B Tech in Civil Engineering

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
II	MAT 2154	Engineering Mathematics – III	2	1	0	3	MAT 2255	Engineering Mathematics – IV	2	1	0	3
	CIE 2151	Fluid Mechanics	3	1	0	4	CIE 2251	Basic Reinforced Concrete Design	3	1	0	4
	CIE 2152	Highway Engineering	3	1	0	4	CIE 2252	Building Material Technology	2	0	3	3
	CIE 2153	Mechanics of Structures	3	1	0	4	CIE 2253	Engg. Geology	2	1	0	3
	CIE 2154	Surveying	3	1	0	4	CIE 2254	Waste water Management	2	1	0	3
	CIE 2155	Water Supply Engineering	3	0	0	3	CIE 2255	Water Resource Engineering	2	1	0	3
	CIE 2161	Material Testing Lab	0	0	3	1	****	Open Elective –1	3	0	0	3
	CIE 2162	Surveying Practice –I	0	0	3	1	CIE 2261	Building Design and Drawing	0	0	3	1
							CIE 2262	Fluid Mechanics Lab	0	0	3	1
			17	**5**	**6**	**24**			**16**	**5**	**9**	**24**
III	**FIFTH SEMESTER**						**SIXTH SEMESTER**					
	HUM 3052	Essentials of Management	2	1	0	3	HUM 3051	Engineering Economics and Financial Management	2	1	0	3
	CIE 3151	Analysis of Indeterminate Structures	3	1	0	4	CIE 3251	Applied Soil Engineering	2	1	0	3
	CIE 3152	Basic Structural Steel Design	3	1	0	4	CIE 3252	Estimation, Costing and Valuation Practice	2	0	3	3
	CIE 3153	Construction Management	3	0	0	3	CIE 3253	Railway and Airport Engineering	2	1	0	3
	CIE 3154	Geotechnical Engg.	3	1	0	4	****	Program Elective –1	3	0	0	3
	****	Open Elective 2	3	0	0	3	****	Program Elective –2	3	0	0	3
	CIE 3161	Computer Applications Lab	0	0	3	1	****	Open Elective – 3	3	0	0	3
	CIE 3162	Environmental Engg. Lab	0	0	3	1	CIE 3261	Structural Design and Drawing	0	0	3	1
	CIE 3163	Soil Mechanics Lab	0	0	3	1	CIE 3262	Surveying Practice – II	0	0	3	1
			17	**4**	**9**	**24**			**18**	**2**	**9**	**23**
IV	**SEVENTH SEMESTER**						**EIGHTH SEMESTER**					
	****	Program Elective –3	3	0	0	3	CIE 4298	Industrial Training	0	0	0	1
	****	Program Elective –4	3	0	0	3	CIE 4299	Project Work/Practice School	0	0	0	12
	****	Program Elective –5	3	0	0	3						
	****	Program Elective – 6	3	0	0	3						
	****	Program Elective – 7	3	0	0	3						
	****	Open Elective 4	3	0	0	3						
			18	**0**	**0**	**18**						**13**

Minor Specialization		Other Electives
I. Building Construction and Management CIE 4051: Advances in Concrete Technology CIE 4052: Building Code and Requirements CIE 4053: Construction Materials and Quality Management CIE 4054: Precast Technology **II. Environmental Engineering** CIE 4055: Air Pollution and Control CIE 4056: Environmental Impact Assessment and Auditing CIE 4057: Industrial Waste water Treatment CIE 4058: Solid Waste Management **III. Geotechnical Engineering** CIE 4059: Design of Foundation and Earth Retaining Structures CIE 4060: Geo-environmental Engineering CIE 4061: Ground Improvement Techniques CIE 4062: Soil Reinforcement and Geosynthetics **IV. Structural Engineering** CIE 4063: Design of Reinforced Concrete Structures CIE 4064: Design of Steel Structures CIE 4065: Finite Element Method of Analysis CIE 4066: Pre-stressed Concrete Design **V. Transportation Engineering** CIE 4067: Urban Mass Transport System CIE 4068: Urban Transport Planning CIE 4069: Pavement Material and Design CIE 4070: Traffic Systems and Engineering	**VI. Water Resources Engineering** CIE 4071: Integrated Water Shed Management CIE 4072: Hydraulics and Hydraulic Machines CIE 4073: Hydrological Analysis CIE 4074: Water Resources Planning and Management **VII. Material Science** PHY ****: PHY ****: CHM ****: CHM ****: **VIII. Business Management** HUM 4051: Financial Management HUM 4052: Human Resource Management HUM 4053: Marketing Management HUM 4054: Operation Management **IX. Computational Mathematics** MAT 4051: Applied Statistics and Time Series Analysis MAT 4052: Computational Linear Algebra MAT 4053: Computational Probability and Design of Experiments MAT 4054: Graphs and Matrices	CIE 4075: Bridge Engineering CIE 4076: Coastal Engineering CIE 4077: Contract Management CIE 4078: Elements of Earthquake Engineering CIE 4079: Fecal Sludge and Septage Management CIE 4080: Non-Destructive Testing of Concrete structures CIE 4081: Remote Sensing and GIS **Open Electives** CIE 4301: Air and Noise Pollution CIE 4302: Contract Management for Engineers CIE 4303: Environmental Management CIE 4304: Geology for Engineers CIE 4305: Introduction to Remote Sensing and GIS CIE 4306: Strength of Materials

THIRD SEMESTER

MAT 2154: ENGINEERING MATHEMATICS III [2 1 0 3]

No. of Lecture hours per week: 3 Total number of lectures – 40 Hrs.

Vector Calculus: Gradient, divergence and curl, geometrical meaning, and identities. Line integrals, surface integrals and volume integrals. Green's theorem in plane, Gauss divergence theorem, Stokes' theorem – applications. **[12 Hrs.]**

Partial differential equations and applications: Basic concepts, solution of equations involving derivatives with respect to one variable only. Solutions by indicated transformation and separation of Variables. One dimensional wave equation (vibrating string) and its solution by using the method of separation of Variables. D'Alembert's solution of wave equation. One dimensional heat equation using Gauss divergence theorem and its solution by separation of variables. Solution of two dimensional Laplace equations. **[9 Hrs.]**

Fourier Series: Periodic functions, Euler's formulae. Fourier series of odd and even functions and functions with arbitrary period. Half range expansions. Harmonic analysis, Fourier integrals, Fourier transforms, Fourier sine and cosine transforms. Application of Fourier series to forced vibration problems. **[9 Hrs.]**

Introduction to probability: Finite sample space, conditional probability and independence. Bayes' theorem. Random Variables: One dimensional random variables, Mean, Variance. Two and higher dimensional random variables: mean, variance, correlation coefficient and regression. **[10 Hrs.]**

References:

1. Murray R. Spiegel, *Vector Analysis*, Schaum Publishing Co., 1959.
2. Erwin Kreyszig, *Advanced Engineering Mathematics, (9e)*, Wiley Eastern, 2006.
3. P. L. Meyer, *Introduction to Probability and Statistical Applications*, (2e), Oxford and IBH Publishing, Delhi, 1980.
4. B. S. Grewal, *Higher Engineering Mathematics, (43e)*, Khanna Publishers, 2014.

CIE 2151: FLUID MECHANICS [3 1 0 4]

Total number of lectures – 48

Pre-requisites: Mechanics of Solids, Mathematics

COURSE OUTCOME:

At the end of the program the student will be able to

CO1: Define fluid properties and describe their influence on behaviour of fuid at rest and in motion.
CO2: Associate the principles of fluid mechanics to solve problems related to fluid at rest.
CO3: Associate the principles of fluid mechanics to solve problems related to fluid in motion.
CO4: Compute the parameters related to fluid flow through pipes and open channels.

CO5: Identify the devices used for measurements of parameters related to fluid at rest and in motion.

INTRODUCTION: Scope and importance, distinction between fluid, solid & gas. **(2 hrs)**
FLUID PROPERTIES: Specific weight, mass density, specific volume, specific gravity, dynamic viscosity, kinematic viscosity. Definition and derivation of newton's law of viscosity. Surface tension and capillarity. Compressibility and vapour pressure. Real fluid, ideal fluid, Newtonian and non - Newtonian fluid. Compressible and incompressible fluid. **(6 hrs)**

PRESSURE AND ITS MEASUREMENT: Pascal's law. Variation of fluid pressure in static fluids. Atmospheric pressure, absolute pressure, gauge pressure, vacuum pressure- definition & measurement. **(4 hrs)**

HYDROSTATICS FORCES ON PLANE SURFACES: Total pressure and center of pressure. Forces on inclined plane surfaces & curved surfaces. Pressure distribution diagram and application. **(4 hrs)**

KINEMATICS OF FLUID MOTION: methods of describing fluid motion-Lagrangian Eulerian approach. Classification of flow, continuity equation in different Cartesian co-ordinates. **(4 hrs)**

DYNAMICS OF FLUID MOTION: Euler's equation of motion and Bernoulli's equation – limitations, modifications, application of Bernoulli's theorem- Venturimeter, orificemeter and pitot tube. **(5 hrs)**

FLOW THROUGH PIPES: Laminar flow through pipes – Reynold's number, numericals. Turbulent flow through pipes – losses in pipe lines, derivation of Darcy Weisbech equation. Pipes in series and parallel, concept of equivalent pipe, hydraulic gradient line and energy gradient line, pipe siphon, water hammer. **(9 hrs)**
FLOW MEASUREMENT: Flow through orifices, mouthpieces. Flow through notches and weirs. Flow under variable head – time of emptying with no flow, time of emptying / filling with inflow. **(5 hrs)**

FLOW IN OPEN CHANNELS: introduction, types of open channel flow. Geometric elements of open channel flow; Chezy's and Manning's formula. Hydraulically efficient channel cross section- rectangular and triangular. Specific energy, specific energy curve, critical depth and alternate depth. Specific force, specific force curve and conjugate depths. critical flow in rectangular channel, Froude's number, hydraulic jump, sequent depth, energy loss. **(9 hrs)**

References:

1. Streeter V.L. and Wiley E.B, *Fluid Mechanics*, McGraw Hill book Co., New York. 1998
2. Modi P.N. and Seth S.M. *Hydraulics and Fluid Mechanics*, Standard Book House, New Delhi. 2005
3. Bansal R. K, *Fluid Mechanics and Hydraulic Machines*, Laxmi Publishers, New Delhi. 2010
4. Jain A.K., *Fluid Mechanics*, Khanna Publishers, New Delhi. 2002
5. Garde R.J., *Fluid Mechanics through problems*, New age international Pvt. Ltd., Publishing, New Delhi. 2003

CIE 2152: HIGHWAY ENGINEERING [3 1 0 4]

Total number of lectures: 48hrs

***Course outcomes*:-**

At the end of the program the student will be able to

CO1: Identify the basic components of the highway.
CO2: Discuss the various geometrical elements of highway.
CO3: Describe the fundamentals of traffic flow and design traffic flow control system.
CO4: Identify vehicular and climatic conditions and calculate pavement thickness.
CO5: Prepare economic analysis reports of highway.

Introduction: - Highway engineering, Scope of highway engineering, Highway classification, Factors controlling highway alignment, Engineering survey for highway location. **2hrs**

Design of Highway Geometric Elements:- Elements of geometrics of Highway, factors effecting friction and skid, Camber system, pavement surface characteristics, width of formation, Sight distance-stopping and Overtaking, geometrics of Hilly roads. **8hrs**

Design of Horizontal Alignment: - Super elevation, Extra widening, Transition curve, Setting out of simple, compound, reverse and transition curves. **10hrs**
Design of Vertical Alignment: - Summit and Valley Curves, setting out of vertical curves. **4hrs**
Traffic Engineering: - Traffic engineering, vehicular and road user characteristics, Traffic studies-Speed, Density and Volume, Relation between speed, travel time and traffic volume, Traffic density and passenger car units, Traffic flow characteristics, Traffic Regulation and control. **6hrs**

P**avements Design**: - Types of pavements, Factors which influences design and selection of different types of pavements, Brief study on pavement materials, Design of Flexible and Rigid pavements- IRC method. **8hrs**

Highway Drainage System:-Types of highway drainage and its design. **4hrs**

Highway Economics and Maintenance: -Economic Analysis of Highway, Distress in Flexible and Rigid pavements, Highway maintenance and pavement evaluation. **6hrs**

References:

1. Khanna S.K and Justo C.E.G., *Highway Engineering, (10e)*, Nemchand and Bros., Roorkee 2015.
2. Kadiyali L.R., *Traffic Engineering and Transportation Plannin,g (5e)*, Khanna Publisher, New Delhi 2000.
3. E.J. Yoder, *Principles of Pavement Design*, John Wiley & Sons, Inc. New York, 1975.
4. Yang H. Huang, *Pavement Analysis and Design*, Prentice Hall, 2003.

CIE 2153: MECHANICS OF STRUCTURES [3 1 0 4]

Prerequisite: Mechanics of solids, Engineering Mathematics.

CO1: Identify and compute member forces in determinate planar trusses , bending moment and shearforce in determinate beams.
CO2: Identify and compute stresses in beams, shafts subjected to torsion , forces in columns and resultant stresses on inclined planes.
CO3: Calculate and sketch the influence line diagrams for forces in determinate beams.
CO4: Associate with strain energy concepts , compute deformation in determinate structures using Unit Load and Castigliano's method.
CO5: Compute deformation in determinate beams using Macaulay's, Moment - Area and Conjugate beam methods, to determine stress resultants in three hinged parabolic arches and suspension bridges

Total number of lectures – 48

Analysis of Determinate Trusses: Plane trusses- method of joints and method of sections. (04)
Bending moment and shear force diagrams for determinate beams. (06)
Bending and shear stresses: Determination of bending and shear stresses in statically determinate beams of various cross sections (06)
Torsion in circular shaft: Simple torsion theory, solid and hollow circular shafts, power transmitted by shafts (03)
Stability of columns: Slenderness ratio, failure by buckling, Euler's formula, concept of equivalent length for different support conditions, limitation of Euler's formula, Rankine-Girdon Formula. (04)
Stress on inclined planes: Stresses on any given plane,Principal stresses and their planes. (04)
Analysis of Arches: Analysis of three hinged parabolic arches. Determination of horizontal reaction, normal thrust, radial shear and bending moment. (04)
Strain Energy: Strain energy due to axial force, shearing force, bending moment and twisting moment. Law of conservation of energy, virtual work on rigid and elastic bodies, Betti's theorem, Maxwell's law of reciprocal deflections, Castigliano's theorems. (02)
Deflections: Determination of deflection in statically determinate beams using Mecaulay's method, Moment -area method and Conjugate beam method. (08)
Deflection: Determination of deflection in beams, simple frames and trusses by strain energy methods-Unit load method and Castigliano's method. (07)

References:

1. Timoshenko, *Strength of Materials Vol. I & Vol. II* , CBS Publishers & Distributers, New Delhi, 2002.
2. James M Gere & Stephen P Timoshenko, *Mechanics of Materials* , CBS Publishers & Distributers, New Delhi, 2004.
3. Basavarajaiah & Mahadevappa , *Strength of Materials*, CBS Publishers, 2001.
4. Reddy C.S., Basic *Structural Analysis*, Tata McGraw Hill, New Delhi, 2004.
5. Ramamrutham & Narayanan, *Strength of Materials*, Dhanpat Rai Publishers, 1989.

CIE 2154: SURVEYING (3 1 0 4)

Total number of lectures – 48

Course Outcome:

Student should be able to

CO1: Identify the principles and divisions of surveying
CO2:Associate the principles, instruments and applications of chain, compass surveying, plane table surveying.
CO3: Associate the principles, instruments and applications of levelling contouring and theodolite surveying.
CO4:Discuss principles of Tacheometry and illustrate the applications.
CO5:Discuss principles of Photogrammetry, Hydrographic and Underground Surveying and illustrate the applications.

Introduction : Principles of Surveying, methods – Plane and geodetic; Principles of chain surveying, offsets – Cross staff and principles of optical square – Error in offset – obstacles in chaining. (06)

Compass Survey: Principles, use and Adjustment of prismatic compass, surveyors compass, Bearings and Included angles – Declination – Local attraction – Graphical adjustment of compass traverse – latitudes and Departures in a traverse. (06)

Plane Table survey: Methods – Orientation – Solving two and three point problem with Bessel's method – Plane table traversing. (02)

Levelling : Introduction – Simple levelling – Differential levelling – Errors in Levelling – Curvature and Refraction- Sensitiveness of bubble tube – Cross sectioning and Profile levelling – Reciprocal Levelling (08)

Contours: Introduction - Application and uses – Methods in Contouring – Characteristics of contours (02)

Theodolite Survey: Introduction and description of Theodolite – Repetition and Reiteration methods Temporary adjustments of theodolite – Trigonometric levelling using height and distance formulae. (06)

Tacheometry: Principles, methods - instruments - distance and elevation formulae for horizontal and inclined site with staff vertical and normal, tangential method. (06)

Photogrammetric Surveying: **Terrestrial Photogrammetry** - principles - photo theodolite, horizontal and vertical distances of points from photographic measurement. **Aerial Photogrammetry** - scale of vertical photograph, drag and lift - computation of flight plan. (07)
Under Ground Surveys: Introduction - application of under-ground surveys - auxiliary theodolite - aligning the theodolite. (02)
Hydrographic Survey: Shore line survey - methods of sounding -locating - reduction of soundings and plotting. Three point problem. (03)

References:

1. PunmiaB.C, *Surveying*, Vol.I and II, Lakshmi Publishers, New Delhi. 2015
2. Duggal S.K, *Surveying*, Vol. I and II, Tata Mcgraw Hill – Publishing Co.Ltd,New Delhi. 2017
3. Arora K.R , *Surveying*, Vol.(I, II, III), Standard Book house, New Delhi. 2015
4. Kanetkar T.P and Kulkarni S.V, *Surveying and levelling* parts 1 and 2, Pune VidyarthiGrihaPrakashan. 2008
5. ThomasNorman, *Surveying*, Edward Arnold Publishers (ELBS), Budapest.

CIE 2155: WATER SUPPLY ENGINEERING [3 0 0 3]

Total number of lectures - 36

Course outcome:

CO1: Define and explain water demand and identify the sources of water
CO2: Identify and discuss the various characteristics of water
CO3: Apply the guidelines for the design of water treatment units
CO4: Describe the unit operations and process for water treatment
CO5: Classify water distribution networks and Identify pipe appurtenances

Syllabus Structure

Introduction: Need for protected water supply, essentials of water supply, project documents preparation.	02
Quantity of water - Population forecasting - different methods, rate of demand - factors affecting and its variation.	05
Sources of water: different sources of water, intakes/ water borne diseases and their control, conveyance of water (Pump capacity, Economical diameter).	03
Quality of water - Physical, chemical and biological characteristics, analysis of water, drinking water standards.	04
Treatment of water - Aeration of water - types of aerators, theory of sedimentation, sedimentation with coagulation, coagulants, feeding devices, mixing devices, flocculation - design considerations.	08
Filtration - types of filters - design considerations. Disinfection – theory, methods of disinfections, chlorination. Other treatment methods - softening of water, Removal of iron and manganese, defluoridation, desalination.	08
Distribution of water - distribution methods, systems of supply, service reservoirs and their capacity, layouts of distribution.	04
Pipe appurtenances: service connection, location of water supply pipes in buildings. wastage of water - Leakage detection & prevention, corrosion and its prevention.	02

References:

1. *Manual on water supply and treatment CPHEEO*, Ministry of Urban development, New Delhi 1991.
2. Garg S.K., *Environmental Engg.-I*, Khanna Publishers, New Delhi 1999,.
3. Birdie G.S., *Water Supply and Sanitary Engg*., Dhanpath Rai and Sons, New Delhi 1987.
4. B.C. Punmia, *Water Supply and Sanitary Engg*., Dhanpath Rai and Sons, New Delhi.
5. Modi and Sethi, *Water Supply and Sanitary Engg*., Dhanpath Rai and Sons, New Delhi.

