventional aerobic and anaerobic biological treatment methods*

Course Outcome: *On completion of this course, the students shall have an ability to understand the industrial waste sources, effects and its treatment. The students shall understand the various methods of disposal of industrial waste. They shall further have an understanding of the nature and characteristics of industrial waste and regulatory requirements regarding industrial waste treatment and lastly, they will have an ability to plan industrial waste minimization.*

Course Content

Module 01: General

Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards.

Module 02: Sampling

Sampling and analysis of industrial wastes, Treatability study, good housekeeping, bioassay test, population equivalence.

Module 03: Stream sanitation

Effects of industrial wastes on self-purification of streams and fish life, Statement and significance of the parameters of Streeter and Phelp's equation and BOD equations, Deoxygenating and reaeration , Oxygen sag and numericals based on this.

Module 04: General treatment of industrial wastes

Neutralization, equalization, segregation. Modification of conventional aerobic and anaerobic biological treatment methods. Dewatering and disposal of sludges – floatation, vacuum filtration, centrifugation, filter press and
membrane filters.

Module 05: Detailed consideration of wastes produced from following industries

Manufacturing processes normally followed , Volume and effects of raw and treated effluent on streams, sewers, characteristics of effluents and land Treatment methods, reuse-recovery

1) Textiles: cotton
2) Pulp and paper:- Sulphate process 3)Electroplating
4) Dairy
5) Sugar-sugarcane
6) Distilleries
7) Tanneries
8) Refineries

Module 06: Provision of various acts

Provision of various acts pertaining to industrial wastes / effluents, introduction to environmental impact assessment and environmental audit.

Module 07: Common Effluent

Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation and Maintenance Problems and Economical aspects.

Text/Reference Books

1. Industrial Water Pollution Management. Gurnham E. F. John Wiley.

2. Biological Waste Treatment. Eckenfelder & Connor. Pergamon Press.
3. Theories and Practices of Industrial Waste Treatment. Wesley A.
4. Pollution Control in Process Industries. Mahajan. S. P. Tata McGraw Hill.
5. Industrial Waste. Rudolfs. W. (Ed). L E C Publishers Inc.
6. The Treatment of Industrial Wastes. Besselievre. E. D. Mcgraw Hill.
7. Industrial Waste Disposal. Ross. R. D. (Ed) Reinhld Bok Croporation.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4123	L-T-P-C
Industrial Waste Treatment Lab	0-0-1-1
Pre-requisite	Environmental Engineering

Term work

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further. In addition to the assignments, each student shall prepare a report on visit to the site mentioned in the preceding section.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4124	L-T-P-C
Pavement Design and Construction	4-0-0-4
Pre-requisite	Transportation Engineering/Highway Engineering

Objective: *To introduce the different types of pavements depending upon the mode of transportation using it and further, depending upon the structural behavior. To understand the concept of consideration of wheel loads, axle loads, wheel-axle configuration and allied aspects as a pre-requisite in the analysis and design of the pavement. To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations. To study the various methods of analysis and design of the pavements and its sub- sequent applications to the various types of pavements. To study the different types of distresses in pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements. To study the construction of the concrete roads and low volume roads. To study the quality control and quality assurance in the road construction and introduce pavement management system.*

Course Outcome: *Understand the structural actions involved in the pavement due to different types of load acting thereon and the various methods of analysis of pavements. Understand the applications of the analysis in the design of pavements using different methods of pavement design. Know the different types of distresses occurring in the existing pavements and carry out the structural and functional evaluation of the*

pavements. Apply the knowledge of evaluation in pre-empting the failure and to arrive upon the methodology of the rehabilitation of pavements. Understand the various aspects of the construction of concrete roads and low volume roads. Understand the pavement management system and quality control and assurance criteria and subsequently, its application in the highway construction.

Course Content

Module 01: Introduction

Pavement structure and functional attributes, factor affecting pavement design, types of wheel loads for highways and airports, development of design method for highway and airport pavements.

Module 02: Stress in pavements

Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF, ESWL. Stresses in Rigid pavement: load and temperature stresses, combined stresses.

Module 03: Flexible Pavement Design

Airport pavement: Corps of Engineer's method, FAA method CDOT method, Asphalt institute method. Highway Pavement: Empirical methods using no soil strength criteria, empirical method based on soil strength criteria: CBR method as specified by IRC, Road note 29 methods, AASHTO method, Asphalt institute method. Fatigue and rutting as a failure criterion.

Module 04: Rigid Pavement Design

Airport pavements: PCA methods, corps of Engineer's method, FAA method. Joints and reinforcement requirement. Highway pavement: Current British procedure, IRC method.

Module 05: Evaluation and strengthening

Flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkaleman beam deflections, design of overlays, skid resistance and measurement.

Module 06: Concrete road construction

Mix design, concrete strength, size of aggregates, gradation, and workability, preparation of base form work, placing of reinforcement, compaction, and finishing, curing, joints.

Module 07: Low Cost Roads (Rural Areas)

Classification of low cost roads, construction of low cost roads, stabilization of subgrade, base and its advantages, construction of granular base courses, macadam surface, macadam bases, low cost materials and methods used for highway construction, suitability of different types of roads under different situation. Soils.

Module 08: Road making machinery

Role of labour versus machinery, in road construction, earth work machinery, rock excavation machinery, aggregate transportation and watering equipment, wet mix WMM Plant, Asphalt plant, (computerized), drum mix, Continuous batch mix, compaction equipment, bituminous equipment, storage, heating and spraying equipment, hot mix plants, cold mix plants, paver, finisher, concrete road making machinery, equipment usage rates, factors affecting usage rate

Module 09: Quality control & Quality assurance

Quality control (QC) and Quality assurance (QA) during construction of various pavements, importance, process control and end product control, statistical methods in quality control, control charts, frequency of testing etc.

Module 10: Pavement Management

Introduction to pavement management systems.

Text/Reference Books

1. Principles and Practice of Highway Engineering. Kadiyali L.R. Khanna publications Delhi.
2. Highway Engineering. Khanna S.K. Justo C.E.G. & Veeraraghavan A. Nemchand and Bros. 10th Revised Edition. Roorkee
3. Highway Engineering. Sriniwaskumar R. University Press Hyderabad.
4. Pavement Analysis and Design. Huang Y. H. Prentice Hall. New Jersey 1993.
5. Pavement Design. Yoder & Witzech. McGraw-Hill 1982.
6. Principles, Practice and Design of Highway Engineering. Sharma S.K. S Chand and Co. Pvt. Ltd. Delhi.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4125	L-T-P-C
Pavement Design and Construction Lab	0-0-1-1
Pre-requisite	Transportation Engineering/Highway Engineering

Term work

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/ or questions on each modules/ sub-modules and contents thereof, further.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4126	L-T-P-C
Bridge Design and Engineering	4-0-0-4
Pre-requisite	Water Resource Engineering/Structural Analysis

Objective: *Selection of suitable type of bridge according to the site condition. IRC loadings, load distribution and railway loading. Design of bridge superstructure and substructures. Different types of bridge foundations. Erection of bridge super structure.*

Course Outcome: *Select the suitable type of bridge according to the site condition. Understand IRC loads, distribution of these loads among longitudinal beams of a bridge. Design of balanced cantilever concrete bridge, prestressed concrete bridge, lattice girder Railway Bridge, RC Arch bridges and box bridges. Design different types of foundations, piers and abutments, their methods of construction. Understand various types of bearings and their suitability, erection of bridge superstructure.*

Course Content

Module 01: Introduction

Types of Bridges, Selection of suitable type of bridge, aesthetics, economic span.

Module 02: Design Loads and their Distribution

IRC loads, analysis of deck slab and IRC loads, Load distribution among longitudinal beams of a bridge, railway loading.

Module 03: Design of Superstructure

Design of balanced cantilever concrete bridge, design of prestressed concrete bridge, design of lattice girder railway bridge, introduction to design of RC Arch bridges and box bridges.

Module 04: Design of Substructure

Different types of foundations, their choice and methods of construction, design of well foundation, design of piers and abutments, various types of bearings and their suitability.

Module 05: Construction Methods

Erection of bridge superstructure, cantilever construction.

Text/Reference Books

1. Design of Bridge Superstructures. Jagdeesh T.R. & Jayaram M.A. Prentice Hall India Private Ltd. New Delhi.
2. Essentials of Bridge Engineering. Victor D.J. Oxford and IDH.
3. Concrete Bridge Practice. Raina V. K. Tata Mc Graw Hill.
4. Bridge Engineering. Ponnuswamy S. Tata Mc Graw Hill.
5. Design of Bridges. Raju N. K. Oxford and IDH.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4127	L-T-P-C
Bridge Engineering and Design Lab	0-0-1-1
Pre-requisite	Water Resource Engineering/Structural Analysis

Term Work

The term work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further

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Semester - VIII

(Department Level Optional Course - IV)

CE-4128 L-T-P-C
Appraisal and Implementation of Infrastructure Project 4-0-0-4

Objective: *The course is designed to understand the basic study as well as feasibility studies of Infrastructure projects, to learn various appraisals for deciding the worthwhileness of the projects, to make students acquainted with the important tools like break even analysis, S.W.O.T analysis, to know about economic analysis of the projects*

Course Outcome: *On successful completion of the course, it is expected that: The students shall be able to understand about the infrastructure projects and implementation methods. The students shall be able to know how to prepare project report and detailing about the project. The students shall be able to understand and apply various appraisal criteria's for deciding the worthwhileness of the project. The course shall inculcate the managerial skills and knowledge of financial aspects among the students which will be helpful for them in future during the implementation of projects.*

Course Content

Module 01: Construction Projects and Report Preparation

Infrastructure projects and its classification, Project Formulation and phases involved in it., Feasibility studies, SWOT analysis., Preparation of Project report.

Module 02: Projects Appraisal

Project Development Cycle, What is appraisal? Need of appraisal etc., Steps of appraisal design.

Module 03: Market Appraisal

Demand analysis, forecasting demand etc., Sources of information, Market Survey, Uncertainties in demand forecasting.

Module 04: Technical Appraisal

Technical Viability, Location, Land, Building etc., Size of plant, Technology, Machinery, raw materials etc. Energy requirements, Water supply, effluent disposal etc.

Module 05: Managerial Appraisal

Assessment of entrepreneurs, Organizational structure, Managerial requirements of project., Chief Executive, Board of Directors etc. Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.

Module 06: Financial Analysis and Economic appraisal

Cost of project, Profitability, Break Even Analysis etc., Economic appraisal: Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.

Module 07: Project Implementation

Agencies involved in Implementation. Methods of implementation like Built, operate and Transfer its Variants like B.O.O, B.O.OT, B.L.T etc.

Module 08: Project Financing

Types and Sources of finance (Local, National and International)

Project financing Issues.

Text/Reference Books

1. Project Preparation, Appraisal, Budgeting, and Implementation. Chandra P. Tata McGraw Hill.

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Semester - VIII

(Department Level Optional Course - IV)

CE-4129 L-T-P-C
Appraisal and Implementation of Infrastructure Project Lab 0-0-1-1

Term Work

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4130	L-T-P-C
Soil Dynamics	4-0-0-4
Pre-requisite	Geotechnical Engineering

Objective: *To study fundamental concepts of vibrations, degrees of freedom and damping systems. To study phenomena like liquefaction and their effects. To study principals of machine foundation design and dynamic earth pressure theories on retaining wall. To learn test methods of evaluating dynamic properties of soil.*

Course Outcome: *Acquire the knowledge of concepts, principles and applications of soil under dynamic loading. Develop an ability to design with reference to code provisions and solve the practical soil problems subjected to vibrations. Provide an impetus to new developments in related dynamic topics.*

Course Content

Module 01: Vibration

Vibration of elementary system, degree of freedom, analysis of system with one degree of freedom, spring-mass system, harmonic vibration, uniform circular motion natural frequency, free and forced vibrations with and without damping, type of damping.