CIE 2161: MATERIAL TESTING LAB [0 0 3 1]

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

CO1 Identify the tests and determine the mechanical properties of steel, interpret the results.
CO2 Identify the tests and determine the mechanical properties of timber, interpret the results.
CO3 Identify the tests and determine the physical and mechanical properties of bitumen, classify, interpret the results.
CO4 Identify the tests and determine the breaking strength of tiles, bricks and laterite stones, interpret the results.
CO5 Identify the tests and determine the hardness of various metals, interpret the results.

Total number of lectures - 10

Tension test on mild steel	(01)
Compression test on cast iron	(01)
Compression test on timber and Shear test on mild steel specimen	(01)
Torsion test on mild steel specimen and Rockwell hardness test	(01)
Brinell's Hardness test and bending test on wood	(01)
Impact tests : a) Izod b) Charpy and Fatigue test (Demonstration)	(01)
Tests on Bitumen: Specific Gravity, Viscosity, Softening Point Flash and Fire Point, Ductility and Penetration Value.	(01)
Compression test on Aluminium	(01)

References:

1. Suryanarayana A.V.K., *Testing of Metallic Materials*, Prentice Hall of India, New Delhi. (1990)
2. Khanna& Justo, *Highway Materials Testing*,Nemchand and brothers.(1989)
3. Technical Teachers' Training Institute, *Laboratory Manual of Strength of Materials*, Oxford University Press. (1983)
4. Relevant I S Codes.

CIE 2162: SURVEYING PRACTICE – I [0 0 3 1]

Total number of lectures 12

COURSE OUTCOMES:

CO1 Practice surveying using chain and compass
CO2 Practice plane table surveying technique
CO3 Practice differential leveling techniques
CO4 Practice trigonometric surveying
CO5 Practice setting out of simple curve using chain and tape

Chain and Compass survey (01)

Traversing a given building using chain and compass

Plane table surveying

Radiation and intersection methods. (01)

Solving three point problem by Bessel's method (01)

Levelling

Differential Levelling (H.I and Rise and fall methods) (01)

Reciprocal Levelling and Block levelling (Contouring by grid method) (01)

Theodolite -

Repetition and Reiteration Method (01)

Determination of R.L of an object when its base is inaccessible by Single plane and Double plane methods (01)

Simple Curve Setting using chain and tape-

Setting out simple curve by Radial and perpendicular offset method (01)

Successive Bisection method (01)

Offset from chord produced (01)

Construction Surveying

Setting out center line for Building, Bridges and Pipeline. (2)

References

1. Kanetkar T.P. and Kulkarni S.V, *Surveying and leveling-Part I and II,* Vidyarthi Griha Prakashana - Pune.(1996)
2. Punmia B.C., *Surveying - Vol. I,* Lakshmi Publications, New Delhi. (2005)
3. Arora K.R., *Surveying, Vol. I and II,* Standard Book House, New Delhi. (1993)
4. David Clark,(1983), " Plane and Geodetic Surveying for Engineers " , Vol I and II – CBS publication and Distributors, New Delhi
5. ThomasNorman , " Surveying" , Edward Arnold Publishers (ELBS),Budapest.

FOURTH SEMESTER

MAT 2255: ENGINEERING MATHEMATICS IV [2 1 0 3]

Numerical solutions of partial differential equations by finite difference methods, five-point formula, Laplace Poisson Equations, Heat equation, Crank Nicolson's method, Wave equation.

Introduction to calculus of variations, geodesics, isoperimetric problems, approximate methods, Weighted Residual Approach, Least square method.

Application of Finite Difference technique: Statically determinate and indeterminate beams, Buckling of columns. **[13 Hrs.]**

Introduction to Tensor Analysis, simple problems. **[05 Hrs.]**

Distributions: Binomial, Poisson, uniform, normal, gamma, chi-square and exponential. Moment generating function, Functions of one dimensional and two dimensional random variables, Sampling theory, Central limit theorem and applications. **[12 Hrs.]**

Optimization Techniques: Introduction to Linear programming, Formation of Linear Programming problem, solution by graphical method, Simplex method. Two phase simplex method, Transportation problems. **[10 Hrs.]**

References:

1. M Rajasekaran S, *Numerical methods for Science and Engineering*, Wheeler and Co. Pvt. Ltd., Allahabad, 1992.
2. Sastry S.S., *Introductory methods of Numerical Analysis*, Prentice Hall of India, New Delhi. 1995.
3. A. R. Mitchel and R. Wait, *Finite Element Methods in Partial Differential Equations*, John Wiley, 1997.
4. P. L. Meyer, *Introduction to Probability and Statistical Applications,(2e),* Oxford and IBH Publishing, Delhi, 1980.
5. Hamdy A. Taha, *Operation research*, (8e), PHI, 2007.
6. S. Narayanan, T. K. Manicavachagom Pillay, G. Ramanaiah, *Advanced mathematics for engineering students*, S. Viswanathan Pvt.. Ltd., 1985.

CIE 2251: BASIC REINFORCED CONCRETE DESIGN [3 1 0 4]

At the end of this course, the student should be able to

CO1: Discuss the design philosophy of reinforced concrete structures.

CO2: Describe the standard code procedures for design of reinforced concrete beams and illustrate.

CO3: Describe the standard code procedures for design of reinforced concrete slabs and illustrate.

CO4: Describe the standard code procedures for design of reinforced concrete columns and footings, and illustrate.

CO5: Describe the standard code procedures to calculate crack width and deflection in beams and illustrate.

Total number of lectures – 48

Role of reinforcement, behavior of RCC section. **Straight line Theory:** Assumptions, Determination of Neutral Axis, Determination of stress and strain due to bending moment – Moment of Resistance of singly reinforced and doubly reinforced beam sections. (09)

Limit state method: principle of limit state method of design, characteristic loads, characteristic strengthand partial safety factors. Stress strain characteristics for concrete and steel. (02)

Introduction to stress block parameters for collapse, limit state of serviceability. (02)

Design of rectangular beams (singly and doubly reinforced), flanged beams, Design for Shear and Torsion. (10)

Design of one way and two way slabs for various boundary conditions (08)

Limit state of collapse in compression, Design of axially loaded short and slender R.C. Columns, uniaxial and bi-axial bending using SP16 hand book. (08)

Determination of short term and long term deflections of R.C. beams, Determination of Crack width. (06)

Design of axially loaded isolated footings. (03)

References:

1. Karve S.R, and Shah V.L., *Limit State Theory and Design of Reinforced Concrete*, Structures Publishers, Pune, 1996.
2. Varghese P.C., *Limit State Design of Reinforced Concrete*, Prentice Hall of India, New Delhi, 1999.
3. Shah H.J., *Reinforced concrete*, Vol. I, Charotar Publishing house, Anand, 2005.
4. CODE BOOKS: IS: 456 – 2000**,** *Code of practice for plain and Reinforced concrete*, Bureau of Indian Standards, New Delhi**.**
5. SP-16 – 1984, *Design Aids for Reinforced concrete IS 456*. Bureau of Indian Standards, New Delhi

CIE 2252: BUILDING MATERIALS TECHNOLOGY [2 0 3 3]

CO1: Describe types of Aggregates, their functional requirements and standard specification for quality control; Identify tests to determine physical properties of Aggregates and interpret the results for usage in construction

CO2: Describe types of Cement, their chemical composition and physical properties and standard specification for quality control; Identify tests to determine physical properties of cement and interpret results for it's use in construction.

CO3: Describe types of concrete, their composition, physical properties of fresh concrete, mechanical properties of hardened concrete and standard specification for quality control; Identify tests to determine workability of plane and self compacting concretes, mechanical properties of hardened cocrete and interpret results for it's use in construction.

CO4: Develop concrete mix design as per standard code of practice IS: 10262-2009

CO5: Describe types of masonry blocks, flooring tiles, pavement blocks and methods of their use in construction

CO6: Describe composition and characteristics of Fly ash bricks, Geo polymer concrete, Reactive powder concrete and their use in construction.

Theory-

Aggregates: Types, Functional requirements, Standard specifications for Quality Control.

Cement: Types, Functional requirements, Chemical composition, process of Hydration, Standard specifications for Quality Control.

Concrete: Types, Grsdes, Functional requirements, Environmental conditions, Standard specifications for Quality Control, Tests on fresh and hardened concrete. Concete mix design as per IS: 10262-2009.

Masonry- Building blocks, Types, types of Bonding, Flooring Tiles, Pavement blocks, Standard specifications for Quality Control.
Alternative materials: Fly ash bricks, Geo polymer Concrete, Reactive powder Concrete

Laboratory-
Tests on Aggregates, Cement, Fresh and Hardened Plane Concrete, Tests on workability of Self Compacting Concrete.

References:

1. Sushil Kumar, *Building Construction*, Standard Publication 1976
2. Shetty M.S., *Concrete Technology,* S. Chand and Co. 2006
3. Neville and Brooks, *Concrete Technology*, Pearson Education, 2003
4. Singh Gurucharan, *Materials of Construction*, Standard Publishers. 1988)
5. *Relevant Handbooks :* SP 20-1991, SP10-1975, SP:62 (S&T) :1997, *National Building Code*, BIS, New Delhi 1988

CIE 2243: ENGINEERING GEOLOGY [3 0 0 3]

Total Number of lectures: 36

Course Outcomes:

CO1	Define the importance of Geology and the properties of geological materials for Civil Engineering applications.
CO2	Describe the impact of internal and external forces on the earth and their applications in Civil Engineering.
CO3	Discuss the importance of geological features and their impact on Civil Engineering structures.
CO4	Visualize and discuss the groundwater system, geomorphological features and rock types for Civil Engineering.
CO5	Describe the principles of Remote Sensing, GIS and geophysical techniques and their applications in Civil Engineering and discuss the techniques to control climate change.

Introduction: Different branches of Geology, scope and importance of Engineering Geology in the field of Civil Engineering **(1 hour)**.
Physical Geology: Origin of Earth, Interior structure of Earth, Differentiation between crust, mantle and core based on its physical and chemical properties, Stratigraphic timescale **(2 hours)**.
Plate Tectonics and Seismology: Continental drift theories, different types of seismic waves, characteristics of strong ground motion and its effects **(2 hours)**.
Earthquake and Tsunami: Causative factors, recording instruments, Indian earthquakes, seismic zonation map of India **(2 hours)**.
Mineralogy: Introduction to mineralogy, rock-forming and ore minerals, their physical properties **(2 hours)**.
Petrology: Introduction to rock cycle, classification of rocks – igneous, sedimentary and metamorphic. Textures and structures of these rocks, rocks as building materials **(4 hours)**.
Weathering and soil formation: different agents of weathering: Physical, biological and chemical; soil profile, classification of soils, soil erosion and prevention, conservation of soils

(2 hours).

Landforms and processes associated with river, wind, and groundwater: Origin and development of river systems, erosional and depositional features, aeolian landforms, aquifers, saline water intrusion, ground water quality, groundwater prospecting **(5 hours)**.

Structural Geology: Dip and Strike, outcrop, instruments used in structural geology, folds, faults, joints, unconformities – their types, origin and recognition in the field and importance in civil engineering projects **(5 hours)**.

Engineering Geology: Introduction, Dams, reservoirs, tunnels, bridges, and highways – geological consideration in site selection **(4 hours)**.

Landslides: Causes and prevention; Case studies with relevance to India **(1 hour)**.

Remote Sensing and GIS: Introduction and applications in civil engineering **(2 hours)**.

Geophysical methods for sub-surface investigation: Seismic and electrical methods **(1 hour)**.

Climate Change: Introduction, causes and solutions to control climate change **(1 hour)**.

Visit to the field: Field visit to observe various river erosional features and weathering, geological structures: folds, faults and joints in the rock formations **(2 hours)**.

References:

1. Parbin Singh, *Engineering Geology*, S.K. Kataria and Sons, New Delhi. (2002).
2. Mukherjee P.K., *A text book of Geology*, World Press, Kolkata (2003).
3. Venkata Reddy D., *Engineering Geology for Civil Engineering*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, (1995).
4. Internet resources.

CIE 2254: WASTE WATER MANAGEMENT [2 1 0 3]

Total number of lectures – 36

Course Outcomes:

CO1: Describe the properties of sewage
CO2: Discuss unit operations and processes
CO3: Discuss the design procedure for the primary wastewater treatment units and illustrate.
|CO4: Discuss the design procedure for the secondary wastewater treatment units and illustrate.
CO5: Discuss the harmful effects and appropriate method for sewage disposal.

Syllabus Structure

Introduction: Aim and object of sewage disposal, systems of sewage disposal.	02
Quantity of sanitary sewage and storm sewage: flow variations, quantity of sewage and storm water, Design of sewers.	04

Construction of sewerage system: Sewer appurtenances, Laying of sewers, testing of sewers, Pumping of sewage, house drainage systems, systems of plumbing, typical layout plan showing house drainage. 06

Characteristics of sewage: Physical, Chemical and biological characteristics of sewage, Aerobic and anaerobic process. 03

Treatment of sewage: Unit operations- flow diagrams for sewage treatment, screens, grit chamber, skimming tank, primary and secondary sedimentation. 06

Unit process - Suspended & attached Growth Systems, Trickling filters - theory, parts, operation and design. Rotating biological contactors. Activated sludge process - meaning, flow diagram, modifications, bulking of sludge, sludge volume index.Chlorination of sewage,Sludge treatment. 07

Disposal of sewage–IS standards for sewage disposal, Methods of disposal: dilution - self-purification of streams, oxygen sag curve. Land disposal – suitability, sewage farming and sewage sickness. Low cost sewage treatment. 05

Industrial Effluent Treatment: Introduction**,** General characteristics of industrial wastes, IS standards for industrial effluent disposal on land, water and sewers. Population equivalent, Concept CETP & zero effluent system. 03

References:

1. Garg S. K., *Environmental Engg.- II*, Volume – II,Khanna Publishers, New Delhi 2014.
2. Birdie G.S., *Water Supply and Sanitary Engineering*, Dhanpat Rai and Sons, New Delhi 1987.
3. IS Standards 2490 - 1974 ,3360 – 1974, 3307 – 1974, Indian Standard Institution, ManakBhavan, New Delhi.
4. *Manual on sewage and sewage treatment CPHEO*, Ministry of Urbandevelopment, New Delhi.
5. *Standard Methods – APHEA*, American Public Health Association, 1015 Fifteenth Street, NW Washington DC.

CIE 2255: WATER RESOURCES ENGINEERING [2 1 0 3]

Total No. of Hours: 36

COURSE OUTCOMES:

CO1: Describe the techniques for quantity estimation of hydrological cycle components.
CO2: Apply concepts of hydrology for problems of runoff and flood flows
CO3: Determine irrigation requirements of crops and compute the water storage requirement.
CO4: Discuss the water storage structures and illustrate the elementary design of gravity dam.
CO5: Discuss the water conveyance systems and illustrate the elementary design of impervious floor on permeable foundations.

Introduction ─ Scope of the subject, World water resources, Need for planned utilization of water resources, Hydrologic Cycle, Hydrological Data and Hydrological Equation **(3 hrs)**

Types of precipitation, Rainfall intensity, duration and measurement, Estimation of Mean rainfall on the basin ─ Need, Water losses – Infiltration, infiltration indices, Illustrations, Evaporation, Transpiration, Estimation of Evapotranspiration, Run-off- Process, estimation, Stream Gauging, Flow-Duration curves, Flow-Mass curves. **(9 hrs)**

Flood studies – Importance, Estimation of Flood Magnitude, Flood Routing, Flood Control Measures, River training works. Hydrographs-types and uses. **(9 hrs)**

Dams – Introduction, Classification &Types, Gravity dams, Arch dams, Buttress dams, Earth dams, Spillways and Energy Dissipaters, Design of Gravity dams – Forces acting on the dam, Design requirements, Single step method for design of low gravity dams, Illustrations. **(9 hrs)**

Diversion head works – components; weirs on permeable foundations, Design of impervious floor by Bligh's creep theory, Canal masonry works – Falls, Regulators, Cross Drainage Works (Descriptions only, no designs). **(6 hrs)**

References:

1. Viessman and Knapp, *Introduction to Hydrology*, Harper and Row Publishers, Singapore. 1989
2. H.M.Raghunath, *Hydrology*, Wiley Eastern pulications, Delhi. 1985
3. Modi.P.N, *Irrigation, water resource and water power*, Standard book house publications, Delhi. 1988
4. R. K. Sharma, T. K. Sharma, *Irrigation Engineering*, S.Chand and Co., New Delhi. 2002
5. Santhosh Kumar Garg, *Irrigation Engineering and Hydraulic Structures*, Khanna Publishers, Delhi. 1998

CIE 2261: BUILDING DESIGN AND DRAWING [0 0 3 1]

Course Outcome:

CO1: Visualise the layout,orientation and elevation of the building

CO2: Sketch components of building

CO3: Visualise and sketch functional space for residential building

CO4: Visualise and sketch functional space for commercial building

CO5 : Develop building drawings using drafting software

Foundations:

Plan, elevation and sectional views giving all details for different types of foundation - stepped wall foundations, RCC Isolated Footings (1)

Doors and Windows:

Plan, elevation and sectional views giving all details for

a) Wooden doors with
   i) Fully panelled
   ii) Partial panelled and partial glazed (1)
b) Wooden windows with
   i) Fully panelled
   ii) Partial panelled and partial glazed (1)

Design and Drawing of Residential Buildings:

a. Functional design of building (Residential, Public and Industrial),positioning of various components of buildings, orientation of buildings, building standards, bye laws, set back distances and calculation of carpet area, plinth area and floor area ratio.
b. Plan, Elevation and Sectional views of Single bedroom house with RCC roof. (3)

Introduction to Auto cad:

a. Functional design of building using inter connectivity diagrams (bubble diagram), development of line diagram only for following buildings: i) Primary health centre, ii) Primary school building, iii) College canteen iv) Bank
b. For a given single line diagram, preparation of water supply, sanitary and electrical layouts (6)

References:

1. Balagopal Pabhu T.S., Vincent Paul K. and Vijayan C., *Building Design of Civil Engg. Drawing*, Spades Publishers, Calicut. 1999
2. Shah and Kale, *Principle of Building Drawing*, Tata McGraw Hill Publishing Co., New Delhi. 1985
3. Sharma and Kaul, *Text book of Building Construction*, S. Chand, New Delhi. 1976
4. Gurucharan Singh, *Building Construction*, Standard Publishers & distributors New Delhi.
5. *IS National Building Code – 1970.*

CIE 2262: FLUID MECHANICS LAB [0 0 3 1]

Total number of Hours – 36

COURSE OUTCOMES:

CO1: Identify the apparatus, determine the parameters of pipe flow and interpret the results.
CO2: Identify the apparatus, determine the friction factor of pipe and interpret the results.
CO3: Identify the apparatus, determine the parameters of open channel flow and interpret the results.
CO4: Identify the apparatus, determine discharge through flumes and interpret the results.
CO5: Identify the apparatus, determine the parameters of flow through openings in tank, reservoir and interpret the results.

Calibration of Triangular Notch	**(3 hrs)**
Calibration of Rectangular Notch Calibration of Cippoletti Notch	**(3 hrs)**
Calibration of Venturimeter Calibration of Orifices	**(3 hrs)**
Calibration of Mouth pieces Calibration of Orifice meter	**(3 hrs)**
Calibration of Broad crested weir Calibration of Curved weir	**(3 hrs)**
Calibration of Ogee weir Calibration of Plug Sluice	**(3 hrs)**
Determination of Friction factor of pipes	**(3 hrs)**
Experiment on Venturi flume Experiment on Standing wave flume	**(3 hrs)**
Demonstration of Parshall Flume	**(3hrs)**
REPETITION CLASS	**(3 hrs)**

TEST **(6 hrs)**

References:

1. Modi P.N. and Seth S.M., *Hydraulics and Fluid Mechanics* Standard Book House, New Delhi.2005
2. Jain A.K., *Fluid Mechanics,* Khanna Publishers, New Delhi 2002
3. Streeter V.L and Wiley E.B., *Fluid Mechanics,* McGraw Hill Co. New York 1998
4. Bansal R. K. *Fluid Mechanics and Hydraulic Machines,* Laxmi Publishers, New Delhi 2010

FIFTH SEMESTER

HUM 3052: ESSENTIALS OF MANAGEMENT [3 0 0 3]

Total no. of hours: 36

Course Outcomes:

On completion of this course the student should be able to:

CO1: Understand the roles of mangers, principles of management, and managerial skills
CO2: Develop an organization structure and plan for manpower in a given business organization
CO3: Set objectives and propose strategies to accomplish them in a business context
CO4: Apply leadership and motivational theories in the organizational context
CO5:Acquire budgetary skills
CO6: Understand the salient international business theories and practices
CO7: Prepare a business plan.

Introduction: Definitions, Systems approach, Nature & scope of management, Functions of managers, and Corporate Social Responsibility (CSR). [03]

Planning: Types of plans, Steps in planning; Process of Management-by-Objectives (MBO)- Setting objectives; Planning premises; and Strategic planning process and tools. [06]

Organizing: Nature and purpose of organising, Span of management, Factors determining the span, Basic departmentation, Line & staff concepts, Functional authority, Art of delegation, and Decentralisation of authority. [04]

Staffing: HR Planning, Recruitment, and Development & Training. [04]

Leading: Theories of motivation, Special motivational techniques; Leadership behaviour & styles; Leadership grid; and Organizational communication. [05]

Controlling: Basic control process, Critical control points and standards; Types of budgets, budgetary and non-budgetary control techniques & devices; Overall control and preventive controls; Budget summaries; Profit & loss control, Control through Return-on-Investment (ROI), Direct control, and Preventive control. [04]

International Management: Managerial practices in Japan and USA; Theory-Z; Nature & purpose of international business, Multinational corporations, and Unified global theory of management. [02]

Entrepreneurship: Entrepreneurial traits-Creativity and Innovation; Market Analysis; Business plan concepts, Business plan development, and Financial projections. [08]

References:

1. Harold Koontz & Heinz Weihrich., *Essentials of Management*, McGraw Hill, New Delhi, 2012.
2. Peter Drucker., *Management: Tasks, Responsibilities and Practices*, Harper and Row, New York, 1993.
3. Peter Drucker., *The Practice of Management*, Harper and Row, New York 2004.

CIE 3151: ANALYSIS OF INDETERMINATE STRCUTURES [3 1 0 4]

Course Outcome:

Graduates will be able to

CO1: Compute the forces in two hinged parabolic arch.
CO2: Describe the methods using strain energy, consistent deformation and three moment theorem to analyze indeterminate beams.
CO3: Describe slope deflection method, moment distribution method and stiffness matrix method to analyze the indeterminate beams and frames.
CO4: Discuss various collapse mechanisms to calculate the plastic moment capacity of beams and frames, and illustrate.
CO5: Discuss Muller Breslau principle and develop influence line diagrams for beams.

Total number of lectures - 36

Analysis of two hinged parabolic arches. Determination of horizontal reaction, normal thrust, radial shear and bending moment. Lateral yielding, rib shortening, and effect of temperature change. (04)

Analysis of Simple Statically Indeterminate Beams: Analysis of propped cantilever, fixed and continuous beams by strain energy and consistent deformation methods. (07)

Analysis of statically indeterminate beams and frames: using slope deflection, and moment distribution methods. Analysis of continuous beams by three-moment theorem. (13)

Plastic Analysis: Ductility, Behaviour in the plastic range, concept of plastic hinge, plastic moments, shape factor for different shapes of cross - section, redistribution of moment, collapse mechanism. Upper and lower bound theorems. Determination of collapse loads using statical and kinematic methods for beams and frames structures. (07)

Matrix Methods: Introduction to matrix methods – Types and different approaches. Stiffness matrix method – Application to beams and frames to find deformations. (12)

Rolling loads and Influence lines: **Introduction to influence line diagram, application of Muller Breslau's Principle.**

References:

1. Reddy C.S., *Basic structural Analysis*, Tata McGraw Hill, New Delhi, 2010.
2. Ramamrutham S.,*Theory of Structures*, Dhanpat Rai Publishing Company, New Delhi 2014.
3. Rao Prakash D.S., *Structural Analysis*, Universities Press, India 1997.
4. Hibbeler RC., *Structural analysis*, Pearson Education, United States 2015.
5. Daniel L Schodak., *Structures*, Pearson Education, United States 2015.

CIE 3152: BASIC STRUCTURAL STEEL DESIGN [3 1 0 4]

Course Outcome:

CO1-Describe the behavior of steel structures and solve problems related to bolted connection.

CO2-Identify and solve problems related to welded connection and tension member.
CO3-Identify and solve problems related to compression member.
CO4- Identify and solve problems related to column splice, column base and laterally supported beam
CO5- Identify and solve problems related to laterally unsupported beam, roof truss and welded plate girder.

Total number of lectures – 48

Introduction –different type of steel structures, properties of structural steel. Type of standard steel section Indian standard sections, difference in design of steel and RCC structures. Limit state method of design. (**03)**

Bolted connection- Introduction, type of bolts, advantages and disadvantages of bolted connection over riveted and welded connections. Behavior of bolted joints, failure mode of bolted joints Strength of bearing bolt, in tension, shear and bearing. Efficiency of joint. Eccentric bolted connection, in-plane bolt group and out-of plane bolt group. **(09)**

Welded connections – advantages and disadvantages, types of welded joints- Fillet welded joints , butt welded joints, slot and plug welded joints, type of butt welded joints Fillet weld - size and throat thickness. Strength of weld and welded joints. Eccentric connections in-plane weld group and out-of plane weld group. **(06)**

Tension Members - Introduction, design strength of tension member, design problems, Tension splices. **(04)**

Compression members- Introduction, type of standard and built-up section used, buckling class of sections, design compressive strength of steel members. Design of Laced and Battened columns. **(09)**

Design of column splices - Introduction and types of column splices, design of column base, type of column bases – simple and gusseted base. **(05)**

Flexure member – Introduction, laterally supported and laterally unsupported beams. Plastic moment capacity of section. Classification of cross sections based and calculation of flexural strength of laterally supported beams, with low shear and combined shear, web buckling and crippling strength, effective length of beams, warping and torsional restrains. **(08)**

Plate Girders (welded only) – Introduction, components of plate girder, economical depth, design of plate girder with no stiffeners. **(04)**

References:

1. Duggal S.K., *Limit State Design of Steel Structures*, Tata McGraw Hill education private Limited – New Delhi 2008.
2. Subramanian N., *Design of Steel Structures*, oxford university New Delhi 2008.
3. IS 800-2007, *General construction of steel in code of practice*, Bureau of Indian Standards, New Delhi.
4. SP-6 (Part I) 1964, *Structural Steel Sections*. Bureau of Indian Standards, New Delhi

CIE 3153: CONSTRUCTION MANAGEMENT [3 0 0 3]

Course Outcome:

CO1: Discuss the significance of construction management and network representation
CO2: Apply the significance of construction planning and scheduling using PERT network
CO3: Apply the significance of construction planning and scheduling using CPM network;
CO4: Apply the principles of CPM to time-cost optimization and updating construction projects
CO5: Discuss the economic aspects and applicability of various construction equipment.

1. Introduction to Construction Management- Classification of construction works, various stages in the Construction of a Project, construction team, Work Breakdown Structure (02)
2. Planning for Construction Projects- Steps involved in planning, Objectives of planning, Stages of planning, Stages of planning by different agencies. (03)
3. Scheduling– Definition, Preparation of construction schedules, Advantages, Bar charts and Milestone charts – Preparation, Merits, Demerits. (02)
4. Network Analysis-Introduction, Terms and definition, Network representation, Rules for drawing a network diagram, Fulkerson's rule for numbering the events. (03)
5. Pert Analysis– Time estimates, Calculation of slack, critical path, probability of completion time of project. (03)
6. CPM analysis- Differences between CPM and PERT, Calculation of float, critical path. (03)
7. Cost Analysis- Direct cost, indirect cost, Total project cost, Cost slope, steps involved in optimisation of cost. (04)
8. Project updating- Data required for updating, updating flow chart. (02)
9. Management of Construction equipment- Classification of construction equipment, factor affecting selection of construction equipment, Planning of construction equipment, Economic life of equipment, preventive maintenance and repairs, cost of owning and operation of construction equipment and related problems, Introduction to earthmoving, hoisting, hauling equipment, aggregate crushers, tunneling, and paving equipment. (14)
ng, hauling equipment, aggregate crushers, tunneling, and paving equipment.

References:

1. Dr. Seetharaman. S., *Construction Engg. and Management*, Umesh Publication. 1997
2. Sengupta B., Guha M, *Construction Management and Planning* McGraw Hill Companies. 1998
3. Dr. Punmia B.C. and Khandelwal K.K., Project Planning and Control with PERT and CPM Laxmi Publication 2002
4. Varma Mahesh, *Construction equipment and its planning and application*, Metropolitan Publication. 1987

CIE 3154: GEOTECHNICAL ENGINEERING [3 1 0 4]

Total number of lectures – 46

Introduction, Soil structure, Clay minerals, Index properties of soil, Total, effective and neutral stresses, Flow through soil, Seepage through soils, Compaction of soil, Stress distribution in soil, consolidation of soil, Shear strength of soil –Direct shear, Triaxial, Unconfined compression and Vane shear tests, Drained, Undrained and Consolidated undrained tests and their applications.

Course Outcome:

CO1: Recognize the basic properties of soil, identify their interrelationships and classify the soil as per IS code.
CO2: Interpret one and two dimensional flow of water through soil.
CO3: Compute the in-situ stresses and stresses due to external load at any point within the soil.
CO4: Interpret the compression of soil due to compaction and consolidation.
CO5: Describe the shear strength parameters and determine the shear strength of soil.

Introduction: Introduction to Geotechnical Engineering, Soil structure-Single grained, Flocculated and Dispersed structure, Clay minerals. (03)

Index properties of soil : Soil as a three phase system, Physical properties of Soil - Specific gravity, Void ratio, Porosity, Degree of saturation, Bulk density, Dry density, Saturated density, Relative density, Moisture content, Inter - relationships between them, Atterberg's limits, Sieve Analysis, Hydrometer analysis, IS Classification of soils (10)

Total, effective and neutral stresses: Principles of Effective, Neutral and Total Stresses (02)

Flow Through Soil: Concept of permeability. Darcy's law, Factors affecting permeability, Laboratory determination of permeability of soils, Permeability of stratified deposits. (04)

Seepage Through Soils: Quick sand condition, Laplace equation (No Derivation) , Flow nets-properties and applications, Graphical method of construction of flow nets for sheet pile and cut off walls. (04)

Compaction of Soil: Optimum moisture content, Maximum dry density and Zero air voids line, Factors affecting compaction, IS light and heavy compaction tests, Equipments for compaction control in the field. (03)

Stress Distribution in Soil: Boussinesq's theory for stresses in soils. Use of Boussinesq's equations for determination of stress distribution (No derivation) - for point load, Uniformly loaded circular and rectangular areas, Construction and use of New Mark's chart. (04)

Consolidation of Soil: Concept, Spring analogy, Definition of - Compression Index, Coefficient of Compressibility, Coefficient of Volume Compressibility. Normally Consolidated, Over and Under consolidated soils. Casagrande's method for determination of Pre-Consolidation pressure, Its significance, Terzaghi's one dimensional consolidation theory (No derivation). Consolidation tests, Use of laboratory curve fitting methods. (08)

Shear Strength of Soil: Concept of shear strength of soils, Mohr-Coulomb theory and failure criteria, Laboratory determination of shear strength parameters - Direct shear, Triaxial, Unconfined compression and Vane shear tests, Drained, Undrained and consolidated undrained tests and their applications. Case study of Tenton Dam (08)

References:

1. Bowels J.E., *Foundation Analysis and Design*, (4e), McGraw-Hills Book Company, 1998.
2. Punmia B.C., Jain AK and Jain AK ., *Soil Mechanics and Foundations*, (17e), Laxmi Publications Pvt. Ltd., 2017
3. Arora K.R., *Soil Mechanics and Foundation Engineering, (7e),* Standard, Publishers and Distributors, 2011.
4. Murthy V.N.S., *A Text Book of Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors-New Delhi, 2008.
5. Gopal Ranjan and. Rao A.S.R., *Basic and Applied Soil Mechanics*, New Age International Pvt. Limited, Publishers, 2016.

CIE 3161: COMPUTER APPLICATION LAB [0 0 3 1]

Course Outcome:

At the end of this course, the student should be able to

CO1: Solve for the response of two-dimensional structures using STAAD.Pro and interpret the results.
CO2: Solve for the response of three-dimensional structures using STAAD.Pro and interpret the results.
CO3: Illustrate the design of structures using STAAD.Pro
CO4: Solve for the response of frame structures using ETABS and interpret the results.
CO5: Illustrate the design of structures using ETABS.

Total number of lectures – 36 hrs

1. Introduction to STAAD Pro. software package- modeling and analysis of continuous beams (06)
2. Analysis of plane trusses, plane frames, and space frames using STAAD Pro. (15)
3. Design of frames using STAAD Pro. package. (06)
4. Introduction to ETABS – modeling and analysis of 3D space frames. (09)

References:

1. Sharma T.S., *STAAD Pro. V8i for beginners – with Indian examples* (1e), Notion Press 2014
2. Rajendran D., *Analysis & Design of a Multistorey Building using STAAD.Pro & E-TABS (with Manual Calculation)* (1e), Designtech Publishers 2016
3. Bentley, *STAAD Pro. – Technical Reference Manual*, Retrieved from https://communities.bentley.com/cfs-file/__key/telligent-evolution-components-attachments/13-275895-00-00-00-24-18-/Technical_5F00_Reference_5F00_V8i.pdf 2012
4. Computers and Structures, Inc., CSI Analysis Reference Manual, Retrieved from http://docs.csiamerica.com/manuals/etabs/Analysis

CIE 3162: ENVIRONMENTAL ENGG. LAB [0 0 3 1]

Total number of practical classes – 10

Course outcomes:

CO1: Identify the sampling procedures for testing drinking water and industrial waste water.
CO2: Identify the tests to determine the physical and chemical characteristics of drinking water and interpret the results for domestic purpose.
CO3: Identify the tests to determine the physical and chemical characteristics of waste water and interpret the results for safe disposal.
CO4: Identify the tests to determine the bacteriological characteristics of water and interpret the results.
CO5: Discuss quality of water as per standard code of practice.

Determination of solids - total solids, suspended solids, dissolved solids, volatile solids, Fixed solids, settlable solids. (01)
Turbidity determination and Jar test. (01)
Determination of Alkalinity, Acidity and pH. (01)

Determination of Calcium, Magnesium and total Hardness. (01)
Determination of Chlorides and percentage available chlorine in Bleaching powder. (01)
Determination of dissolved oxygen and BOD (01)
Residual chlorine and chlorine demand. (01)
Determination of Iron and Fluorides.
Determination of C.O.D. (01)
Total count test and MPN determination
Determination of Ammonical Nitrogen and Nitrates. (01)
Demonstration of High volume sample and sound lever meter.
Demonstration of determination of oil, grease and Sulphates. (01)

References:

1. Standard Methods for the Examination of Water and Waste Water – ALPHA – AWWA – WPCF
2. Sawyer and Mc Carty, *Chemistry for Environmental Engineering*, McGraw Hill, New York 1994,.
3. IS – 3025 – 1964 – Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry, IIT New Delhi.
4. Drinking water Standards IS – 10500-2012.

CIE 3163: SOIL MECHANICS LABORATORY [0 0 3 1]

Total number of Classes – 12

Course Outcome:

CO1: Identify the tests to determine index properties of soil and interpret the results for geotechnical solutions.
CO2: Identify the tests to determine compaction characteristics of soil and interpret the results for geotechnical solutions.
CO3: Identify the tests to determine the hydraulic conductivity for different types of soils and interpret the results for geotechnical solutions.
CO4: Identify the tests to determine shear strength parameters of soil and interpret the results for geotechnical solutions.
CO5: Observe and discuss the uses of plate load test, Static cone penetration test, Consolidation test and California bearing ratio tests.

Determination of moisture content, specific gravity, Atterberg limits, In-situ unit weight, Sieve analysis, Coefficient of permeability by constant head and variable head permeameter, Standard compaction test, Use of proctor needle, Triaxial shear test, Unconfined compression test, Direct shear test, Vane shear test, Determination of CBR, Demonstration of Plate laod test, Cone penetration test and hydrometer analysis.

1. Determination of moisture content by oven drying method and pycnometer, use of Torsion moisture meter. (01)
2. Determination of specific gravity by density bottle and pycnometer. (01)
3. Determination of Atterberg's limits-Liquid limit, plastic limit and shrinkage limit. (01)
4. Determination of in-situ unit weight by core cutter method and sand replacement method (01)
5. Grain size analysis (01)

6. Determination of coefficient of permeability by constant head and variable head permeameter (01)
7. Determination of maximum dry density and optimum moisture content using standard Compaction and use of proctor needle (01)
8. Determination of shear strength parameters using :
   (a) Unconfined compressive strength test
   (b) Direct shear test
   (c) Vane shear test
   (d) Triaxial compression test (03)
9. Determination of California bearing ratio (01)
10. Demonstration of-
    Consolidation Test
    Static cone penetration test
    Plate load test (01)

References:

1. Relevant IS codes
2. Bowles J.E., *Engineering properties of soil and their measurement, (2e),* McGraw – Hill Book Company, New York, 1986.
3. Lambe T.W, *Soil testing for Engineers*, John Wiley and Sons, INC.
4. Cheng Liu and Jack B. Evett, *Soil properties, Testing, Measurement and Evaluation*, Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 1987.