Module 02: Wave propagation

Wave propagation in elastic rods, in an elastic infinite medium and insemi elastic half space, wave generated by surface footing

Module 03: Liquefaction of soils

Liquefaction of soils, criterion and factors affecting liquefaction of soil, laboratory and field studies on liquefaction, liquefaction studies in oscillatory simple shear, evaluation of liquefaction potentials, liquefaction of clay

Module 04: Principles of machine foundation design

Principles of machine foundation design, criteria for satisfactory machine foundation, degree of freedom of a block foundation analysis of vertical and sliding vibration of a machine foundation, mass of soil participating in vibration.

Module 05: Vibration isolation

Vibration isolation and screening methods, improvement of distressed machine foundation.

Module 06: Dynamic properties of soils

Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils.

Module 07: Basics of dynamic earth pressure

Basics of dynamic earth pressure on retaining walls: conventional gravity type, reinforced soils, distribution of pressure, point ofpplication of the resultant, simple examples.

Text/Reference Books

1. Soil Dynamics. Prakash S. McGraw-Hill.
2. Principles of Soil Dynamics. Das B.M. PWS-Kent Publishing Company.
3. Dynamics of Bases and Foundations. Barkan D. D. McGraw Hill.
4. Relevant IS codes.

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Semester - VIII

(Departmental Level Optional Course - IV)

CE-4131	L-T-P-C
Soil Dynamics Lab	0-0-1-1
Pre-requisite	Geotechnical Engineering

Term Work

The marks of the term-work shall be judiciously awarded for various components of the term work depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments, proper compilation of the project report and that of experiments/ practical, if conducted; and further, minimum passing marks to be obtained by the students.

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Semester - VIII

(Department Level Optional Course - IV)

CE-4132	L-T-P-C
Design of Hydraulics Structures	4-0-0-4
Pre-requisite	Water Resource Engineering

Objective: *The course is designed to study planning of reservoir and selection criteria for gravity dam, to study various types of dams including planning and design, to study the design of earth and rock fill dams, to study spillways and energy dissipaters and flood control works.*

Course Outcome: *On successful completion of this course, the student shall be able to: Select the site for dam with preliminary and final investigations, fix storage capacity, analyze reservoir losses, and estimate sedimentation in reservoirs. Analyze forces acting on gravity dam its failure and carry out stability analysis of gravity dams. Understand forces on an arch and buttress dams and its design. Understand details of construction and maintenance of earth fill and rock fill dams including stability analysis criteria. Understand design principles of spillways, energy dissipation works and flood control works. Design small bridges and culverts and its principles of hydraulic design.*

Course Content

Module 01: Reservoir Planning and Management

Reservoir – types, storage capacity of reservoir, storage zones, designing reservoir capacity, flow duration curves, mass curves of inflow and outflow, reservoir losses, reservoir sedimentation, silt control, selection of type of dam, selection of site of dam, preliminary and final investigations of dam sites.

Module 02: Gravity Dams

Definition, typical cross section, forces acting on gravity dam, modes of failure and structural stability analysis, profile of dam- elementary and practical profile, low and high gravity dam, design consideration and fixing of section of dam, methods of design, construction of galleries in dams, types of joints, temperature control in concrete dams, foundation treatment.

Module 03: Arch and Buttress Dams

Definition and types of arch dams, forces acting on arch darn, design of arch dams, types of buttress dams.

Module 04: Earth and Rock Fill Dams

Types of earth dams, method of construction, causes and failures of earth dams, design criteria, selecting suitable preliminary section, seepage line for different conditions and its location, seepage control through embankment and through foundations, Swedish circle method with pore pressure, details of construction and maintenance, types of rock fill dams, stability analysis, advantages.

Module 05: Spillways and Flood Control Works

Introduction, location of spillway, design consideration of main spillway, controlled and uncontrolled spillway, types of spillways, design principles of ogee spillway. Chute spillway. Siphon spillway and shaft spillway, energy dissipation below overflow and other types of spillways, design of bucket type energy dissipater and stilling basin, flood mitigation reservoirs. Crest gates, types, advantages, design of radial gate, outlet works through dams, intake structures.

Module 06: Miscellaneous Topics

Design of small bridges and culverts, data collection, high flood discharge, linear waterway calculation, scour depth, causeways and culverts, principles of hydraulic design of causeways and culverts, design details of surplus weir, flush escape, direct sluice, canal drops, canal regulators, diversion head works: component parts, functions, weirs and barrages, Blighs Creep theory, Lanes weighed theory. Cross drainage (CD) works: Types of CD works

Text/Reference Books

1. Irrigation Engineering and Hydraulic Structures. Ukarande S. K. Ane‘s Books Pvt. Ltd. 2015.
2. Irrigation and Waterpower Engineering. Punmia B.C. & Pande B.B.L. Laxmi Publications Pvt. Ltd. New Delhi.
3. Irrigation Water Resources and Waterpower Engineering. Modi P.N. Standard Book House Delhi.
4. Irrigation Engineering and Hydraulics Structures. Garg S. K. Khanna Publishers Delhi.
5. Theory and Design of Irrigation Structures. Varshney R. S. & Gupta R. C. Nem Chand and Bross Roorkee.
6. Engineering for Dams (Vol.-I to Vol.-III). Crager J. & Hinds. John Wiley.
7. Hydro Power Structures. Varshneye. R.S. Nem Chand and Bross Roorkee.
8. Concrete Dam. Varshney R. S. Oxford and IBH Publishing Co.

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Semester - VIII

(Department Level Optional Course - IV)

CE-4133	L-T-P-C
Design of Hydraulics Structures Lab	0-0-1-1
Pre-requisite	Water Resource Engineering

Term Work

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further.

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Semester - VII

(University Level Optional Course -I)

CE-4151 L-T-P-C
Disaster Management and Mitigation Measures 3-0-0-3

Objective: *This course is designed to understand physics and various types of disaster occurring around the world, to identify extent and damaging capacity of a disaster, to study and understand the means of losses and methods to overcome /minimize it.*

Course Outcome: *Students will be able to: get to know natural as well as manmade disaster and their extent and possible effects on the economy, plan of national importance structures based upon the previous history, get to know the simple do's and don'ts in such extreme events and act accordingly.*

Course Content

Module 01: Introduction

Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.

Module 02: Natural Disaster and Manmade disasters

Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion.
Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing

population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Module 03: Disaster Management, Policy and Administration

Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.

Module 04: Institutional Framework for Disaster Management in India

Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.

Module 05: Financing Relief Measures

Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.

Module 06: Preventive and Mitigation Measures

Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.

Text/Reference Books

1. Disaster Management. Gupta H.K. Universities Press Publications.

2. Disaster Management. An Appraisal of Institutional Mechanisms in India. Dagur O.S. Centre for land warfare studies New Delhi. 2011.
3. Introduction to International Disaster Management. Copolla D. & Heinemann B. Elsevier Publications.
4. Disaster Management Handbook. Pinkowski J. CRC Press Taylor and Francis group.
5. Disaster management & rehabilitation. Dasgupta R. Mittal Publications New Delhi.
6. Natural Hazards and Disaster Management, Vulnerability and Mitigation. Singh R B. Rawat Publications.
7. Concepts and Techniques of GIS. Lo C.P. Albert. K.W. & Yonng. Prentice Hall (India) Publications.

Digital Material

1. Natural Hazard Prof. Javed Malik IIT Kanpur, NPTEL (https://nptel.ac.in/courses/105104183/)

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Semester - VII

(University Level Optional Course – I)

CS-4151	L-T-P-C
Management Information System	3-0-0-3

Objective: *The objectives of this course are to discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built, define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage, identify the basic steps in systems development.*

Course Outcome*: At the end of the course student will be able to explain how information systems Transform Business, identify the impact information systems have on an organization, describe IT infrastructure and its components and its current trends, understand the principal tools and technologies for accessing information from databases to improve business performance and decision making, identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.*

Course Content

Module 01: Introduction

Introduction to Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS

Module 02: KMS and BI

Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management; Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results

Module 03: Ethical issues and privacy

Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls

Module 04: Social Computing

Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, commerce. E-business and E-commerce – B2B B2C.

Module 05: Mobile Computing

Mobile Computer Networks, Wired and Wireless Technology, Pervasive computing, Cloud computing model.

Module 06: Information Systems

Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.

Text/Reference Books

1. Management Information Systems. Rainer K. & Prince B. Wiley.
2. Management Information Systems: Managing the Digital Firm. Laudon K. C. & Laudon J. P. 10th Ed. Prentice Hall. 2007.
3. Managing Information Systems: Strategy and Organization. Boddy D. & Boonstra A. Prentice Hall. 2008.

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Semester - VII

(University Level Optional Course – I)

CS-4152 L-T-P-C
Cyber Security & Laws 3-0-0-3

Objective: *The objectives of this course are to understand and identify different types cybercrime and cyber law, recognized Indian IT Act 2008 and its latest amendments, learn various types of security standards compliances.*

Course Outcome*: At the end of the course student will be able to understand the concept of cybercrime and its effect on outside world, interpret and apply IT law in various legal issues, distinguish different aspects of cyber law, apply Information Security Standards compliance during software design and development.*

Course Content

Module 01: Introduction to Cybercrime

Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.

Module 02: Cyber offenses & Cybercrime

How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices,

Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

Module 03: Tools and Methods Used in Cyberline

Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)

Module 04: The Concept of Cyberspace

E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law

Module 05: Indian IT Act

Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act,2000, IT Act. 2008 and its Amendments

Module 06: Information Security Standard compliances

SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.

Text/Reference Books

1. Cyber Security. Godbole N. & Belapure S. Wiley India.
2. The Indian Cyber Law. Vishwanathan S. T. Bharat Law House, New Delhi.
3. The Information technology Act, 2000. Professional Book Publishers.
4. Cyber Law & Cyber Crimes. Mali P. Snow White Publications.
5. Information Systems Security. Godbole N. Wiley India.
6. Cyber Security & Global Information Assurance. Knapp K. J. Information Science Publishing.
7. Cryptography and Network Security. Stallings W. Pearson Publication.
8. Websites for more information is available on: The Information Technology ACT, 2008 - TIFR: https://www.tifrh.res.in.

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Semester - VII

(University Level Optional Course - I)

EC-4151 L-T-P-C
Design of Experiments 3-0-0-3

Objective: *This course is designed to understand the issues and principles of Design of Experiments (DOE), list the guidelines for designing experiments, become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization*.

Course Outcome: *Students will be able to plan data collection, to turn data into information and to make decisions that lead to appropriate action, apply the methods taught to real life situations, and finally plan, analyze, and interpret the results of experiments*.

Course Content

Module 01: Introduction

Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.

Module 02: Fitting Regression Models

Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.

Module 03: Two-Level Factorial Designs and Analysis

The 2^2 Design, The 2^3 Design, The General 2^K Design, A Single Replicate of the 2^K

Design, The Addition of Center Points to the 2^K Design, Blocking in the 2^K Factorial Design, Split-Plot Designs.

Module 04: Two-Level Fractional Factorial Designs and Analysis

The One-Half Fraction of the 2^K Design, The One-Quarter Fraction of the 2^K Design, The General 2^{K-P} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.

Module 05: Conducting Tests

Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute Vs Variable data sets.

Module 06: Taguchi Approach

Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples.

Text/Reference Books

1. Response Surface Methodology: Process and Product Optimization using Designed Experiment. Mayers R.H. Douglas C. Montgomery C M. & Anderson C. 3rd edition, John Wiley & Sons New York. 2001.
2. Design and Analysis of Experiments. Montgomery D.C. John Wiley & Sons New York 2001.
3. Statics for Experimenters: Design, Innovation and Discovery. George E. P. Hunter J.S. Hunter W.G. 2nd Ed. Wiley.
4. Practical Experiment Designs for Engineers and Scientists. John Wiley and Sons Inc.
5. Design and Analysis of Experiments. Dean A.M. & Voss D.T. Statistics. Springer.
6. Taguchi Technique for Quality Engineering. Ross P.J. McGraw Hill.
7. Quality Engineering using Robust Design. Phadke M.S. Prentice Hall.