SIXTH SEMESTER

HUM 3051: ENGINEERINING ECONOMICS AND FINANCIAL MANAGEMENT [3 0 0 3]

Total number of lectures: 36

Course Outcomes:

On completion of this course the student should be able to:

CO1: Make comparisons of project alternatives during the planning and implementation phases.
CO2: Determine the future value of a payment made in the present.
CO3: Distinguish the present value of a payment to be made in the future.
CO4: Estimate the future value of periodic payments.
CO5: Compare and contrast the interest rate required on an investment to achieve a future sum.
CO6: Compute the annual worth of proposed alternatives.
CO7: Describe the best time to replace an aging asset.
CO8: Explain the best method of depreciation to minimize tax liability.

Introduction: Nature and significance, Micro & macro-economics, Law of demand-supply, and Elasticity of demand supply, equilibrium of demand & supply. [04]

Time Value of Money: Present and future worth of money, Uniform-gradient cash flow, Interest factors for discrete compounding, and Nominal & effective interest rates. [10]

Economic Analysis of Alternatives: Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, and Replacement analysis. [10]

Break-even and Minimum-cost Analysis: Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives and Minimum cost analysis. [02]

Depreciation: Physical & functional depreciation, Methods of depreciation - Straight line, Declining balance, Sum-of-the-years digits, Sinking fund and Service output methods [02]

Introduction to Financial Management: Nature and objectives, Scope and Functions. [02]

Financial Statement Analysis: Balance sheet and Profit & loss statement, Meaning & contents. Ratio analysis, Financial ratios such as Liquidity ratios, Leverage ratios, Turnover ratios, and Profitability ratios, Time series analysis, Common size analysis, Du-Pont analysis, Drawbacks of financial statement analysis.

References:

1. Prasanna Chandra., *Fundamentals of Financial Management*, Tata Mc-Graw Hill Companies, New Delhi, 2005.
2. James L Riggs, David D Bedworth and Sabah U Randhawa., *Engineering Economics*, Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2004.
3. T. Ramachandran., *Accounting and Financial Management*, Scitech Publications Pvt. Ltd. India, 2001.
4. Eugene F. B. & Joel F. H., *Fundamentals of Financial Management*, (12e), Cengage Learning Publisher, 2009.

CIE 3251: APPLIED SOIL ENGINEERING [2 1 0 3]

Total number of lectures – 36

Soil Exploration, Earth pressure at rest, active and passive conditions, Stability of slopes - Finite and infinite slopes, Bearing capacity of shallow footings, Pile foundations, Pile driving, Load carrying capacity of a single pile using static formula, Group action and Negative skin friction, Settlement of pile foundations, Under-reamed piles and bored compaction piles.

Course Outcome:

CO1: Discuss the methods of soil exploration.
CO2: Describe the lateral earth pressure and illustrate
CO3: Discuss types of slope, methods to compute stability and illustrate.
CO4: Discuss the methods to determine bearing capacity for shallow foundation and illustrate.
CO5: Discuss the load carrying capacity and settlement of pile foundation and illustrate.

Soil Exploration: Objectives, Methods of boring, Types of samples and samplers, Requirements of good sampler, Significant depth, Depth and spacing of bore holes, Penetration tests, Ground water investigations, Geo-physical exploration, Exploration log, Planning of exploration programme. (05)

Earth pressure: Earth pressure at rest, active and passive conditions, Rankine's theory for active and passive condition, Bell's equation for c-Φ Soil, Graphical method (08)

Stability of slopes - Finite and infinite slopes, Types of failure of Finite slopes. Factor of safety, Stability of finite slopes by Swedish circle method and friction circle method, Factor of safety using Taylor's stability chart. (08)

Bearing capacity of shallow footings – Classification of footings, Types of shallow footings, Definitions, modes of shear failure, Terzaghi's theory (No derivation), Factors affecting bearing capacity, IS code method, Estimation of bearing capacity from plate load and penetration tests, Permissible, total and differential settlement. (08)

Pile foundations: Classification, Pile driving, , Load carrying capacity of a single pile by static formula, Group action and Negative skin friction, Settlement of pile foundations, IS pile load test, Under-reamed piles and bored compaction piles. (07)

References:

1. Bowels J.E., *Foundation Analysis and Design*, (4e), McGraw-Hills Book Company, 1998.
2. Punmia B.C., Jain AK and Jain AK ., *Soil Mechanics and Foundations*, (17e), Laxmi Publications Pvt. Ltd., 2017
3. Arora K.R., *Soil Mechanics and Foundation Engineering*, (7e), Standard, Publishers and Distributors 2011.
4. Murthy V.N.S., *A Text Book of Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors-New Delhi, 2008.
5. Gopal Ranjan and. Rao A.S.R., *Basic and Applied Soil Mechanics*, New Age International Pvt. Limited, Publishers, 2016.

CIE 3252: ESTIMATION, COSTING AND VALUATION PRACTICE [2 0 3 3]

Total number of lectures - 24

Course outcomes:

At the end of this course student should be able to:

CO1: Describe the methods of quantity estimation of different civil engineering structures.
CO2: Describe the specification of different items of work in Civil Engineering Structures.
CO3: Discuss the methods of preparing bar bending schedule of Civil Engineering Structures.
CO4: Analyze the rate for different item of work based on local rates and specifications.
CO5: Evaluate the worth of a land/ building using appropriate method of valuation.
CO6: Discuss the principles of contract management in civil engineering.

Estimation: Introduction, Definition, Purpose, Types, Contingencies, Lump-sum, work charged establishment. Approximate estimate-Types, Plinth Area, Carpet Area, Method of measurement of work as per IS 1200, General rules of measurement of work, Method of measurement of different item of work Introduction. (06)

Introduction to Methods of estimation of buildings, center line method, long and short wall method (01)

Specification: Necessity, How to Write, General Specification, Detailed Specification, Open Specification, Standard Specification, Specification of different items of work, Earth work in excavation, PCC, RCC, DPC, Brick Masonry, RR Masonry, CR Masonry, Different types of Flooring, Plastering Painting, Roofing. (04)

Rate Analysis: Purpose, factors effecting, overhead charges, turn out of work, rate analysis for different items of building (01)

Valuation: Purpose of valuation, scrap value, salvage value, market value, factors which affect the value, sinking fund, year's purchase, depreciation, determination of depreciation, different methods of valuation, land and building method of valuation, calculation of standard rent, rental method of valuation. (06)

Departmental Procedure: Tender Documents, EMD, Security Deposit, Tender Notice, Muster Roll, Measurement Book, RA Bill, work slip, Defect Liability Period, Retention Money, Contract Management-: Agreement, Types of contract, Termination. (04)

Earth work in road: Lead & Lift, Quantity of earth work in road construction, General methods for computation of earth work, Volume of earth work in Roads, Trapezoidal method, Prismoidal method, Volume of earth work from Contour Plan, Spot levels, Mass Diagram (02)

Practice lab:

Quantity estimation of residential building, multi-storied buildings, center line method, long and short wall method. (05)
Preparation of bar bending schedule for the given component of RC structure. (01)
Rate analysis for different components of building. (02)

Quantity Estimation of earth work in road formation. (02)
Quantity Estimation of road and culverts. (01)

References:

1. M. Chakraborti., *Estimating, Costing, Specification & Valuation in Civil Engineering*, (16e) Published by the Author, 2003.
2. B.N. Dutta.,*Estimating and Costing in Civil Engineering*, (16e), UBS Publishers' Distributors Ltd. 2000.
3. CPWD., *Manual for Standard Specification and Rate Analysis*
4. IS 1200: Part 1 to 16: *Method of measurement of building and civil engineering work*

CIE 3253: RAILWAY AND AIRPORT ENGINEERING [2 1 0 3]

Total no. of lectures: 36 hrs

Course outcomes:-

At the end of the program the student will be able to

CO1: Recognize the basic components of the Railway and Runway.
CO2: Can handle the design, construction, and operation of railroads that use a fixed guide way.
CO3: Tasks that include determining horizontal and vertical alignment design and station location.
CO4: Design and construct airports and can account for the impacts and demands of aircraft in their design of airport facilities.
CO5: Describe the fundamentals of traffic control and management systems of railways and airports.

RAILWAY ENGINEERING: -

Introduction: - Role of railways in transportation, Indian Railways, Selection of Routes, Gauges and types, Typical cross sections-single and double line B G track in cutting, embankment and electrified tracks **3hrs**

Tractive resistance: - Resistant due to friction, wave action, curves, gradients, speed of the train; Hauling capacity and Tractive efforts. **3hrs**

Permanent way: - Components parts rail and rail fastenings, ballast, sleepers, Railway creep, Anti-creep devices, coining of wheel, wear of rail. **3hrs**

Alignment Details: - Grades and curves, effect of normal and ruling gradients, pusher and balance grades, super elevation, equilibrium cant, cant deficiency and grade compensation **3hrs**

Points and crossing: -Necessity of turnouts, Switches and track junction, Design of turnouts. **3hrs**

Track Junctions:- Introduction, Types of Track Junctions, Design calculation of simple junctions. **3hrs**

Miscellaneous **Topics:-** Railway Station and Yards - Types of railway stations, classification of yards, Triangle, Turn Table, Scotch Block, Fouling marks, Buffer Stops. Signals - Classification, function, Control on movement of train by different methods. Interlocking - Types and function. **3hrs**

AIRPORT ENGINEERING: -

Introduction: - History and development of aviation, Aviation organizations and their functions, Aircraft characteristics and its influence on airport planning, Factors to be considered in Airport Planning, Site selection survey, Obstructions, Airport configuration**.** **3hrs**

Geometric Design: - Runway orientation, Basic runway lengths, Geometric design of Runway Taxiways and Exit Taxiways. **5hrs**

Airport Capacity and Designing of Terminal Area : - Runway and Terminal capacity and its improvement, Delay related capacity, Gate position and gate capacity, Planning and Designing of Terminal area , Aircraft parking system. **5hrs**

Visual aids and Air traffic control system: - Flight rules, Navigational and landing aids, ILS **2hrs**

References:

1. Saxena S C and Arora S P, *A Text Book of Railway Engineering*, (8e), Dhanpat Rai Publications (p) Ltd.-New Delhi, 2017.
2. Khanna S K, Arora M G and Jain S S,, *Airport Planning and Design*, (6e), Nemchand and Brothers Publications, Roorkee, 1999.
3. Horenjeff, R. and McKelvey, F., *Planning and Design of Airports*, (4e), Mc Graw Hill Company, New York, 1994.
4. Ashford, N. and Wright, P.H., *Airport Engineering*, (3e), John Wiley and Sons, New York, 1992.

CIE 3261: STRUCTURAL DESIGN AND DRAWING [0 0 3 1]

Course outcomes:-

CO 1: Sketch the structural detailing of RC beams,slabs and continuous beams as per standard code of practice.
CO 2: Illustrate the design of stair case, Circular tank and sketch the structural detailing as per standard code of practice.
CO 3: Sketh the structural detailing of isolated column footing and column as per standard code of practice.
CO 4: Illustrate the design of Cantilever retaining wall and sketch the structural detailing as per standard code of practice.
CO 5: Sketch details of Beam to beam & beam to column connections in steel buildings and Built-up Columns with lacings and battens.

Total 36 hrs

Detailing of singly and doubly reinforced rectangular beams-	03
Detailing of one-way slabs, Detailing of Two-way slabs, Detailing of continuous beams.	06
Design and detailing of Dog legged staircase.	03
Design and Detailing of the circular tank and rectangular tank.	06
Detailing of isolated footing and detailing of column reinforcement.	03
Design and Detailing of Cantilever retaining wall.	06
Beam to beam and beam to column connections in steel buildings. Built-up Columns with lacings and battens .	09

References:

1. Subramanian N., *Design of Reinforced Concrete Structures* (1e), Oxford University Press, 2013.
2. Shah H.J., *Reinforced Concrete – vol. 1(Elementary Reinforced Concrete)* (11e), Charotar Publishing House Pvt. Ltd., 2016
3. Chandra R., Gehlot V., *Elements of Limit State Design Of Concrete Structures,* Scientific Publishers, 2004
4. Gambhir M. L., *Fundamentals of Structural Steel Design* (1e), Tata McGraw Hill Publishing Co. Ltd., 2013
5. Relevant Code and Hand Books : IS 456 (2000), SP 34 (1987), IS 800 (2007), SP 6 – 1 1964

CIE 3262: SURVEYING PRACTICE – II [0 0 3 1]

Total number of lectures 12

COURSE OUTCOMES:

CO1 Practice principles of tacheometry
CO2 Practice the use of minor equipment in Surveying.
CO3 Practice setting out of compound, reverse and transition curves.
CO4 Practice the use of Electronic theodilite
CO5 Practice the use of Total Station

Tacheometric surveying

Determination of Tacheometric constants.	(01)
To find the gradient of a line joining two points at different elevations.	(01)

Curve Surveying: (Using theodolite)

Setting out a compound curve.	(01)
Setting out a reverse curve.	(01)
Setting out a transition curve (Bernoulli's Lemniscate)	(01)

Minor Instruments

Study of minor instruments-:
Hand level, Clinometers, Abney level, Use of Planimeter , Ceylon ghat tracer (01)

Total Station Method

Study of the instrument	(01)
Calculating distance, difference in height between two inaccessible points	(01)
Traversing using total station	(01)
Generating contour plan.	(01)
Minor Project using total station	(02)

Reference books

1. PunmiaB.C ,(2005), " Surveying and levelling" , Vol.I and II , Lakshmi Publishers , New Delhi.
2. AroraK.R , (1993), " Surveying", Vol.I, Standard Book house, New Delhi.
3. Kanetkar T.P and Kulkarni S.V,(1996), " Surveying and levelling " parts I and 2, Pune VidyarthiGrihaPrakashan.
4. ThomasNorman , " Surveying" , Edward Arnold Publishers (ELBS),Budapest.
5. David Clark,(1983), " Plane and Geodetic Surveying for Engineers " , Vol I and II – CBS publication and Distributors, New Delhi.

SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

EIGHTH SEMESTER

CIE 4298: INDUSTRIAL TRAINING

CO1 Recognize relevant stakeholders for professional training.
CO2 Observe and relate the professional practices to relevant stream of knowledge.
CO3 Prepare a comprehensive training report.
CO4 Explain the training report through presentation.
CO5 Observe ethical skills of communication.

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

CIE 4299: PROJECT WORK/PRACTICE SCHOOL

CO1 Develop research objectives through literature review
CO2 Prepare appropriate analytical/experimental method/model
CO3 Apply the method/model to solve research problems and interpret the result
CO4 Prepare the report following ethical standards
CO5 Explain the process and outcome of research to appropriate stakeholders

The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATIONS

I. Building Construction and Management

CIE 4051: ADVANCES IN CONCRETE TECHNOLOGY [3 0 0 3]

CO1: Discover the structure of concrete and discuss its influence on properties of concrete
CO2: Illustrate the early age properties of hardened concrete and their related tests
CO3: Explain materials for making concrete and their influence on properties of concrete and apply principles to develop concrete mix using standard code of practice
CO4: Describe various high performance concretes, their production and application
CO5: Identify the techniques and devices used for quality control of concrete

Microstructure and Properties of Hardened Concrete, Introduction, Microstructure of Concrete, Strength, Dimensional Stability, Durability, Hydraulic Cements, Aggregates, Admixtures, Proportioning Concrete Mixtures, Concrete at Early Age, Nondestructive Methods, Concrete Materials, Mix Proportioning, and Early-Age Properties, Advances in Concrete Technology, Special Types of Concrete, Concrete Mechanics.

References:

1. Monteiro and Mehta *Concrete: Microstructure, Properties, and Materials*, (4e), McGraw-Hill 2014.

CIE 4052: BUILDING CODE AND REQUIREMENTS [3 0 0 3]

Course outcomes

CO1: Discuss the standard code of practice for construction of low income housing units.
CO2: Discuss Standard code of practice for fire and safety of housing units.
CO3: Discuss standard code of practice for loads acting on buildings
CO4: Discuss standard code of practice for earthquake resistant construction of buildings.
CO5: Discuss standard code of practice for lighting and sanitation systems in buildings.

Introduction to National Building Code-: Salient features of National Building Code, Scope and Terminologies related to building construction, Permit forms and Inspection (06)

General Building requirements-: Land Use classification, Classification of Buildings, Area and Height Limitations, Requirements of various parts of Building (06)

Fire and Safety: fire prevention, life safety, fire protection (03)

Design and Construction-: construction practices and safety, requirements in wind load design (05)

Earth quake resistant of masonry wall: design of masonry wall –special considerations in earth quake zone, guide lines for improving earth quake resistance (05)

Building Services-: Lighting and ventilation: determination of luminous flux, efficiency, CRI, CCT, lighting design of building, Ventilation- design consideration, methods, air requirements, air conditioning (07)

Acoustics, Sound Insulation and Heat Insulation in buildings (04)

REFERENCE:

National Building Code of India 2005

Bureau of Indian Standards-: SP 64 (2001), SP 7 (2005)

References:

1. *National Building Code of India* 2005
2. *SP 64 (2001), SP 7 (2005),* Bureau of Indian Standards

CIE 4053: CONSTRUCTION MATERIALS AND QUALITY MANAGEMENT [3 0 0 3]

Course outcomes

CO1: Discuss integrated material management for construction management practices.
CO2: Apply the principles of integrated material management practices for material planning and organizing.
CO3: Apply the principles of integrated material management practices for material purchase and stores.
CO4: Describe total quality management philosophy for construction management practices.
CO5: Apply the principles of total quality management for construction management practices.