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Semester - VII

(University Level Optional Course - I)

EC-4152	L-T-P-C
Energy Audit & Management	3-0-0-3

Objective: *This course is designed to understand the importance energy security for sustainable development and the fundamentals of energy conservation, introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management, relate the data collected during performance evaluation of systems for identification of energy saving opportunities.*

Course Outcome: *Students will be able to identify and describe present state of energy security and its importance, the basic principles and methodologies adopted in energy audit of an utility, the energy performance evaluation of some common electrical installations and identify the energy saving opportunities, the energy performance evaluation of some common thermal installations and identify the energy saving opportunities, and analyze the data collected during performance evaluation and recommend energy saving measures.*

Course Content

Module 01: Energy Scenario

Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

Module 02: Energy Audit Principles

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR).

Module 03: Energy Management and Energy Conservation in Electrical System

Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment's and appliances, star ratings.

Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

Module 04: Energy Management and Energy Conservation in Thermal Systems

Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.

General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.

Module 05: Energy Performance Assessment

On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.

Module 06: Energy conservation in Buildings

Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources.

Text/Reference Books:

1. Handbook of Electrical Installation Practice. Stokes G. Blackwell Science.

2. Designing with light: Lighting Handbook. Valia A. Lighting System.
3. Energy Management Handbook. Turner W.C. John Wiley and Sons.
4. Handbook on Energy Audits and Management. Tyagi A.K. Tata Energy Research Institute (TERI).
5. Energy Management Principles, Smith C.B. Pergamon Press.
6. Energy Conservation Guidebook. Patrick D.R. Fardo S. Richardson R.E. Fairmont Press.
7. Handbook of Energy Audits. Thumann A. Younger W.J. Niehus T. CRC Press.

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Semester - VII

(University Level Optional Course - I)

EC-4153 L-T-P-C
Development Engineering 3-0-0-3

Objective: *This course is designed to understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development, Implications of 73rd CAA on Planning, Development and Governance of Rural Areas, An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals, the Nature and Type of Human Values relevant to Planning Institutions.*

Course Outcome: *Students will be able to apply knowledge for Rural Development, Management Issues, Initiatives and Strategies, Develop acumen for higher education and research, Master the art of working in group of different nature, and Develop confidence to take up rural project activities independently.*

Course Content

Module 01: Introduction

Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive

principles; Panchayati Raj - beginning of planning and community development; National extension services.

Module 02: Post-Independence rural Development Balwant Rai Mehta Committee

Three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee-linkage between Panchayati Raj, participation and rural development.

Module 03: Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development

Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.

Module 04: Post 73rd Amendment Scenario 73rd Constitution Amendment Act

Including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions- organizational linkages; Recent changes in rural local planning; Gram Sabha-revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.

Module 05: Values and Science and Technology Material development and its values

the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.

Module 06: Ethics

Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education.

Text/Reference Books

1. ITPI, Village Planning and Rural Development. ITPI New Delhi.
2. Human Settlements. Thooyavan K.R. MA Publication. Chennai. 2005.
3. GoI Constitution (73rd GoI, New Delhi Amendment) Act GoI New Delhi.
4. Planning Commission: Five Year Plans. Planning Commission.
5. Planning Commission: Manual of Integrated District Planning. Planning Commission New Delhi.
6. Planning Guide to Beginners.
7. The Urban Complex Doubleday Weaver, R.C.
8. Ethics in Planning. Farmer W.P. et al. American Planning Association Washington.
9. Normative Ethics in Planning, Journal of Planning Literature Vol.5 No.2 pp. 123-150.
10. Conflicting Rationalities. Implications for Planning Theory and Ethics. Watson V. Planning Theory and Practice, Vol. 4 No.4 395 – 407.

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Semester - VII

(University Level Optional Course – I)

ME-4151	L-T-P-C
Product Life Cycle Management	3-0-0-3

Objective: *The course is designed to familiarize the students about principles, current practices, and applications of Product Lifecycle Management (PLM) and make them aware about the sustainable design of product and process for early consideration of the constraints and factors become more important to successfully develop competitive products. The course discuss integrated, information driven approach to all aspects of a product's life from its design inception, through its manufacture, deployment and maintenance, and culminating in its removal from service and final disposal.*

Course Outcome: *The learners will be able to identify PLM's impacts on corporate strategy, structure and operations and will be able to distinguish product development processes, associated engineering information with the product development process and construct and manage product data using PLM/PDM technologies*.

Course Content

Module 01: **Introduction to Product Lifecycle Management (PLM)**

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its

identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM

Module 02: Product Design and Development

Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design process.

Module 03: Product Data Management (PDM)

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation

Module 04: Virtual Product Development Tools

For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case Studies.

Module 05: Incompressible Fluid Flow

Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life. Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design

Module 06: Life Cycle Assessment and Life Cycle Cost Analysis

Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework

Of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle. Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis

Text/Reference Books

1. Product Lifecycle Management: Paradigm for 21st Century Product Realisation. Stark J. Springer-Verlag. 2004.
2. Product Design for the environment-A life cycle approach. Giudice F. Rosa G.L. Risitano A. Taylor & Francis. 2006.
3. Product Life Cycle Management. Antti S. & Anselmie I. Springer. Dreamtech.
4. Product Lifecycle Management: Driving the next generation of lean thinking. Grieve M. Tata McGraw Hill. 2006.