Introduction to the concept of Integrated Material Management: Meaning, Functions, and Advantages, Classical approach v/s Integrated approach. **(03)**

Selective Inventory Control: Meaning and need for Selective Inventory Control, Inventory related Costs, Selective control methods- FSN, HML, VED, SOS and GOLF methods, Worked examples on ABC and XYZ analysis. **(04)**

Codification and Standardisation: Need for Material Standardisation with examples, Methods of Variety Reduction- Renard's numbers, 1-2-5 series, M-series with examples, Meaning and need for Grouping and Coding, Objectives and Classification, Alphabetical, Alpha-Numerical, Numerical, Kodak and Brisch systems of coding. **(06)**

Material planning budgeting and procuring: Background to Material Plan, Steps to prepare Material Plan-Work Breakdown Structure (WBS) and Bill of Quantities (BOQ), Exercise to prepare Material Plan **(03)**

Purchase Management: Introduction, 5-R's, Planning, Organising and Directing Functions of Purchase Management, Need for Purchase System, Computational Techniques for Price forecasting under Fluctuating Prices- Thumb Rule and Time Series- Average Method, Moving Average, Method, Weighted Moving Average Method, Exponential Smoothing, Regression Analysis, Purchase Strategy- Conservative Strategy, Hind Sight Approach, Purchasing Capital equipment, Source selection. **(10)**

Introduction to Total Quality Management (TQM) Concept: Evolution, Benefits v/s Hindrances, Dimensions and Cost of Quality, Quality control and Quality Assurance TQM Philosophies: Concept of Ishikawa, Taguchi, Shingo, Deming's philosophies. TQM Tools: An overview of Flowcharts, Check sheets, Histogram, Cause and effect diagrams, Pareto diagram, Scatter diagram and Control charts. Introduction to Quality Function Deployment (QFD) and benefits of QFD, House of Quality (HoQ)-Steps in building HoQ. **(09)**

Introduction to ISO systems of quality assurance: ISO 9000, ISO 14001. **(01)**

References:

1. Gopal Krishnanan P., Sundaresan M., *Material Management Integrated Approach*, Prentice Hall India, New Delhi. 1992
2. Datta A.K., *Material Management and Inventory Control: Principles and Practice*, Jaico Publishing House, Bombay. 1988
3. Woodside Gayle, Aurrichio Patrick *ISO 14001, Auditing manual* Mc-graw Hill, New Delhi. 2000
4. BhatSridhara K *Total Quality Management*, Himalaya Publication House, Mumbai. 2007
5. Oakland John S *TQM, Text with cases*, Butterworth- Heinemann, Oxford. 2006

CIE 4054: PRECAST TECHNOLOGY [3 0 0 3]

Course outcomes:

CO1 Discuss the comparative advantages, disadvantages and suitability of precast concrete structures
CO2 Discuss types of precast construction
CO3 Describe materials used and quality control in precast construction.
CO4 Discuss modular consideration and standardization
CO5 Discuss the design principles for precast construction

1. Introduction: Comparative advantages of precast constructions over in-situ constructions, Suitability of precast construction, Limitations of Precast construction. 6 Hrs
2. Types of Precast constructions- Structural Precast Systems, Precast Buildings, Housing, Apartment Buildings, Utility Buildings, Large Space buildings and Mixed Construction 8 Hrs
3. Materials and Quality control-Production Process, Tolerance, Transportation and Erection 6 Hrs
4. Modular Consideration and Standardization- General principles for Frame and skeletal structures, Bearing walls, Floors, Beams and Columns (types, modulations and connections) 6 Hrs
5. Design principles: Approaches to Design, Structural System and Overall Stability, Structural Integrity, Loads on Stability Elements, Connections-Basic Force Transfer Mechanism, Types of Connections, Earthquake Design 10 Hrs

References:

1. Kim S. Elliott , *Precast Concrete Structures*, Butterworth- Heinemann, An imprint of Elsevier Science, 2002
2. *FIP Planning and Design Handbook on Precast Building Structures*, SETO Ltd., 1994

3. Hubert Bachmann, Alfred Steinle, *Precast Concrete Structures*, Ernst & Sohn GmbH & Co. KG, 2011
4. IS 10297-1982

II. Environmental Engineering

CIE 4055: AIR POLLUTION AND CONTROL [3 0 0 3]

Total number of lectures – 36

Course outcomes:

CO1: Identify the types of air pollutants, their behavior and the chemical reactions in the atmosphere.

CO2:Describe the various meteorological factors, general characteristics of stack plumes and estimate the stack height.

CO3: Discuss the effects of air pollutants and their global effects.

CO4: Describe the sampling procedures and the methods to control air pollutants.

CO5: Discuss the air pollution act, air quality, emission standards and compute air pollution index.

Syllabus structure

Definition, classification and properties of air pollutants, Behaviour of air pollutants, chemical reactions in atmosphere- smog. 05

Meteorology variables, primary and secondary lapse rate, Inversions, stability conditions, general characteristics of stack plumes, Design Problems, stack height estimation. 06

Effects of air pollution – human health, animals, plants and materials. Global effects of air pollution - acid rain, Green house effect, ozone layer depletion. Air quality and Emission standards, Air pollution index. 11

Industrial plant location and planning. 02

Sampling, analysis and control - Measurement of gaseous and particulate pollutants, stack sampling, smoke and smoke measurement, control methods - different types. 09

Air-pollution due to gasoline driven and diesel driven engines, effects and control. Air pollution Act 03

References:

1. Rao H.V.N. and Rao M.N, , *Air pollution*, Tata Mc Graw Hill, New Delhi 1989.
2. Rao C.S., *Environmental Pollution control*, Wiley Eastern Ltd. Delhi 1995.
3. Wark Kenneth and Wamer C.F, *Air Pollution its Origin and Control*. Harper and Row, Publ.
4. Sincero. A. P.and Sincero G.A. *Environmental Engineering*. Prentice Hall.
5. *Air Pollution* - Sampling and Analysis - APHA.

CIE 4056: ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING [3 0 0 3]

Total number of lectures – 36

Course Outcomes:

CO1: Identify the impact of large scale engineering activities on the environment and society

CO2 :Identify the role and strength of an Environmental Impact Assessment (EIA) in decision making.
CO3: Describe the format and the methodologies used in the preparation of an EIA report.
CO4: Discuss the role of stakeholders and preparation of a comprehensive follow up procedure in an EIA report.
CO5: Discuss the ethics that govern the EIA procedure.

Syllabus structure

Environmental Impact Assessment – Introduction, benefits and limitations, procedure of EIA in India.	04
Impact identification – Ad hoc, checklists, matrices, networks and overlay.	06
Description of affected environment, indices and indicators for describing affected environment.	03
Prediction and assessment of impacts on air, surface water, soil, noise, biological, cultural and socio-economic environment.	12
Public participation in environmental decision making. Preparation of written documentation.	03
Environmental monitoring and its importance.	02
EIA case study on a developmental project / activity	03
Environmental audit - meaning, benefits, procedure and case studies	03

References:

1. Barbara Caroll,. *Environmental Impact Assessment Handbook*: A Practical Guide for Planners, Developers and Communities. Thomas Telford, London 2002.
2. Canter, L.W.,. *Environmental Impact Assessment*, (2e), McGraw-Hill 1996.
3. Christopher Wood.. *Environmental Impact Assessment:* A Comparative Review. Prentice Hall, New Jersey 2003.
4. Riki Therivel, Peter Morris,. *Methods of Environmental Impact Assessment*, Spon Press, London 2001.

CIE 4057: INDUSTRIAL WASTEWATER TREATMENT [3 0 0 3]

Course outcomes:

CO1: Identify the environmental standards for industrial waste disposal.
Co2: Explain the characteristics and evaluation technique for industrial wastewater.
CO3: Explain the methods of industrial waste reduction.
CO4: Describe the theories of wastewater treatment processes for major industries.
CO5: Develop treatment process and design criteria for wastewater of major industries.

Syllabus Structure

UNIT I: INDUSTRIES AND ENVIRONMENT

Industrial scenario in India - Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests. **9**

UNIT II - TREATMENT OF INDUSTRIAL WASTE WATER

Volume Reduction, Strength Reduction, Equalization, Neutralization and Proportioning. Oil separation - Flotation - Precipitation - Heavy Metal Removal - Refractory organics separation by adsorption - Aerobic and anaerobic biological treatment - Sequencing batch reactors - High Rate reactors - Chemical oxidation - Photocatalysis - Wet Air Oxidation - Ion Exchange - Membrane Technologies - Nutrient removal. **9**

UNIT III - MANAGEMENT OF TREATMENT PLANTS

Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse - Industrial reuse - Disposal on water and land - Residuals of industrial wastewater treatment - Quantification and characteristics of Sludge - Thickening, digestion, conditioning, dewatering and disposal of sludge - Management of RO rejects. **9**

UNIT IV - PRACTICAL APPLICATION IN INDUSTRIES

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper - Petroleum Refining - Pharmaceuticals - Sugar and Distilleries - Food Processing - fertilizers and Thermal Power Plants. **9**

References:

1. Eckenfelder, W.W., *Industrial Water Pollution Control*, Mc-Graw Hill, 2000.
2. Frank Woodard, *'Industrial waste treatment Handbook'*, Butterworth Heinemann, New Delhi, 2001.
3. Paul L. Bishop, *Pollution Prevention: - Fundamentals and Practice*, Mc-Graw Hill International, Boston, 2000.
4. Nelson, L. Nemerrow, *Industrial wastewater Pollution*, Addison-Wesley Publishing Company 2000.
5. Mahajan S.P. *Pollution Control in Process Industries*, Tata McGraw Hill Publishing Company 1998

CIE 4058: SOLID WASTE MANAGEMENT [3 0 0 3]

Total number of lectures – 36

Course outcomes

CO1: Discuss the appropriate methods of collection, storage and transfer of solid waste
CO2: Identify the inappropriate solid waste disposal practices and its impact on environment.
CO3: Classify the sources, characteristics of waste and describe biological and Industrial methods of treating solid waste.
CO4: Discuss the significance of engineered systems of landfill and their energy recovery options.

CO5: Discuss the significance of Reduce, Reuse and Recycling of solid wastes.

Syllabus structure

Introduction: Solid waste - Definition, Sources of wastes, classification, Characterization, Composition and Properties of solid Wastes.	04
Waste generation Collection and transportation: Solid waste generation, Methods to estimate waste quantities, Waste handling, Separation, Storage and Processing at source, Material recovery facility collection rate Collection system, Equipments used, manpower requirement, collection routes optimization, Transfer station.	12
Processing and recycling: Unit operations for separation and processing, size reduction, separation, density separation, biological processing, Incineration-process and other methods of processing – combustion, pyrolysis, gasification, energy recovery system.	08
Disposal: Methods, Landfills- types, design of landfills, operation of landfills leachates, closure of landfill, monitoring of landfill.	08
Siting of wastes management facilities: Siting guidelines, Planning and developing a site for solid waste management.	04

References:

1. Tchobanoglous, G., Theisen, H. and Vigil, S. A.. *Integrated solid waste management*, McGraw-Hill international edition, Civil Engineering Series. 1993
2. Bhide and Sundaresan,. *Solid Waste Management in Developing Countries* – Indian National Scientific Documentation Centre. New Delhi 2000.
3. Ramachandra T.V.. *Management of Municipal Solid Waste*, Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore 2006.

III. Geotechnical Engineering

CIE 4059: DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES [3 0 0 3]

Bearing capacity- Brinch Hansen's, Meyerhoff's, Skempton's and Vesic's bearing capacity equations, Piles subjected to lateral loads-Broms theory, Sheet piles, Retaining walls-cantilever and counterfort, Cofferdams, Well Foundation-Bearing capacity, Lateral stability, Foundations in expansive soils , Machine Foundations,.

Total number of lectures – 36

CO1: Discuss the various methods to determine the bearing capacity of soil for shallow foundation and well foundation and illustrate.
CO2: Discuss the design principles of shallow foundations, foundations in expansive soil and illustrate.
CO3: Determine the resistance of piles subjected to lateral loads.
CO4: Recognize different types of retaining walls, its stability and illustrate.
CO5: Discuss the various types and design parameters of machine foundation

Bearing capacity: Brinch Hansen's, Meyerhoff's,, Skempton's and Vesic's bearing capacity equations, Plate load test and penetration tests, Design principles of Shallow foundations: Isolated, combined and raft foundations (09)

Piles subjected to lateral loads: Ultimate lateral resistance of piles in cohesionless and cohesive soils -Brom's theory, Sheet piles: Principle and design of cantilever sheet pile wall and anchored sheet pile wall (08)

Retaining walls: Introduction, Design of cantilever retaining wall and counterfort retaining wall Design and stability analysis of cofferdams, Braced excavation. (08)

Well Foundation: Introduction, Bearing capacity, Lateral stability - Terzaghi's method and IRC method (03)

Foundations in expansive soils: Introduction, Problems of foundations on expansive soils, Remedial measures, Under-reamed pile foundations. (03)

Machine Foundations: - Introduction, types of machine foundations, Degree of freedom, General criteria - Mass -spring - dash pot model, Block foundation subjected to vertical, horizontal and rocking vibrations, Elastic half space approach, Soil spring constants and Vibration isolation. (05)

References:

1. Bowles J.E., *Foundation Analysis and Design*, McGraw Hill, New York, 1997
2. Winterkorn H.F and Fange H.Y., *Foundation Engineering Hand book*, Van Nostand Reinhold Company, New York. 1991
3. Teng W.C., *Foundation Design*, Prentice Hall of India, New Delhi, 1981.
4. Swami Saran., *Analysis and Design of Substructures*, (2e), Oxford and IBH Publishers, 2015
5. Srinivasalu P and Vaidyanathan C.V., *Hand Book of Machine Foundations*, Tata McGraw Hill, 1987.

CIE 4060: GEO-ENVIRONMENTAL ENGINEERING [3 0 0 3]

Total number of lectures – 36

Course outcomes

CO1: Understanding of Geoenvironmental problems and relevant regulations. CO2: Understand the concept and modelling of subsurface flow and contaminant transport.
CO3: Understand the In-situ waste containment system for the landfills.
CO4: Design the liner system for the engineered landfills.
CO5: Discuss the soil and groundwater remediation technologies and waste recycle and recovery options.

Introduction, Geoenvironmental Problems, Regulations and Practice, Composition and Properties of Soils and Wastes, Subsurface Flow and Contaminant Transport, Subsurface contamination, In-situ waste containment, Waste Containment Liner Systems, Leachate Collection and Removal Systems, Waste Containment System Liner Design, Final Cover

Systems, Contaminated Site Investigation and Risk Assessment, Soil and Groundwater Remediation Technologies, Beneficial Use Of Waste Materials: Recycling, Case studies.

Introduction: Emergence of Geoenvironmental Engineering and types of Geoenvironmental Problems, Relevant Regulations, Impact of Regulations on Geoenvironmental Practice. (02)

Composition and Properties of Soils and Wastes: Composition of Soils; Properties of Soils (Geotechnical and chemical), Sources and Classification of Wastes; Properties of Wastes.(02)

Subsurface Flow and Contaminant Transport: Introduction, Hydrologic Cycle and Groundwater, Aquifer, Aquiclude, and Aquitard, Hydraulic Head and Aquifer Properties, Groundwater Flow in Aquifers, One-Dimensional Steady Flow, Flow Toward a Pumping Well, Pumping and Slug Testing, Two- and Three-Dimensional Groundwater Flow. Flow Modeling**,** Contaminant Types and Geochemical Processes; Biodegradation**,** Transport Processes; Transport and Fate Modeling. (03)

Subsurface contamination: Sources, Contaminants, Regulations, and Remedial Approach, Contaminated site characterization. (02)

In-situ waste containment: Vertical Barriers, Bottom Barriers, Surface Caps or Covers, Groundwater Pumping Systems, Subsurface Drains. (02)

Waste Containment Liner Systems: Introduction, Low-Permeability Soil Liners Geomembrane Liners; Geosynthetic Clay Liners Geotextiles, Geonets, Geogrids, and Geocomposites; Interface Shear Strengths. (03)

Leachate Collection and Removal Systems: Criteria and Components; Leachate Quantity Estimation, Collection Pipes, Drainage Materials; Leachate Recirculation and Treatment.(03)

Waste Containment System Liner Design- Leakage through Liners and Performance Data; Contaminant Transport Analysis Material Stresses, Geomembrane Puncture Resistance; Waste and Liner Slope Stability. (04)

Final Cover Systems: Regulatory Requirements; Cover Systems and Materials; Infiltration Analysis Erosion Assessment; Drainage Layer Capacity; Gas Collection and Management Cover Geomembrane Analysis; Waste and Cover Slope Stability; Waste Settlement. (03)

Contaminated Site Investigation and Risk Assessment: Site Investigation- Geologic Data; Hydrogeologic Data; Chemical Data; Data Analysis Risk Assessment. (03)

Soil and Groundwater Remediation Technologies: Soil Remediation Technologies- Soil Vapor Extraction; Soil Washing; Stabilization/Solidifcation; Electrokinetic Remediation Soil Remediation Technologies- Thermal Desorption; Vitrification; Bioremediation; Phytoremediation Groundwater Remediation Technologies- Pump-and-treat; In-situ Flushing; Permeable Reactive Barriers Groundwater Remediation Technologies- In-Situ Air Sparging; Monitored Natural Attenuation; Bioremediation. (04)

Beneficial Use Of Waste Materials: Recycling: Introduction, Types and Evaluation of Waste Materials, Fly Ash, Blast Furnace Slag, Foundry Sand, Papermill Sludge, Municipal Sludge,

Incinerator Ash (Sewage Sludge Ash),Glass, Plastics, Scrap Tires, Demolition Debris and Recycled Concrete, Wood Wastes. (03)

Case studies: (02)

References:

1. Sharma, H.D. and Reddy, K.R., *Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies*, John Wiley & Sons, Inc, . 2004.
2. Sharma, H.D. and Lewis, S.P., *Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation*, John Wiley & Sons, Inc, 1994.
3. Qian, X., Koerner, R.M., and Gray, D.H., *Geotechnical Aspects of Landfill Design and Construction*, Prentice Hall, 2002.
4. Daniel, David E. *Geotechnical Practice for Waste Disposal*, Chapman & Hall, 1993.

CIE 4061: GROUND IMPROVEMENT TECHNIQUES [3 0 0 3]

Total number of lectures – 36

Introduction to ground improvement techniques, mechanical modification, hydraulic modification, physical and chemical modification, thermal modification, modification by inclusions.

CO1: Discuss the necessity of ground improvement techniques.
CO2: Discuss mechanical and hydraulic modification techniques for ground improvement and illustrate.
CO3: Discuss physical and chemical modification techniques for ground improvement.
CO4: Discuss grouting and reinforced earth and illustrate.
CO5: Apply appropriate ground improvement technique for typical ground condition.

Introduction: Introduction to ground improvement, necessity of ground improvement, classification of ground modification techniques. (02)

Mechanical modification: Methods of compaction-shallow and deep compaction, Properties of compacted soil, Compaction control tests, Vibratory methods (06)

Hydraulic modification: Objectives and techniques, traditional dewatering methods, well points, preloading, vertical drains-sand drains and prefabricated drains, vacuum consolidation, electro-kinetic dewatering. (08)

Physical and chemical modification: Modification by admixtures- granular admixtures, cement, lime, flyash, industrial wastes etc., Construction techniques and applications. Stabilization of soil with lime columns and cement columns. Modification at depth by grouting-techniques, grouting plant, applications of grouting. (10)

Thermal modification**:** Thermal properties of soils, Heat treatment of soils, Ground freezing, strength and behavior of frozen ground (02)

Modification by inclusions: Evolution of soil reinforcement, principles and advantages of reinforced earth, behavior of reinforced earth, design methods, material specifications, Soil

nailing – Applications, construction procedure, design and specification. Geosynthetics - Types, Civil Engineering applications of geo-synthetics. (08)

References:

1. M.R. Hausmann., *Engineering Principles of Ground Modifications*, (3e), McGraw Hill Publishing Co, 2002.
2. Moseley M.P., *Ground Improvement*, (2e), Blackie Academic and Professional, Boca Taton, Florida, USA, 2007.
3. Robert M. Koerner ., *Designing with Geosynthetics*, (2e), Prentice Hall New Jersey, USA, 2000
4. Purushotham Raj, *Ground Improvement Techniques*, Laxmi Publications, New Delhi, 2016.
5. Das.B.M., *Principles of Foundation Engineering*, CENGAGE Learning, 2010

CIE 4062: SOIL REINFORCEMENT AND GEOSYNTHETICS [3 0 0 3]

Total number of lectures – 36

Introduction, concept of reinforced soil, different types of geosynthetics, properties and tests on geosynthetics, design of reinforced soil retaining walls, design of reinforced earth foundations, reinforced soil slopes, soil nailing techniques, pavement application, drainage and filtration applications of geosynthetics, construction of landfills using geosynthetics.

CO1: Discuss the components of reinforced earth wall and concept of soil reinforcement.
CO2: Discuss the technology of geosynthetics.
CO3: Solve the problems of earth retention, slope stability and foundation using geosynthetics.
CO4: Explain the application of geosynthetics for problems in pavements.
CO5: Explain use of geosynthetics in landfills.

Different types of geosynthetics: Types of geosynthetics-geotextiles, geogrids, geonets, geocells, geo-composites, their manufacturing methods and uses.
Properties and tests on geosynthetics: Properties – physical, chemical, mechanical, hydraulic, endurance, degradation considerations, testing & evaluation of properties. (05)

Reinforced soil : Definition, historical background of reinforced soil, applications and potential of soil reinforcement, design mechanism and concept of reinforced soil, factors affecting the performance and behaviour of reinforced soil. (02)

Design of Reinforced Soil retaining walls: Mechanics of reinforced earth retaining wall, components of reinforced soil walls, design principles: internal and external stability, typical design problems. (07)

Design of Reinforced Earth Foundations: Modes of failure of foundation, determination of force induced in reinforcement ties – location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, bearing capacity improvement in soft soils, and typical design problems. (05)

Reinforced soil slopes: Causes for slope failure, construction of steep slopes with reinforcement layers on competent soils, different slope stability analysis methods like planar wedge method, circular slip methods, numerical problems, erosion control on slopes using geosynthetics, (04)

Soil Nailing Techniques: Concept, advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing- construction sequence and components of system, design aspects. (04)

Pavement application: Geosynthetics for separation and reinforcement in flexible pavements, design by Giroud-Noiray approach, reflection cracking and control using geosynthetics. (04)

Drainage and filtration applications of geosynthetics: Different filtration requirements, filtration in different types of soils and criteria for selection of geotextiles, estimation of flow of water in retaining walls, pavements, etc. andselection of geosynthetics. (03)

Construction of landfills using geosynthetics: Different components of landfills, collection techniques for leachate, application of different geosynthetics like geonets, geotextiles for drainage in landfills, use of geomembranes and geosynthetic ClayLiner (GCL) as barriers, Some issues in usage of geosynthetics. (02)

References:

1. Koerner. R.M., *Designing with Geosynthetics*, (5e), Prince Hall Publication, USA, 2005.
2. Sivakumar Babu G. L., *An introduction to Soil Reinforcement and Geosynthetic*, Universities Press, Hyderabad, 2009
3. Swami Saran, *Reinforced Soil and its Engineering Applications*, I. K. International Pvt. Ltd, New Delhi, 2006.
4. G.V. Rao, P.K Banerjee, J.T. Shahu,G.V. Ramana., *Geosynthetics - New Horizons*, Asian Books Private Ltd., New Delhi, 2004.
5. Jones CJEP, *Earth reinforcement and Soil structures*, Thomas Telford Publishing, London, 1996.

IV. Structural Engineering

CIE 4063: DESIGN OF REINFORCED CONCRETE STRUCTURES [3 0 0 3]

Course Outcomes:

CO1: Discuss the design philosophy of flat slabs, retaining walls, grid floors, portal frames, foundations, silos and bunkers.
CO2: Illustrate the design procedure for flat slab as per standard code of practice.
CO3: Illustrate the design procedure for retaining walls and foundations as per standard code of practice.
CO4: Illustrate the design procedures for grid floor and portal frame as per standard code of practice.
CO5: Illustrate the design procedures for silos and bunkers as per standard code of practice.

Total number of lectures – 36

Flat slabs: Introduction, design of interior panel of flat slab with and without drops by direct design method. (07)

Retaining walls: Introduction, types of retaining walls and their suitability for adoption, design of Cantilever and Counter fort type retaining walls. (09)

Analysis and design of Single bay single story portal frame, and grid floor. (06)

Foundations: Introduction, types of foundations, pressure distribution under footings, design of combined footing, strap footing and mat/raft foundation. (07)

Silos and Bunkers: Introduction, design of silos and bunkers. (07)

References:

1. Unnikrishna Pillai., Devadas Menon., *Reinforced Concrete Design*, (3e), Tata McGraw Hill Publishing Company Limited, New Delhi.2009.
2. Shah H. J., *Reinforced Concrete*, Vol. II, (6e), Charotar Publishing House Pvt. Ltd., Anand, Gujarat. 2012.
3. Varghese P. C.,*Design of Reinforced Concrete Foundations*, PHI Learning Private Limited, New Delhi.2010.
4. Varghese P. C., *Advanced Reinforced Concrete Design*, PHI Learning Private Limited, New Delhi.2011.
5. IS:456 – 2000, *Code of practice for plain and Reinforced concrete*, Bureau of Indian Standards, New Delhi
6. SP-16 – 1984, *Design Aids for Reinforced concrete IS 456*, Bureau of Indian Standards, New Delhi.

CIE 4064: DESIGN OF STEEL STRUCTURES [3 0 0 3]

CO1- Describe plate girder and illustrate design procedure for plate girder
CO2- Describe the procedure for design of gantry girder and illustrate
CO3- Describe the procedure for design of steel columns and illustrate
CO4- Describe the procedure for design of moment resisting connections and illustrate.
CO5- Describe the procedure for design of composite beams and light gauge steel structures, and illustrate

Total number of lectures – 36

Introduction, elements of Plate girders with stiffeners, general considerations proportioning of web, proportioning of flanges, flexural strength, shear strength of web, shear buckling design methods. Plate Girder end panel design, Plate Girder bearing stiffener, Load carrying stiffener and Intermediate web Stiffeners design, welded connections design. **(12)**

Introduction to Gantry girder, loads, design procedure, Gantry girder section check for Fatigue strength. **(07)**

Design of compression member subjected to combined axial and uniaxial bending, combined axial and biaxial bending for column sections. Design of flexural members for unsymmetrical bending. **(08)**

Introduction to light gauge steel members, post buckling strength of the light gauge members, effective width calculations for unstiffened, stiffened and multi stiffened elements. Axially loaded compression members of light gauge steel members, laterally supported beams in light gauge steel members. **(07)**

Introduction to Prefabricated steel structures and their applications. **(02)**

References:

1. Duggal S.K., *Limit State Design of Steel Structures*, Tata McGraw Hill education private Limited – New Delhi. 2008.
2. Subramanian N., *Design of Steel Structures*, oxford university New Delhi, 2008.
3. IS 800-2007, *General construction of steel in code of practice*, Bureau of Indian Standards, New Delhi.
4. SP-6 (Part I) 1964, *Structural Steel Sections*, Bureau of Indian Standards, New Delhi.
5. IS 801-1975, *Code of practice for use of cold framed light gauge steel*, Bureau of Indian Standards, New Delhi.

CIE 4065: FINITE ELEMENT METHOD OF ANALYSIS [3 0 0 3]

Total number of lectures 36

CO1: Describe the principles of finite element method.
CO2: Apply finite element method to determine member forces in bars.
CO3: Apply finite element method to determine member forces in trusses.
CO4: Apply finite element method to determine member forces in continuous beams and plane frames.
CO5: Solve plane stress and plane strain problems using finite element method.

Brief general description of the method, theory of elasticity - constitutive relationships - plane stress and plane strain. (02)

Concept of an element, types of elements, displacement models - displacement models by generalized coordinates, shape functions for different types of elements. (04)

Variational method of formulation - minimization of potential energy approach, formulation of element stiffness and consistent load vector for different types of elements (04)

Application of finite element method to analyze pin jointed and rigid jointed structures (17)

Application of FE method to plane stress and plane strain problems using three noded triangular element and isoparametric four-noded element. (09)

References:

1. Zinkiewiez O.C., *The Finite Element Method*, (3e), Tata McGraw Hill Book Co, New Delhi, 1979.
2. Desai C.S. and Abel J.E., *Introduction to the Finite Element Method*, (1e), CBS publications, New Delhi, 1987.
3. Krishnamoorthy C.S., *Finite Element Analysis*, (2e), Tata McGraw Hill Publishing Company Ltd., New Delhi, 1987.
4. Bathe K.J., *Finite Element Procedures in Engineering Analysis*, (2e), Prentice Hall Engle Wood, Cliffs, New Jersey, 1997.

CIE 4066: PRESTRESSED CONCRETE DESIGN [3 0 0 3]

(Total number of lectures – 36)

Course Outcomes:

CO1: Describe the Concept of prestressed concrete
CO2: Discuss loss of prestress and their importance.
CO3: Apply the principles of prestressed concrete to compute stresses and formulate design equations.
CO4: Compute limit state of collapse and serviceability as per IS codes.

CO5: Illustrate design of end block and anchorage zone.

Introduction, Prestressing systems and Material properties:
Basic Concepts, Pretensioning and Post tensioning systems and end anchorages, Advantages and applications of prestressed concrete, Need for high strength concrete and high tensile steel - Stress strain characteristics and properties. Load balancing concept, stress concept, centre of thrust. (05)
Losses in prestress - Various losses in pretensioned and post tensioned systems. (04)

Analysis of prestressed concrete members - Stresses in concrete due to pre-stress and loads, Permissible stresses, limiting zone of pre-stressing force and eccentricity, cable profile, design of simply supported beams. (10)

Limit state of collapse in flexure and shear –I.S. Code recommendations- Ultimate flexural and shear resistance of sections, design of shear reinforcement. (05)

Limit state of serviceability – Prediction of short term and long term deflections of uncracked section as per I.S. code provisions. (04)

Transmission of pre-stress in pre tensioned and post tensioned members: Transmission length, Bond stress. Anchorage stresses in post tensioned members, bearing stress, I.S. code provisions for the design of end block reinforcements. (04)

Analysis of Composite Sections: Analysis of stresses in composite section for propped and un-propped conditions, computation of shear connectors. (04)

References:

1. Krishna Raju N., *Pre-stressed Concrete*, (5e) ,Tata McGraw Hill, , New Delhi, 2012.
2. Dayaratnam P., *Pre-stressed Concrete Structures*, (7e), Oxford and IBH Publications, New Delhi , 2017.
3. Mallick S. K. and Gupta A. P., *Pre-stressed Concrete*, (3e), Oxford and IBH, New Delhi
4. Lin T.Y. and Ned. Burns H., *Design of Pre-stressed Concrete Structures*, John Wiley and Sons, New York, 2017.

Code books:

1. IS:1343-2012, *Code of Practice For Prestressed concrete*, Bureau of Indian Standards, New Delhi.

V. Transportation Engineering

CIE 4067: URBAN MASS TRANSPORT SYSTEM [3 0 0 3]

Total no. of lecture: 36hrs

Course outcome:-
At the end of the program the student will be able to

CO1: Conduct surveys to provide the data required for transportation planning.
CO2: Compute generation of trips using regression models
CO3: Compute zonal trip generation and attraction using synthetic and non-synthetic models.
CO4: Compare mode choice and explain modal split analysis.
CO5:Explain various traffic assignment methods.

Introduction: Recent Trends in transit, Mass transportation characteristics, Demand Characteristics: Spatial, temporal and behavioral characteristic **3hrs**

Public Transport: Definitions, modes of public transport and comparison, public transport travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, basic operating elements. **8hrs**

Transit Network Planning: Planning Objectives, principles, considerations, transit lines types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations. **8hrs**

Transit Scheduling: Components of scheduling process, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling. **8hrs**

Terminals and Depot: Design of bus stops, design of terminals – principles of good layout, types of layout, truck terminal, depot location, twin depot concept, crew facilities and amenities. **6hrs**

Transit Fares: Objectives in transit fare determination, Fare Collection, Fare structures, Special higher and lower fares, Fare level. **3hrs**

References:

1. Kristhi and Lal, *Transporation Engineering*, (3e), PHI, Delhi, 2008.
2. Dickey, J.W., et. al., *Metropolitan Transportation Planning*, TMH edition, 2002.
3. Vuchic V.R., *Urban Public Transportation System and Technology*, Prentice Hall,
4. Agarwal M.K., *Urban Transportation in India*, INAE, Allied Publishers Ltd., 1996.
5. Grey G.E. & Hoel, LA, *Public Transportation* Prentice Hall, Englewood Cliffs, N.J.

CIE 4068: URBAN TRANSPORT PLANNING [3 0 0 3]

Total no. of lecture hours: 38hrs

Course outcome:-

At the end of the program the student will be able to

CO1: Conduct surveys to provide the data required for transportation planning.
CO2: Compute generation of trips using regression models
CO3: Compute zonal trip generation and attraction using synthetic and non-synthetic models.
CO4: Compare mode choice and explain modal split analysis.
CO5: Explain various traffic assignment methods.

Transportation Planning Process and Surveys:- Scope of the subject, System approach to Transport planning, Definition of study area, Zoning and Types of Surveys. **6hrs**

Trip Generation:- Introduction, Trip purpose, Factors governing Trip Generation and Attraction, Analysis of Trip Generation and Attraction – Regression and Category Analysis. **6hrs**

Trip Distribution:- Introduction, O-D Matrix, Growth Factor methods – Uniform Factor, Average, Fratar and Furness methods, Synthetic methods – Gravity model, Tanner model, Intervening opportunities model and Competing opportunities models. **6hrs**

Traffic Assignment:- Purpose of Traffic Assignment, Principles, Assignment Technique – All or nothing Assignment, Multiple Route Assignment, Capacity Restraint Assignment, Diversion Curves. **6hrs**

Modal Split:- Introduction, Factors affecting Modal Split, Modal Split in the planning process, Probit and Logit Analysis. **6hrs**

Land-use Transport Models:- Introduction, Selection of Land-use Transport Model, Lowry Derivative Models, Garin-Lowry Model. **6hrs**

References:

1. Kadiyali L.R., *Traffic Engineering and Transportation Planning*, (6e), Khanna Publisher, New Delhi.
2. Jotin Khisty C and Kent Lal B, *Transporation Engineering-An Introduction*, (3e), 2010, PHI, New Delhi,
3. Papacostas C S., *Fundamentals of Traffic Engineering*, Prentice Hall.
4. M.J.Bruton, *Introduction to Transportation Planning* - Hutchinson cf London Ltd.
5. B.G.Hutchinson, *Introduction to Urban System Planning* -; Mc Gra Hill.

CIE 4069: PAVEMENT MATERIALS AND DESIGN [3 0 0 3]

Total no. of lecture hours: 36hrs.

Course outcome:-

At the end of the program the student will be able to

CO1: Discuss components of pavements.
CO2: Discuss pavement materials.
CO3: Describe the stresses and strains in the layers of pavement due to various loads and illustrate.
CO4:Compute pavement thickness for vehicular parameters and climatic conditions.
CO5: Examine the serviceability of pavement and suggest suitable rehabilitation measures.

Introduction: - Types of pavements, Design wheel load – Maximum wheel load, Equivalent single wheel load, Soil classification, Strength determination of soil, Strength properties of mineral aggregates. **5hrs**

Design of Flexible pavement: - Stress in Flexible pavements, Design factors, Design methods – IRC and AASHTO. **6hrs**

Bituminous Materials:- Introduction, Properties of Bitumen, Test on Bitumen and Bituminous materials, Binders, Engineering properties of Bituminous materials and Mix design. **4hrs**

Design of Rigid pavement:- Westergaard's design factors, Critical load position and stress computation, Temperature stresses, Warping stresses, Bradburry equation for stress calculation, frictional stress, combination of stress , Design of slab thickness, position and types of joints, design of joints – design of tie bars and spacing of dowel bars. **8hrs**

Design of cement concrete mixes:- Factor considered, BIS method of cement concrete mix design, IRC method, Dry Lean Cement concrete, Concrete mix design for rural roads. Roller compacted concrete. **3hrs**

Soil Stabilisation Roads:- Introduction, Mechanical Satbilisation, Combining material to obtain required gradation, Soil-Lime stabilisation, Lime-Cement-Soil stabilization, Soil-Cement stabilization, Soil Bitumen stabilization. **3hrs**

Design of Runway Pavement: - Requirements, Types of pavements, Design of Flexible pavement, Design of Rigid pavement. **3hrs**

Pavement Failure and Evaluation: - Types of failure in flexible and rigid pavements, causes of failure and precautionary measures, Structural evaluation of Flexible pavement- Benkelman Beam Deflection Method, Falling weight deflectometer, GPR Method, Structural evaluation of Rigid pavement- Functional Evaluation by visual inspection and unevenness measurements. **4hrs**

References:

1. Khanna S.K and Justo C.E.G., *Highway Engineering*, (10e), Nemchand and Bros., Roorkee 2015.
2. Dr Kadiyali L.R and Dr Lal N.B, *Prinicples and Practices of Highway Engineering*, (4e), Khanna Publisher, New Delhi 2003.
3. E.J. Yoder, Principles of Pavement Design, (2e), John Wiley & Sons, Inc. New York, 1975.
4. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003.

CIE 4070: TRAFFIC SYSTEMS AND ENGINEERING [3 0 0 3]

Total no. of lecture hours: 36hrs

Course outcome:-

At the end of the program the student will be able to

CO1: Recognize the basic components of the transportation system and determine the variables influencing of vehicular flow.
CO2: Apply capacity analysis technique to evaluate the performance of roads and highways using.
CO3: Explain and design the various traffic control & management devices.
CO4: Examine the parking demands of an urban area.
CO5:Examine the safety of transport facilities and suggest preventive measures to improve safety of such facilities.

Traffic Engineering Studies: - Objectives and scope of Traffic Engineering, Speed study, Speed and Delay study, Traffic volume study, Origin-Destination study, Capacity study, Relation between Speed, Travel time and Traffic volume, Passenger Car Unit and Level of Service, Traffic Congestion study. **6hrs**

Traffic Flow Analysis:- Lighthill and Whitham's theory, Assumption, Law of Conservation of Vehicles, Approach to Signalised Intersections, Shock wave, Bottleneck and Greenberg's Extension of Law of continuity. **6hrs**

Design of Traffic Facilities: - Vehicular movements at intersections and conflict points, Design of Channelizing Islands, T, Y and AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists, Grade separated intersection, Rotary, Design of Parking Facilities, Design of Cycling Tracks, Bus Stop Location and Bus Bay Design. **8hrs**

Road Accidents Analysis: - Causes, Collection of Accident Data, Mathematical Equations in Accident Analysis, Prevention. **6hrs**

Design of Traffic Control System: - Traffic Signs, Markings and Signals; Principles of Signal Design, Signal System, Design and Coordination, Regulation of Speed at Different Zones (areas) and Intersections. **6hrs**

Design of Road Lighting System: - Laws of Illumination, Distribution of Light, Glare Problems, Light at Intersections, Rotaries, Bridges and in Tunnels. **4hrs**

References:

1. Papacostas C S., *Fundamentals of Traffic Engineering*, Prentice Hall, 1990.
2. Jotin Khisty C and Lall, *Transportation Engineering*, (3e), Prentice Hall, 2000.
3. Khanna S.K and Justo C.E.G., *Highway Engineering*, (10e), Nemchand and Bros., Roorkee 2015.
4. Kadiyali L.R., *Traffic Engineering and Transportation Planning*, (5e), Khanna Publisher, New Delhi 2000.