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Semester - VII

(University Level Optional Course – I)

ME-4152 L-T-P-C
Reliability Engineering 3-0-0-3

Objective: *To enable students to understand the impact of maintenance management, reliability and cost effectiveness, acquire knowledge and techniques in reliability engineering. make decisions on sound maintenance and reliability improvement and apply the techniques in reliability engineering*

Course Outcome*: The students will be able to: develop fault trees for a sub-system in mechanical and apply various reliability models on fault analysis, evaluate maintenance schedules and assess the corresponding risk with appropriate techniques and tools, review the advantages and limitations on condition based monitoring maintenance, alternative sourcing of inventory and maintenance outsourcing management for mechanical assets and understand Fault tree analysis, Failure Mode Effects and Criticality Analysis (FMECA).*

Course Content

Module 01: Probability

Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.

Module 02: Reliability

Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.

Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models**:** Constant Failure Rate, linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.

Module 03: System Reliability

System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems. Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.

Module 04: Maintainability and Availability:

Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.

Module 05: Incompressible Fluid Flow

Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree analysis.

Text/Reference Books

1. Reliability Engineering. Srinath L.S. Affiliated East-Wast Press (P) Ltd. 1985.
2. Reliability and Maintainability Engineering. Ebeling C.E. Tata McGraw Hill.
3. Engineering Reliability. Dhillion B.S. Singh C. John Wiley & Sons, 1980.
4. Practical Reliability Engg. Conor P.D.T. John Wiley & Sons 1985.
5. Reliability in Engineering Design. Kapur K.C. & Lamberson. John Wiley & Sons.
6. Probability and Statistics. Spiegel M.R. Tata McGraw-Hill Publishing Co. Ltd.

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Semester - VII

(University Level Optional Course – I)

ME-4153	L-T-P-C
Operations Research	3-0-0-3

Objective: *The course imparts the necessary knowledge of optimization techniques and approaches in order to help in decision making process. The course also introduces research methods and current trends in Operations Research.*

Course Outcome: *Upon completing this course the students will be able to: apply operations research techniques like LPP, scheduling and sequencing in industrial optimization problems, solve transportation and assignment problems and use of these OR tools in a wide range of applications in industries and analyse various OR models like Inventory, Queuing, Simulation, Decision etc. and apply them for optimization*

Course Content

Module 01 Introduction

Introduction to Operations Research: Introduction, Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis

Module 02: Transportation Problem & Assignment Problem

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem. Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms

Module 03: Queuing models

Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population

Module 04: Simulation

Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation.

Module 05: Dynamic programming

Dynamic programming: characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

Module 06: Game Theory & Inventory

Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model.

Text/Reference Books

1. Operations Research - An Introduction. Taha, H.A. Prentice Hall 7th Edition. 2002.
2. Operations Research: Principles and Practice. Ravindran A. Phillips D. T. & Solberg J. J. John Willey and Sons 2nd Edition. 2009.

3. Introduction to Operations Research. Hiller F. S. & Liebermann G. J. Tata McGraw Hill. 2002.
4. Operations Research. Sharma S.D. Kedar Nath & Ram Nath Meerut.
5. Operations Research, Swarup K. Gupta P.K. & ManMohan. Sultan Chand & Sons.

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Semester - VIII

(University Level Optional Course – II)

BM-4151 L-T-P-C
Finance Management 3-0-0-3

Objective: *The objectives of this course are overview of Indian financial system, instruments and market, basic concepts of value of money, returns and risks, corporate finance, working capital and its management, & knowledge about sources of finance, capital structure, dividend policy.*

Course Outcome: *Learner will be able to understand Indian finance system and corporate finance & take investment, finance as well as dividend decisions.*

Course Content

Module 01: Overview of Indian Financial System

Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.

Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market.

Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges.

Module 02: Concepts of Returns and Risks

Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.

Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.

Module 03: Overview of Corporate Finance

Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.

Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.

Module 04: Capital Budgeting

Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR).

Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.

Module 05: Sources of Finance

Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure.

Module 06: Dividend Policy

Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach.

Text/Reference Books

1. Fundamentals of Financial Management. Brigham E.F. & Joel F. Houston. Cengage Publications New Delhi. 2015.
2. Analysis for Financial Management. 10th Edition. Robert C. H. McGraw Hill Education, New Delhi. 2013.
3. Indian Financial System. Khan M.Y. McGraw Hill Education 9th Edition New Delhi. 2015.
4. Financial Management. Pandey I.M. S. Chand (G/L) & Company Limited New Delhi. 2015.

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Semester - VIII

(University Level Optional Course – II)

BM-4152 L-T-P-C
Entrepreneurship Development & Management 3-0-0-3

Objective: *The objectives of this course are to acquaint with entrepreneurship and management of business, Understand Indian environment for entrepreneurship, Idea of EDP, MSME*.

Course Outcome: *Learner will be able to understand the concept of business plan and ownerships, interpret key regulations and legal aspects of entrepreneurship in India, & government policies for entrepreneurs*.

Course Content

Module 01: Overview of Entrepreneurship

Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership.

Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship.

Module 02: Business Plans and Importance of Capital To Entrepreneurship

Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur.

Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations.

Module 03: Women's Entrepreneurship

Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises

Module 04: Indian Environment for Entrepreneurship

Key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organizations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc.

Module 05: Effective Management of Business

Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing.

Module 06: Achieving Success in The Small Business

Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business.

Text/Reference Books

1. Entrepreneurship development- Small Business Enterprise. Charantimath P. Pearson Education.
2. Entrepreneurship. Hisrich R.D P. & Shapherd D.A. latest edition The McGraw Hill Company.
3. Entrepreneurship Development. Chabra T.N. Sun India Publications New Delhi.
4. Small and Medium Enterprises in Global Perspective. C.N. New century Publications, New Delhi.
5. Entrepreneurial development and management. Desai V. Himalaya Publishing House.
6. Entrepreneurship. Lall M.& Sahai S. Excel Books.
7. STAY hungry STAY foolish. Bansal R. CIIE IIM Ahmedabad.
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Entrepreneurship- Principles and Practices. Kurakto, Thomson Publication.
10. Laghu Udyog Samachar.