VI. Water Resource Engineering

CIE 4071: INTEGRATED WATERSHED MANAGEMENT [3-0-0-3]

Total number of lectures — 36

Pre-Requisite: Fluid Mechanics, Water Resources Engineering.

COURSE OUTCOMES:

The student will be able to

CO1: Understand the land capability, soil-water and plant relationships in a watershed and factors affecting.
CO2: Apply the concepts of land capability knowledge for the sustainable development in a watershed.
CO3: Analyze the soil-water-plant relationship for an effective use of water.
CO4: Apply the methods of conservation of water, prevention of soil erosion in a watershed.
CO5: Prepare preventive measures for waterlogging and land drainage problems.

1. INTRODUCTION: Definition of watershed, watershed characteristics, Causes & consequences of watershed deterioration; Watershed Management – definition & objectives, management plan; People's participation – Mobilization, Organization. **(4 hrs)**

2. LAND CAPABILITY CLASSIFICATION: Introduction, Purpose, Characteristics; Classification – classes, sub-class, units, mapping; Characteristics of classes, Capability ratings, Land capability improvements, Recommendations for land-use practices, Sustainability. **(8 hrs)**

3. AGRONOMIC ASPECTS: Soil-Water-Plant relationship–soil groups, classification of soil water, water holding capability, extraction by plants, depth & frequency of irrigation; Maintaining soil fertility – essential nutrients, non-essential elements, salinity, alkalinity, reclamation; Crop rotation. **(8 hrs)**

4. WATER CONSERVATION: Introduction, Conservation methods for cropland, Small storage structures planning & design– earthen bunds, weirs, farm pond, nala-bunding; Losses & Conservation techniques. **(6 hrs)**

5. SOIL EROSION & CONTROL: Soil erosion, Erosion problems, Need for soil conservation, Conservation methods – agriculture & non-agriculture lands, Watershed approach, Vegetative cover – grassland management, agro-forestry. **(6 hrs)**

6. WATERLOGGING & LANDDRAINAGE: Waterlogging –introduction, causes & effects, preventive measures, canal lining; Land drainage – surface drainage, open drainage, sub-surface drainage, tile drainage; Design & maintenance of drains. **(4 hrs)**

References:

1. 'Watershed Management: Guidelines for Indian Conditions', by E. M. Tideman, Omega Scientific Publishers.
2. 'Hydrology and Soil Conservation Practices', by Ghanashyamdas Das, Prentice Hall, India.
3. 'Watershed Planning and Management', by Dr. Rajvir Singh, Yash Publishing House.
4. 'Watersheds – Processes, Assessment and Management', by Pau A. Debarry, John Wiley and Sons.
5. 'Watershed Models', by V. P. Singh and Donald K. Frevert, Taylor & Francis.

CIE 4072: HYDRAULICS & HYDRAULIC MACHINES [3 0 0 3]

Total number of lectures - 38

COURSE OUTCOMES:

CO1: Discuss the fundamental characteristics of open channel flow.
CO2: Describe the concepts and sketch the flow profiles of uniform and non-uniform open channel flow.
CO3: Describe and illustrate the design procedure for stable alluvial open channel.
CO4: Discuss the impact force of jet on flat and curved vanes and illustrate.
CO5: Discuss the working principles, performance and use of turbines and pumps.

Fundamentals of Open Channel Flow: Classification of open channel flow, Properties of open channels, velocity and Pressure distribution, Energy and Momentum principles; uniform flow and critical flow - concepts, Formulae and computations. (06)

Gradually Varied Flow: Basic Assumptions, Dynamic equation of GVF, characteristics and classification of flow profiles, Integration, step methods. (06)

Rapidly Varied flow: Characteristics of flow, Flow over spillways, Hydraulic Jump, types – basic characteristics of the jump. Surface profiles, Location of jump, use of Hydraulic Jump as Energy Dissipater. (06)

Design of Stable Channels: Introduction, variables and conditions for design, empirical approach. (04)

Impulse Momentum Principle And Its Applications: Momentum Equation, Impact of free jets - Forces exerted by a jet on stationery, moving and series of flat plates - Forces exerted by a jet on stationary, moving and series of curved vanes. Work done and efficiencies, (04)

Hydraulic turbines: General layout of hydro power plants - classification of turbines - Impulse turbine and reaction turbines, description, typical dimensions and general Principles of working of Pelton, Francis and Kaplan turbines. Work done and efficiencies of impulse and reaction turbines. (Inlet and outlet velocity diagrams and solution to simple problems only) Governing of turbines, specific speed and unit quantities of different types of turbines, selection of turbines and functions of a draft tube. (08)

Hydraulic Pumps: Classification; Description and general principle of operation of centrifugal pumps – work done and efficiencies, multistage pumps; pumps in series and pumps in parallel, specific speed of a pump. Reciprocating Pumps, Functions of Air-Vessels. (04)

References:

1. VenTe Chow, *Open Channel Flow*, McGraw Hill Company Ltd., New York, 1985
2. Subramanya K., *Flow in Open Channels*, Tata McGraw Hill Publishing Company, New-Delhi, 2005
3. Modi P.N. and Seth S.M, *Hydraulics and Fluid Mechanics*, Standard Book House, New Delhi, 2005
4. Bansal R. K. *Fluid Mechanics and Hydraulic Machines*, Laxmi Publishers, New Delhi. 2010

CIE 4073: HYDROLOGICAL ANALYSIS [3 0 0 3]

Total number of lectures - 38

COURSE OUTCOMES:

CO1: Discuss the processes and factors of hydrological cycle .
CO2: Discuss the methods of estimation and analysis of rainfall data.
CO3: Develop rainfall- runoff models for runoff estimation and compute abstraction losses.
CO4: Develop hydrographs and interpret results of its analysis.
CO5: Compute flood flow and discuss various flood routing techniques.

Introduction: Hydrological cycle, Scope and application of hydrology, Hydrological failures, Hydrological budget, Geomorphology of drainage basins. (02)

Analysis of precipitation data: Rain gauge network, Testing consistency of data, Estimation of missing precipitation data, Mean areal precipitation, Intensity-duration-frequency analysis, Depth-area-duration analysis, Design storms and probable-maximum precipitation. (08)

Abstractions: Infiltration process, Infiltration capacity curves, Infiltration indices, Estimation of evaporation and transpiration-empirical methods, Energy balance, Water balance method. (06)

Runoff: Rainfall-runoff correlations- linear, non-linear, simple, multiple, coaxial correlation diagrams, Rational method, S-C-S method. (04)

Hydrographs: Definition and types, Storm hydrograph, Baseflow separation, Unit hydrograph- theory and applications, S-curve, Synthetic unit hydrograph- Synder's method, Introduction to Instantaneous unit hydrograph. (10)

Floods: Definition, Emperical methods, rational method, Envelope curves, Flood frequency methods, Flood routing. (08)

References:

1. Linsley, Pauler and Kohlas, *Hydrology for Engineers*, MGH Publishers, Tokyo. 1975
2. Linsley, Kohler & Paulhus, *Applied hydrology*, MGH Publications, New York. 1949
3. VenTe Chow, D. R. Maidment, L.W. Mays, *Applied Hydrology*, McGraw Hill. 1998
4. H. M. Raghunath, *Hydrology*, Wiley Eastern pulications, Delhi, 1985
5. W. Viessman &J. Knapp "*Introduction to hydrology*", Harper & Row publishers. 1989

CIE 4074: WATER RESOURCES PLANNING & MANAGEMENT [3 0 0 3]

Total number of lectures — 36

Pre-Requisite: Fluid Mechanics, Water Resources Engineering.

COURSE OUTCOMES:

CO1: Describe the techniques for quantity estimation of hydrological cycle components.
CO2: Apply concepts of hydrology for problems of runoff and flood flows
CO3: Determine irrigation requirements of crops and compute the water storage requirement.
CO4: Discuss the water storage structures and illustrate the elementary design of gravity dam.
CO5: Discuss the water conveyance systems and illustrate the elementary design of impervious floor on permeable foundations.

1. INTRODUCTION: General, Purposes served by water resources projects, Classification, Capability & requirement of multipurpose projects, steps involved in planning, common pitfalls. **(4 hrs)**

2. WATER RESOURCE PROJECTS: Irrigation, Water Power, Industrial & municipal supply, Flood control, Navigation; Data collection – importance, storage, retrieval; Extrapolation of data to ungauged catchments, Simulated data, Water balance models, Conjunctive-use management. **(8 hrs)**

3. RESERVOIR PLANNING & OPERATION: Investigation, Selection of site, Reservoir capacity, Choice of dams, Economic height of dams, Yield determination, Demand patterns, Optimal reservoir operation, Rule curves, operating tables, Reservoir induced seismicity. **(6 hrs)**

4. WATER CONVEYANCE SYSTEM: Canal Management – Objectives& Criteria, Need &Inadequacies, Methods for improving management, Planning canal systems, Canal regulation, Delivery to farms; River Training –Objectives, classification, methods, structures. **(6 hrs)**

5. ECONOMICS OF WATER RESOURCE PROJECTS: Benefits – primary, secondary, tangible intangible; Cost-Benefit analysis, Apportionment of total cost, Economic appraisal, Economic & Financial efficiency, Project selection, Water pricing, Assessment of Charges. **(8 hrs)**

6. SOCIO-LEGAL & ENVIRONMENTAL ASPECTS: Riparian rights, Human settlements, Rehabilitation, Environmental aspects, Sustainable development. **(4 hrs)**

References:

1. Loucks, D.P. and Eelco van Beek. *Water resources systems planning and management*: An introduction to methods, models and applications, UNESCO. 2005
2. Vedula, S. and Mujumdar, P.P. *Water resources systems: Modeling techniques and analysis*, Tata McGraw Hill, New Delhi 2005.
3. Mays, L.W. and Tung, Y.K.. *Hydro systems engineering and management*, McGraw Hill, USA 1992.
4. Simonovic, S.P. *Managing water resources*: Methods and tools for a systems approach, UNESCO publishing, France 2009.
5. Jain, S.K. and Singh V. P. *Water Resources Systems Planning and Management*, Elsevier 2003.

OTHER ELECTIVES

CIE 4075: BRIDGE ENGINEERING [3 0 0 3]

Total number of lectures – 36

COURSE OUTCOME:

CO1: Identify basic concepts of design of bridges.
CO2: Illustrate the design of pipe culvert as per Indian Roads Congress standards.
CO3: Illustrate the design of RCC slab and T Beam Bridge as per Indian Roads Congress.
CO4: Compute the stability of substructures.
CO5: Illustrate the design of prestress concrete bridge as per Indian Roads Congress.

INTRODUCTION: Definitions, components of a bridge, classification and importance. 2Hrs

INVESTIGATION FOR BRIDGE: Site selection, data drawing,design discharge linear water way, economical span, location of Piers and Abutments, vertical clearance above HFL, scour depth. Traffic projection, investigation report, choice of bridge type. 7Hrs

STANDARD SPECIFICATION FOR ROAD BRIDGE: IRC bridge code, determination of dead loads and live load, wind loads, longitudinal forces,
Centrifugal forces, horizontal forces due to water current, buoyancy effect, earth pressure, temperature effect, deformation stresses, erection stresses, seismic forces. 2Hrs

Culverts: pipe culverts. 3 Hrs

SUB STRUCTURE: Different types of bridge bearings, piers and masonry abutments, different types of foundation and their choices, wing walls. 12Hrs

CONCRETE BRIDGES: T-beam reinforced concrete bridges and Pre- stressed concrete bridges, RCC slab bridge. 10Hrs

REFERENCE BOOKS

1. T. R. Jagadeesh and M.A Jayaram, "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd, New Delhi.
2. D.J.Victor," Essentials of bridge engineering", Oxford & IBH Publishing Co. Pvt. Ltd.
3. Ponnusamy S, "Bridge Engineering" Tata McGraw Hill Publishing Co., New Delhi , 2008
4. Whitney, C.S, Bridges, Greenwich House,1983
5. Singh, V.P Wells and Caissons, Nemchand & Sons,1979
6. N.K.Raju, " Design of bridges", Oxford & IBH Publishing Co. Pvt. Ltd.
7. Indian Road Congress Codes No.5,6,18,21,24, Jamnagar House, Shah Jahan Road, New Delhi.

CIE 4076: COASTAL ENGINEERING [3 0 0 3]

Total number of lectures – 36

Course Outcome:
CO1: Student must be able to find wave parameter at different depths using wave theory.

CO2: Student must be able to explain the different coastal process as the wave approaches the coast.
CO3: Student must be able to identify the reason for coastal erosion and to suggest the protection work.
CO4: Student must be able to comprehend different components of a port.
CO5: Student must be able to calculate the different types of loads, preliminary analysis of berthing structure and breakwaters.

Introduction of the coastal engineering, importance, origin of coasts, Wind, waves, tides and ocean currents, Wave theories, Wave energy and power, Wave forces: Morison Regime. (07)

Coastal process: wave shoaling, wave refraction, wave diffraction, wave reflection, Wave breaking, types of breakers, Wave run-up, Beach profile, beach process (03)

Coastal erosion: Erosion process, causes for erosion, Littoral drift (03)
Coastal protection work: Seawalls and bulkheads, Design of seawall, Groins, Jetties and their design, Off-shore breakwaters, Artificial beach nourishment, New technologies of shore protection (06)

Environmental impact assessment: concept of coastal zone management, coastal eco-systems, Coastal pollution and its implications. (02)

Port Planning: Introduction to Harbours, General planning, Classification of Harbours, requirements, Planning requirement for Navigation channel, Berth occupancy, Graving and floating dry docks, Planning requirement for slipways. (05)

Berthing structures: Types, loads on berthing structures, Preliminary analysis and design. (05)

Breakwaters: introduction and Types, Rubble mound breakwaters, Preliminary analysis and design. (05)

References:

1. Dominic Reeve, *Coastal Engineering*, (3e), CRSC press, 2018
2. S. Narasimhan, S. Kathiroli, Nagendra Kumar B, *Harbour and coastal Engineering*, Volume I & II, National Institute of Ocean Technology, NIOT, Chennai, Ocean and Coastal Engineering Publications, 2002.
3. William kamphuis J, *Introduction to coastal engineering and management*, (2e), world scientific publishing company, 2009.
4. Robert M Sorensen, *Basic coastal engineering*, (3e), Springer publication, 2005.
5. Coastal Engineering Manual (CEM), U.S.Army Corps of Engineer, Vicksburg, Miss, 2012.
6. Brunn P., *Port Engineering* Gulf, publishing Company, 1981.

CIE 4077: CONTRACTS MANAGEMENT [3 0 0 3]

CO1 : Discuss engineering contracts
CO2 : Describe the process and issues of tendering
CO3 : Discuss the administration, performance and breaches of construction contracts
CO4 : Discuss Alternate Dispute Resolution methods
CO5 : Discuss International contracts and international arbitration

Introduction to contracts: Definitions, Essentials for a legally valid contract, Salient features of a contract, Discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on − Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts. **(04)**

Tendering process: Definitions, List of Documents, EMD, SD, Preparation of Enquiry Documents, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract – Letter of Award, Letter of Intent, Issues in tendering process: Pre - Registration, Pre – Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding, Cartel or Collusion in Tendering. **(09)**

Administration/Performance of contract: Responsibilities (Duties and Liabilities) of Principal and Contractor, Monitoring and Quality control/assurance, Settlement of claims − Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements, Social Obligations/Responsibilities, Labour Welfare, Reports, Records, Files.

(08)

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure or Frustration. **(05)**

Dispute resolution: General, Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/Adjudication by courts.
Conciliation − Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation
Dispute Resolution Boards (DRB) − Constitution Of DRB, Functioning of DRB, Procedure for Hearings, Status of Award. Arbitration – Arbitration Agreement, Terms of Reference.
Litigation. **(08)**

International contracts / contracts with international funding: International Competitive Bidding, Domestic Preference, FIDIC Documents, Conditions, Currency of Bid and Payment, Escalation in Foreign Currency, Financing of projects, Applicable Law and Settlement of Disputes, International Arbitration. **(02)**

References:

1. Prakash V. A., *Contracts Management in Civil Engineering Projects*, NICMAR 1997
2. Patil B. S., *Civil Engineering Contracts and Estimates*, University Press. 2009
3. John G. Betty, *Engineering Contracts*, McGraw Hills., 1993
4. Vasavada B. J *Engineering Contracts and Arbitration,* (Self Publication by Jyoti B.` Vasavada). .,1997
5. Albett Robert W., *Engineering Contracts and Specifications*, John Willey and Sons, New York. 1961
6. Vaid K.N., *Global perspective on International Construction Contracting Technology and Project Management*, NICMAR, Mumbai. 1998

CIE 4078: ELEMENTS OF EARTHQUAKE ENGINEERING [3 0 0 3]

Course Outcomes

CO1: Describe the fundamental concepts related to earthquake and seismic effects on structural configurations.

CO2: Develop equation of motion for the response of single degree of freedom system subjected to free vibration.
CO3. Develop equation of motion for the response of single degree of freedom system subjected to forced vibration
CO4. Compute the storey shear forces on multi-storeyed structure using equivalent static load method.
CO5. Discuss ductility of structure, retrofitting of structures and ductile detailing of structural members.

Introduction: Plate tectonics, elastic rebound theory of earthquake, seismic zoning map of India, seismic waves, seismograms, earthquake magnitude and intensity. (02)

Introduction to theory of vibrations: Types of dynamic loadings, importance of vibration analysis, types of vibration, degrees of freedom, Free vibration of single degree undamped and damped systems, Forced vibration (Harmonic Loading) of single degree undamped and damped systems. (15)

Primary and secondary effects of earthquake. (02)

Lesson learnt from the past earthquakes: Case studies of important Indian earthquakes, major world earthquakes. (04)

Equivalent static method (IS 1893): seismic coefficients- evaluation, estimation of fundamental time period, base shear and its distribution. (05)

Ductile detailing of RC frames as per IS 13920 (1993): Ductile detailing of Beams, ductile detailing of columns and frame members with axial load and moment (05)

Restoration and retrofitting of exciting structures. (03)

References:

1. Pankaj Agarwal and Manish Shrikhande, *Earthquake Resistant Design of Structures*, Prentice-Hall of India Private Limited, New Delhi, 2006
2. Murty, C.V.R, *Earthquake Tips- Learning Earthquake Design and Construction*, National Information Centre of Earthquake Engineering, IIT Kanpur.2005
3. Varghese. P. C., *Advanced reinforced concrete design*, Prentice-Hall of India Private Limited, New Delhi. 2005
4. Chopra A.K., *Dynamics of Structures*, Prentice Hall of India Pvt. Ltd. New Delhi.1996
5. IS:1893 (part 1)- 2002, "Criteria for earthquake resistant design of structures", Bureau of Indian Standards, New Delhi
6. IS: 13920 – 1993, Ductile detailing of reinforced concrete structures subjected to seismic forces-code of practice, Bureau of Indian Standards, New Delhi

CIE 4079: FECAL SLUDGE AND SEPTAGE MANAGEMENT

The student shall be able to:

CO 1: Understand the global, national, state and ULB sanitation.
CO2 : Identify the characteristics, collection, transportation and treatment of fecal sludge.
CO3: Identify end use technology options, case studies, design and plan FSM.

CO4: Classify institutional, regulatory mechanism and finance, policy, regulation, Act, programme, scheme with case studies.

Introduction to sanitation at global, national, state and ULB situation, Components of FSSM such as characterization, collection, transportation and treatment etc., Technology Options such as technology systems end use, case studies, design, FSM plan, etc., Governance institutional, regulatory mechanism and finance, policy, regulation, Act, programme, scheme *etc*., Case studies.

References:

1. Guidelines for Septage management in Maharashtra, 2016
2. Guidelines for ULB to implement Septage management in Maharashtra, 2016
3. A toolkit on IFSN prepared by National Institute of Urban Affairs, 2016

CIE 4080: NONDESTRUCTIVE TESTING OF CONCRETE STRECTURES [3 0 0 3]

Total no. of lecture hours: 36hrs.

***Course outcome*:-**

Upon completion of this course the student will be able to

CO1: Describe the importance of Non-Destructive Testing (NDT) in quality and safety assurance of concrete.
CO2: Identify the types of equipment used for NDT of concrete
CO3: Explain the procedure for major NDT of concrete
CO4: Identify and associate relevant standard codes of practice for NDT
CO5: Interpret various strength parameters and defects in concrete measured by NDT.

Introduction: - Importance and need of non-destructive testing, Basic methods for NDT of concrete structures, Qualification and certification, Testing of concrete, Comparison of NDT methods, Quality control. **2hrs**

Visual Inspection Technique: - Introduction, Tools and equipment for visual inspection, General procedure of visual inspection, Applications of visual inspection, Sketches of typical defects found by visual inspection. **3hrs**

Half-Cell Electrical Potential Method: - Fundamental principle, Equipment for half-cell electrical potential method, General procedure for half-cell electrical potential method, Applications of half-cell electrical potential testing method, Range and limitations of half-cell electrical potential inspection method. **3hrs**

Schmidt Rebound Hammer Test: - Fundamental principle, Equipment for Schmidt/rebound hammer test, General procedure for Schmidt rebound hammer test, Applications of Schmidt rebound hammer test, Range and limitations of Schmidt rebound hammer test. **3hrs**

Carbonation Depth Measurement Test: - Fundamental principle, Equipment for carbonation depth measurement test, General procedure for carbonation depth measurement test, Range and limitations of carbonation depth measurement test. **3hrs**

Penetration Resistance or Windsor Probe Test: - Fundamental principle, Equipment for Windsor probe test, General procedure for Windsor probe test, Applications of Windsor probe test, Advantages and limitations of Windsor probe test. **3hrs**
Resistivity Measurement: - Fundamental principles, Equipment, General procedure, Applications. **3hrs**

Electromagnetic Methods of Testing Concrete: - Fundamental principles, Equipment for electromagnetic inspection, General procedure for electromagnetic testing, Applications of electromagnetic testing method, Range and limitations of electromagnetic testing method, Work or site calibration. **3hrs**

Radiographic Testing: - Fundamental principles, Equipment for radiographic testing method, General procedure for radiographic testing method, Applications of radiographic testing method. **5hrs.**

Ultrasonic Testing: - Pulse velocity test, Ultrasound pulse echo, Impact-echo/resonance frequency/stress wave test, Relative amplitude method, Velocity versus rebound number curves. **5hrs**

Ground Penetrating Radar: - Fundamental principle, Equipment for the GPR technique, Application of GPR techniques, Accuracy and interpretation of GPR, Advantages and limitations of GPR techniques, Safety advice, Examples of inspection of structures. **3hrs**

References:

1. J.H.Bungey, *The Testing of Concrete in Structures*, (4e), Surry University Press, 2006.
2. *Guidebook on Non-Destructive Testing Of Concrete Structures*, Training Course Series No. 17, International Atomic Energy Agency, Vienna, 2002.
3. Christiane Maierhofer, Hans-Wolf Reinhardt and Gerd Dobmann, *Non-Destructive Evaluation of Reinforced Concrete Structures*, Vol. 1 & 2, (1e), Woodhead Publishing Limited, 2010.
4. V.M. Malhotra and N.J. Carino, *Handbook on Nondestructive Testing of Concrete*, 2nd, CRC Press, 2003.

CIE 4081: REMOTE SENSING AND GIS [3 0 0 3]

Total No. of Hours=36

Course Outcomes:

CO1:Describe the concept of electromagnetic spectrum
CO2: Describe components of Remote sensing
CO3: Discuss the concept of GIS to process satellite images
CO4: Develop thematic maps and interpret results
CO5: Describe the use of remote sensing and GIS in the field of engineering

Introduction, Basic concepts of remote sensing, Physics of Remote sensing. **(3 hrs)**

Orbits, Concept of Spatial, spectral, radiometric and temporal resolution. **(4 hrs)**

Visual interpretation, Elements, comparison between visual & digital interpretation, basics of Digital Interpretation of images, operations in digital interpretation, application of Toposheet in base map preparation. **(9 hrs)**

Fundamentals and Objectives of GIS, Components of GIS, contributing disciplines and technologies. **(6 hrs)**

Raster, Vector, Definitions of Triangular irregular network (TIN) and Digital Elevation Model (DEM). **(8 hrs)**

Indian satellite program, Launch vehicles, application areas. **(3 hrs)**

Exercise on Remote sensing and GIS applications in Civil Engineering. **(3 hrs)**

References:

1. Lillesand T. M., and Kiefer, R.W. *Remote Sensing and Image interpretation*, (6e), of John Wiley & Sons 2000
2. John R. Jensen, *Introductory Digital Image Processing: A Remote Sensing Perspective*, (2e), 1995
3. Sabins, F. F. Jr, "*Remote Sensing Principles and Image interpretation*", W. H. Freeman & Co. 1978
4. Allan Brimicombe, "GIS Environmental Modeling and Engineering", Taylor & Francis, 2003

OPEN ELECTIVES

CIE 4301: AIR AND NOISE POLLUTION [3 0 0 3]

Total number of lectures – 36

Course outcomes:

CO1: Identify the types of air pollutants, their behavior and the chemical reactions in the atmosphere.

CO2: Describe the various meteorological factors, general characteristics of stack plumes and estimate the stack height.

CO3: Describe the sampling procedures and the methods to control air pollutants.

CO4: Discuss the global effects of air pollutants, air pollution act, air quality, emission standards and air pollution index.

CO5: Identify the types of noise, its effects, control measures and legislations.

Syllabus structure

Air Pollution – Definitions – Significance in general. Air pollutants, Sources, classification, emission, Behavior of air pollutants, chemical reactions in atmosphere - smog	06
Meteorology variables, primary and secondary lapse rate, Inversions, stability conditions, general characteristics of stack plumes, estimation of plume rise and stack height	10
Effects of air pollution - on human health, animals, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects	06
Industrial plant location and planning.	02
Sampling, analysis and control - Measurement of gaseous and particulate pollutants, stack sampling, smoke and smoke measurement, Particulate emission control, and other removal methods like absorption, adsorption, precipitation etc. Control methods - different types	05
Global effects of air pollution - Acid rain, Greenhouse effect, Ozone layer depletion. Air quality and Emission standards, Air pollution act, Air pollution index.	03
Noise Pollution- Definitions – Significance in general - sources, effects and control measures.	03
Air and noise legislations	01

References:

1. Rao H.V.N. and Rao M.N, *Air pollution*, Tata Mc Graw Hill, New Delhi 1989.
2. Rao C.S., *Environmental Pollution contro*, Wiley Eastern Ltd. Delhi.1995.
3. Wark Kenneth and Wamer C.F, *Air Pollution its Origin and Control. Harper and Row*, Publ.
4. Sincero. A. P.and Sincero G.A. *Environmental Engineering*. Prentice Hall.
5. *Air Pollution* - Sampling and Analysis - APHA.

CIE 4302: CONTRACT MANAGEMENT FOR ENGINEERS [3 0 0 3]

CO1 : Discuss engineering contracts
CO2 : Describe the process and issues of tendering
CO3 : Discuss the administration, performance and breaches of construction contracts
CO4 : Discuss Alternate Dispute Resolution methods
CO5 : Discuss International contracts and international arbitration

Introduction to contracts: Definitions, Essentials for a legally valid contract, Salient features of a contract, Discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on − Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts. **(04)**

Tendering process: Definitions, List of Documents, EMD, SD, Preparation of Enquiry Documents, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract – Letter of Award, Letter of Intent, Issues in tendering process: Pre - Registration, Pre – Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding, Cartel or Collusion in Tendering. **(09)**

Administration/Performance of contract: Responsibilities (Duties and Liabilities) of Principal and Contractor, Monitoring and Quality control/assurance, Settlement of claims − Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements, Social Obligations/Responsibilities, Labour Welfare, Reports, Records, Files.

(08)

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure or Frustration. **(05)**

Dispute resolution: General, Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/Adjudication by courts.
Conciliation − Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation
Dispute Resolution Boards (DRB) − Constitution Of DRB, Functioning of DRB, Procedure for Hearings, Status of Award. Arbitration – Arbitration Agreement, Terms of Reference.
Litigation. **(08)**

International contracts / contracts with international funding: International Competitive Bidding, Domestic Preference, FIDIC Documents, Conditions, Currency of Bid and Payment, Escalation in Foreign Currency, Financing of projects, Applicable Law and Settlement of Disputes, International Arbitration. **(02)**

References:

1. Prakash V. A., *Contracts Management in Civil Engineering Projects*, NICMAR 1997
2. Patil B. S., *Civil Engineering Contracts and Estimates*, University Press 2009.
3. John G. Betty, *Engineering Contracts*, McGraw Hills 1993
4. Vasavada B. J. *Engineering Contracts and Arbitration*, (Self Publication by Jyoti B.` Vasavada) 1997.
5. Albett Robert W., *Engineering Contracts and Specifications*, John Willey and Sons, New York. \(1961

6. Vaid K.N., *Global perspective on International Construction Contracting Technology and Project Management*, NICMAR, Mumbai. 1998

CIE 4303: ENVIRONMENTAL MANAGEMENT [3 0 0 3]

Total number of lectures - 36

Course outcomes:

CO1: Describe Environmental Management System
CO2: Discuss Environmental Impact Assessment and Strategic Environment Assessment.
CO3: Discuss environmental auditing and Life Cycle Assessment.
CO4: Describe codal guidelines and requirements for Environment Management System.
CO5: Identify the need for Environmental Economics and Environmental Design for industries

Syllabus Structure

The context of environmental management, overview of the state of the global environment, the earth's natural systems, sustainability and sustainable development– Case study. Introduction to the evaluation tools, environmental management system (EMS), organizational barriers, management responsibility, elements and extent of application, EMS structure.	04
Environmental Ethics, Laws, International Environmental Legislation, Indian Scenario, International Policy, sectorial allocation.	03
Environmental Impact Assessment –Purpose, Objective, Scope, steps, usage, EIS, SEA, Difference between EIA and SEA, case study	06
Life Cycle Assessment Components of LCA, measuring environmental impact (lifecycle stages of product, boundaries, functional unit, issues at each life-cycle stage, benefits of LCA), strategic framework for LCA and LCA-a tool for sustainability-Case study	05
ISO 14000-Background, the ISO 14000 series, business and standards, voluntary ,elements of EMS-environmental policy, planning, implementation and operation checking & correction action and management review–Case study	05
Auditing Scope and objectives, standards for auditing, registration, implementing the audit, procedures, benefits, environmental auditing as a management tool-Case study	05
Newer concepts of corporate environmental management product design for the environment (ISO 14062), product stewardship, principles of clean production, packaging, sustainable procurement, the social responsibility function of corporations, eco-labelling, ecological and carbon footprints (ISO 14064-65)–Case study	06
Environmental Economics and environmental design-application	02

References :

1. RamachandraT.V, *Environmental Management*, IISC Bangalore 2012
2. Lohani B.N., *Environmental Quality Management*, South Asian Publishers, New Delhi.1984

3. MOEF, Government of India, *Carrying Capacity Based Developmental Planning Studies* for the National Capital Region, 1995-96.
4. Chanlett, *Environmental Protection*, McGraw Hill Publication, New York.1973
5. *Environmental Laws-MOEF*, Government of India

CIE 4304: GEOLOGY FOR ENGINEERS [3 0 0 3]

Total Number of lectures: 36

Course Outcomes:

CO1	Define the importance of Geology and the properties of geological materials for Civil Engineering applications.
CO2	Describe the impact of internal and external forces on the earth and their applications in Civil Engineering.
CO3	Discuss the importance of geological features and their impact on Civil Engineering structures.
CO4	Visualize and discuss the groundwater system, geomorphological features and rock types for Civil Engineering.
CO5	Describe the principles of Remote Sensing, GIS and geophysical techniques and their applications in Civil Engineering and discuss the techniques to control climate change.

Introduction: Different branches of Geology, scope and importance of Engineering Geology in the field of Civil Engineering **(1 hour)**.

Physical Geology: Origin of Earth, Interior structure of Earth, Differentiation between crust, mantle and core based on its physical and chemical properties, Stratigraphic timescale **(2 hours)**.

Plate Tectonics and Seismology: Continental drift theories, different types of seismic waves, characteristics of strong ground motion and its effects **(2 hours)**.

Earthquake and Tsunami: Causative factors, recording instruments, Indian earthquakes, seismic zonation map of India **(2 hours)**.

Mineralogy: Introduction to mineralogy, rock-forming and ore minerals, their physical properties **(2 hours)**.

Petrology: Introduction to rock cycle, classification of rocks – igneous, sedimentary and metamorphic. Textures and structures of these rocks, rocks as building materials **(4 hours)**.

Weathering and soil formation: different agents of weathering: Physical, biological and chemical; soil profile, classification of soils, soil erosion and prevention, conservation of soils **(2 hours)**.

Landforms and processes associated with river, wind, and groundwater: Origin and development of river systems, erosional and depositional features, aeolian landforms, aquifers, saline water intrusion, ground water quality, groundwater prospecting **(5 hours)**.

Structural Geology: Dip and Strike, outcrop, instruments used in structural geology, folds, faults, joints, unconformities – their types, origin and recognition in the field and importance in civil engineering projects **(5 hours)**.

Engineering Geology: Introduction, Dams, reservoirs, tunnels, bridges, and highways – geological consideration in site selection **(4 hours)**.

Landslides: Causes and prevention; Case studies with relevance to India **(1 hour)**.

Remote Sensing and GIS: Introduction and applications in civil engineering **(2 hours)**.

Geophysical methods for sub-surface investigation: Seismic and electrical methods **(1 hour)**.

Climate Change: Introduction, causes and solutions to control climate change **(1 hour)**.

Visit to the field: Field visit to observe various river erosional features and weathering, geological structures: folds, faults and joints in the rock formations **(2 hours)**.

References:

5. Parbin Singh, *Engineering Geology*, S.K. Kataria and Sons, New Delhi. (2002).
6. Mukherjee P.K., *A text book of Geology*, World Press, Kolkata (2003).
7. Venkata Reddy D., *Engineering Geology for Civil Engineering*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, (1995).
8. Internet resources.

CIE 4305: INTRODUCTION TO REMOTE SENSING AND GIS [3 0 0 3]

Total Number of Lectures: 36

COURSE OUTCOMES:

CO1: Describe the concept of electromagnetic spectrum
CO2: Describe components of Remote sensing
CO3: Discuss the concept of GIS to process satellite images
CO4: Develop thematic maps and interpret results
CO5 : Describe the use of remote sensing and GIS in the field of engineering

Introduction, Basic concepts and physics of Remote sensing and, description of various satellite Orbits **(3 hrs)**

Image Composition, Different types of resolutions, Image correction, and noise removal **(10 hrs)**

Image enhancement, visual interpretation, Image classification techniques and various kinds Remote sensing data products and their purchase. **(9 hrs)**

Fundamentals of GIS, Objectives, Components of GIS, contributing disciplines and technologies, Raster, Vector, Exercise on Remote sensing and GIS application. Definitions of Triangular irregular network (TIN) and Digital Elevation Model (DEM) **(7 hrs)**

In-class exercises in GIS- basic functionalities of software, map making, data manipulation and display **(5 hrs)**

Indian satellite program, Launch vehicles, Exercise on RS and GIS applications **(2 hrs)**

References:

1. *Remote Sensing and Image Interpretation* – Lillesand, Kiefer and Chipman
2. John R. Jensen, *Introductory Digital Image Processing: A Remote Sensing Perspective*, (2e), 1995
3. Sabins, F. F. Jr, *Remote Sensing Principles and Image interpretation*, W. H. Freeman & Co 1978
4. Allan Brimicombe, *GIS Environmental Modeling and Engineering*, Taylor & Francis, 2003

CIE 4306: STRENGTH OF MATERIALS [3 0 0 3]

COURSE OUTCOMES:

CO1: Describe bending moment and shear force in statically determinate beams and illustrate.
CO2: Describe bending and shear stress distribution in beams and illustrate.
CO3: Describe Macaulay's method to find deformation in statically determinate beams and illustrate.
CO4: Discuss torsion in circular shafts and illustrate.
CO5: Discuss and illustrate state of compound stress; discuss the analysis of long columns and illustrate.

Introduction- Basic of Mechanics of solids.

Shear Force and Bending Moment in Beams- Introduction to types of beam, supports and loadings. Definition of bending moment and shear force, sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to point load, uniformly distributed loads, uniformly varying loads, couple and their combinations, related numerical problems. (07)

Bending and Shear Stresses in Beams- Introduction, pure bending theory, assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams. Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections, related numerical problems. (07)

Slope and Deflection of beam- Introduction, derivation of Euler-Bernoulli differential equation, Macaulay's method of finding the slope and defection. Slope and deflection of simply supported, cantilever and overhanging beam with different load combinations, application problems. (05)

Torsion in Circular Shaft- Introduction, pure torsion, assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, application numerical. (06)

Compound Stresses- Introduction, state of stress at a point. General two dimensional stress system, principal stresses and principal planes. Mohr's circle of stresses, numerical. (06)

Columns and Struts- Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns, related numerical. (05)

References:

1. Basavarajaiah B.S, amd Mahadevappa P., *Strength of Materials*, University Press (India) Pvt. Ltd.,2010.
2. Ferdinand P. Beer, E. Russell Johnston and Jr.John T. D., *Mechanics of Materials*, (3e), Tata McGraw-Hill.
3. Andrew Pytel, Singer F. L., *Strength of Materials* Harper & Collins 1987.
4. Young D. H, Timoshenko S.P., *Elements of Strength of Materials*, East West Press Pvt. Ltd., 2014.
5. Bansal R.K.,, *A Textbook of Strength of Materials*, Laxmi Publications, 2014.
6. Rattan S.S., *Strength of Materials* McGraw Hill Education (India) Pvt. Ltd., 2013.