11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

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Semester - VIII

(University Level Optional Course – II)

BM-4153	L-T-P-C
Human Resource Management	3-0-0-3

Objective: *To introduce the students with basic concepts, techniques and practices of the human resource management, provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations, familiarize the students about the latest developments, trends & different aspects of HRM, acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.*

Course Outcome: *Learner will be able to understand the concepts, aspects, techniques and practices of the human resource management, the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective. Gain knowledge about the latest developments and trends in HRM & apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers*.

Course Content

Module 01: Introduction to HR

Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.

Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.

Module 02: Organizational Behavior (OB)

Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues

Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness

Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior.

Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor);

Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.

Case study.

Module 03: Organizational Structure &Design

Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.

Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.

Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.

Module 04: Human resource Planning

Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale.

Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning.

Training & Development: Identification of Training Needs, Training Methods.

Module 05: Emerging Trends in HR

Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment.

Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.

Module 06: HR & MIS

Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries.

Strategic HRM

Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals.

Labor Laws & Industrial Relations

Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act.

Text/Reference Books

1. Organizational Behavior. Robbins S. 2013.
2. Human Resource Management Rao V.S.P. Excel publishing. 2010.
3. Human resource management: Text & cases. Aswathapa. 6th edition. 2011.
4. Dynamics of Industrial Relations in India. Mamoria C.B. & Gankar S.V. 15th edition. Himalaya Publishing 2015.
5. Essentials of Human Resource management and Industrial relations. Subba Rao P. 5th Ed. Himalaya Publishing. 2013.
6. Management & Organizational Behavior. Mullins L. Latest Ed. Pearson Publications 2016.

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Semester - VIII

(University Level Optional Course – II)

BM-4154	L-T-P-C
Professional Ethics & CSR	3-0-0-3

Objective: *To understand professional ethics in business & recognized corporate social responsibility.*

Course Outcome: *Learner will be able to understand rights and duties of business, distinguish different aspects of corporate social responsibility, demonstrate professional ethics, cognize legal aspects of corporate social responsibility*.

Course Content

Module 01: Professional Ethics and Business

The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business.

Module 02: Professional Ethics in the Marketplace

Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy. Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources.

Module 03: Professional Ethics of Consumer Protection

Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy. Professional

Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.

Module 04: Introduction to Corporate Social Responsibility

Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India.

Module 05: Corporate Social Responsibility

Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India.

Module 06: Corporate Social Responsibility in Globalizing India

Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.

Text/Reference Books

1. Business Ethics. Texts and Cases from the Indian Perspective. Gupta A.D. Latest Ed. Springer. 2016.
2. Corporate Social Responsibility: Readings and Cases in a Global Context. Andrew Crane A. Matten D. & Spence L. Routledge. 2007.
3. Business Ethics: Concepts and Cases. Velasquez M.G. Pearson 7th Edition New Delhi. 2011.
4. Corporate Social Responsibility in India. Chakrabarty B. Routledge New Delhi. 2015.

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Semester - VIII

(University Level Optional Course- II)

CE-4152	L-T-P-C
Environmental Management	3-0-0-3

Objective: *This course will students to Understand and identify environmental issues relevant to India and global concerns; learn concepts of ecology and familiarize environment related legislations.*

Course Outcome: *On successful completion of the course, the learners shall understand: the concept of environmental management; ecosystem and interdependence, food chain etc.; the interpretation of environment related legislations.*

Course Content

Module 01: Introduction

Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario

Module 02: Global Environmental concerns

Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.

Module 03: Concepts of Ecology

Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.

Module 04: Scope of Environment Management

Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility

Module 05: Total Quality Environmental Management

ISO-14000, EMS certification.

Module 06: General overview

Major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.

Text/Reference Books

1. Environmental Management: Principles and Practice. Barrow C.J. Routledge Publishers London.1999.
2. A Handbook of Environmental Management. Edited by Lovett J.C. & Ockwell D.G. Edward Elgar Publishing.
3. Environmental Management. Ramachandra T.V. & Kulkarni V. TERI Press.
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use. Bureau of Indian Standards. 2005.
5. Environmental Management: An Indian Perspective. Chary S.N. & Vyasulu V. Maclillan India. 2000.
6. Introduction to Environmental Management. Theodore M.K. & Louise Theodore. CRC Press.
7. Environment and Ecology. Majid Hussain. 3rd Ed. Access Publishing. 2015.

Digital Material

1. https://nptel.ac.in/courses/120108004/

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Semester - VIII

(University Level Optional Course – II)

CS-4153	L-T-P-C
Research Methodology	3-0-0-3

Objective: *The objectives of this course are to understand Research and Research Process, acquaint students with identifying problems for research and develop research strategies, familiarize students with the techniques of data collection, analysis of data and interpretation.*

Course Outcome*: At the end of the course student will be able to prepare a preliminary research design for projects in their subject matter areas, accurately collect, analyze and report data, present complex data or situations clearly, review and analyze research findings.*

Course Content

Module 01: Introduction and Basic Research Concepts

Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, principle Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research Issues and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical.

Module 02: Types of Research

Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches

Module 03: Research Design and Sample Design

Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors

Module 04: Research Methodology

Meaning of Research Methodology, Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design, Data Collection, Data Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report

Module 05: Formulating Research Problem

Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis

Module 06: Outcome of Research

Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation

Text/Reference Books

1. Practical Research Methods. Dawson C. UBS Publishers Distributors. 2002.
2. Research Methodology: Methods and Techniques. Kothari C. R. Wiley Eastern Limited. 1985.
3. Research Methodology: A Step-by-Step Guide for Beginners. Kumar R. 2nd Ed. Pearson Education.

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Semester - VIII

(University Level Optional Course – II)

CS-4154 L-T-P-C
Digital Business Management 3-0-0-3

Objective: *The objectives of this course are to familiarize with digital business concept, acquaint with E-commerce, and give insights into E-business and its strategies.*

Course Outcome*: At the end of the course student will be able to identify drivers of digital business, illustrate various approaches and techniques for E-business and management and prepare E-business plan.*

Course Content

Module 01: Introduction to Digital Business

Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts, Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services), Opportunities and Challenges in Digital Business

Module 02: Overview of E-Commerce

E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement, B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges

and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals, Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing, EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC

Module 03: Digital Business

Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system, Application Development: Building Digital business Applications and Infrastructure

Module 04: Managing E-Business

Managing E-Business-Managing Knowledge, Management skills for e-business, Managing Risks in e –business, Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Application

Module 05: E-Business Strategy

E-Business Strategy-E-business Strategic formulation- Analysis of Company‘s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)

Module 06: Case study on e-Business

Materializing e-business: From Idea to Realization-Business plan preparation, Case Studies and presentations

Text/Reference Books

1. A Textbook on E-commerce. Mishra A. & Sarwade W. K. Neha Publishers & Distributors. 2011.
2. E-commerce from vision to fulfilment. Awad E. M. PHI. 2002.
3. Digital Business and E-Commerce Management. Chaffey D. 6th Ed. Pearson. 2014.
4. Introduction to E-business-Management and Strategy. Combe C. ELSVIER. 2006.
5. Digital Business Concepts and Strategy. Coupey E. 2nd Ed. Pearson.

6. Trend and Challenges in Digital Business Innovation. Morabito V. Springer.
7. Digital Business Discourse. Darics E. Palgrave Macmillan. 2015.
8. E-Governance: Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise: A framework for Transformation, TCS consulting journal.
10. Measuring Digital Economy: A new perspective. OECD Publishing.

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Semester - VII

(University Level Optional Course - II)

EC-4154	L-T-P-C
IPR & Patenting	3-0-0-3

Objective: *This course is designed to understand intellectual property rights protection system, promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures and to get acquaintance with Patent search and patent filing procedure and applications.*

Course Outcome: *Students will be able to understand Intellectual Property assets, assist individuals and organizations in capacity building, work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting.*

Course Content

Module 01: Introduction to Intellectual Property Rights (IPR)

Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.

Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development.

Module 02: Enforcement of Intellectual Property Rights

Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement.

Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.

Module 03: Emerging Issues in IPR

Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.

Module 04: Basics of Patents

Definition of Patents, Conditions of patentability, Patentable and nonpatentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent.

Module 05: Patent Rules

Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.).

Module 06: Procedure for Filing a Patent (National and International)

Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement.

Patent databases: Important websites, Searching international databases.

Text/Reference Books

1. A Handbook on Laws Relating to Intellectual Property Rights in India. Adukia R.S. The Institute of Chartered Accountants of India. 2007.
2. Patent system and related issues at a glance. Keayla B.K. National Working Group on Patent Laws.
3. Intellectual Property Law in India. Sengupta T. Kluwer Law International. 2011.
4. Intellectual Property and Human Development: Current Trends and Future Scenario. Wong T. & Dutfield G. Cambridge University Press. 2010.
5. Intellectual Property: Patents, Copyrights, Trademarks and Allied Right. Cornish, Rodolph W. & Llewelyn D. 7th Edition Sweet & Maxwell. 2010,
6. The enforcement of Intellectual Property Rights: A Case Book. Harns L. 3rd Edition WIPO. 2012.
7. Intellectual Property Rights. Ganguli P. 1st Edition, TMH. 2012.

8. Intellectual Property Rights. Krishnan R. & Balasubramanian S. 1st Edition, Excel Books. 2012.
9. Intellectual Property Rights. Kumar M.A. & Iqbal Md. Ali. Serial Publications 2nd Edition. 2011.
10. Fundamentals of IPR for Engineers. Bansal K. & Bansal P. BS Publications 1st Edition. 2012.
11. A Manual on Intellectual Property Rights. Entrepreneurship Development and IPR Unit BITS Pilani, 2007
12. Fundamentals of Patenting and Licensing for Scientists and Engineers. Maa M.Y. World Scientific Publishing Company. 2009.
13. IPR: Drafting, Interpretation of Patent Specifications and Claims. Rathore N.S. Mathur S.M. Mathur P. Rathi A. New India Publishing Agency.
14. Intellectual Property Rights for Engineers. Irish V. IET. 2005.
15. Intellectual Property Law for Engineers and scientists. Rockman H.B. Wiley-IEEE Press. 2004.

Detailed Syllabus for B. Tech. Degree Programme
in
Civil Engineering

Semester - VIII

(University Level Optional Course – II)

ME-4154	L-T-P-C
Project Management	3-0-0-3

Objective: *The aim of this course is to develop the understanding, as well as practical skills, within the field of project management. The traditional lines between permanent and temporary organizational forms are nowadays blurring, which requires new perspectives on management, collaboration and organization. The course provides students with an orientation in this developing landscape as well as knowledge and skills to lead organizational development in practice, by reflecting on a project that the students plan, execute and evaluate.*

Course Outcome: *The leaners will be able to: Define project and project management as empirical phenomena and a field of research, define, interpret and exemplify the challenges in project management both in regards to the outcomes of projects and of the projects itself (process). Identify and describe the characteristics of projects as a form of organization, describe different models, tools and techniques in project management for broad stakeholder involvement and discuss the extent to which these are essential to sustain a coalition of diverse stakeholders, assess different approaches to project management and select the relevant approach to answer an identified problem*

Course Content

Module 01: Project Management Foundation

Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)

Module 02: Initiating Projects

How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics

Module 03: Project Planning and Scheduling

Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).

Module 04: Planning Projects

Planning Projects: Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks.

Module 05: Executing Projects

Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project Meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit. Project Contracting: Project procurement management, contracting and outsourcing.

Module 06: Project Leadership and Ethics

Introduction to project leadership, ethics in projects, Multicultural and virtual projects Closing the project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.

Text/Reference Books

1. Project Management: A managerial approach, Meredith J. & Mantel S. Wiley India.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide). 5th Ed. Project Management Institute PA USA.
3. Project Management. Gido Clements. Cengage Learning.
4. Project Management. Gopalan. Wiley India.
5. Project Management. Lock D. Gower Publishing England.