

Department of Civil Engineering

The Department of Civil Engineering has been in existence since the inception of its parent, M I T Manipal in 1957, and has blossomed into a center of excellence in Civil Engineering. In addition to the undergraduate programme (B.Tech. in Civil Engg.), the department offers three post graduate programmes: M.Tech. in Structural Engineering, M. Tech in Construction Engineering and M.Tech. in Environmental Engineering and the Doctoral programme (Ph.D) and Quality improvement programme (Q.I.P).

A highly qualified and dedicated faculty, well trained and experienced supporting staff, backing of a progressive management, state of the art laboratories, classrooms, library facilities and infrastructure provide a conducive environment for the pursuit of academic excellence.

The department lays emphasis on educating and equipping students to manage the challenges of a professional engineering career. The department has an excellent track record for placement of its graduates too: reputed companies routinely visit the campus for recruitment and nearly all eligible students are absorbed.

The department frequently organizes continuing-education-programmes, technical lectures and talks from experts in emerging areas of Civil Engineering. The department takes pride in the achievement of its distinguished alumni, who hold prestigious positions in private and government organizations, industry and academia, across the globe.

Academic Program Offered

- B.Tech. in Civil Engineering (since 1957)
- M.Tech. in Structural Engineering (since 1992)
- M.Tech. in Construction Engineering (since 1989)
- M.Tech. in Environmental Engineering (since 2010)
- MSc. in Geology (since 2015)
- Ph.D

Facilities and Resources

The department is well equipped with following well established laboratories: Strength of Materials, Concrete and Highway material testing, Environmental Engineering, Soil Mechanics, Structural Engineering, Engineering Geology, Irrigation, Hydraulic Mechanics and Survey.

The department has a strong research focus on Soil Stability and Mechanics, Environmental Science and Pollution Abatement, Concrete Technology, Environmental Geochemistry, Earthquake Engineering and Structural Dynamics. The faculty regularly participates in several academic activities by presenting research papers at national and international levels. The department offers consultancy and testing services for structural analysis, cement, building materials, steel and water samples to private and government organizations, builders and the local populace.

Faculty List

Professor & Head

Dr Mohandas Chadaga, Ph.D (Manipal University)

Professor

Dr A. Krishnamoorthy, Ph.D (Mangalore University)
Dr Narayana Sabhahit, Ph.D (IIT Kanpur)
Dr Udayashankar H. N., Ph.D (Mangalore University)
Dr Gicy M. Koor, Ph.D (NITK, Suratkal)
Dr Narayan Shenoy K., Ph.D (Mangalore University)
Dr K. Balakrishna Rao, Ph.D (NITK, Suratkal)
Dr Kiran Kamath, Ph.D (NITK, Suratkal)
Dr Kiran Kumar Shetty M., Ph.D (Manipal University)

Associate Professor - Senior Scale

Mr N. S. Ananda Rao, MTech
Dr B. H. Venkatrama Pai., Ph.D (Manipal University)
Mr Prakash Rao B., MTech
Dr K. Balakrishna, Ph.D (Mangalore University)
Dr Purushotham G. Sarvade, Ph.D (NITK, Suratkal)
Dr Asha Udaya Rao, Ph.D (Manipal University)

Associate Professor

Mr Srinivasa Raghavan, MTech
Mr K. Phaniraj, BE.,ME
Dr Jagadeesh Pai B., Ph.D (NITK, Suratkal)
Dr Gopinatha Nayak, Ph.D (NITK, Suratkal)

Assistant Professor - Selection Grade

Mr Ravindranatha, MTech
Mr K. Ganesh Kini, MTech
Ms Shambhavi Kamath M., MTech
Ms Shilpa S. Ratnoji, MTech

Assistant Professor - Senior Scale

Mr Balakrishna S. Maddodi, MSc.
Ms Lathashri U. A., MTech
Mr Raghavendra K. Holla B., MTech
Mr Girish M. G., MTech
Mr Shriharsha, MTech
Mr Anup Wilfred Sebastian., MTech

Assistant Professor

Ms Sridevi H., MTech
Mr Arun Kumar Y. M., MTech
Mr Laxman Kudva P., MTech
Ms H K Sugandhini, MTech
Mr Prasanna Kumar M., MTech
Ms Suja T. P., MTech
Mr Avinash A. R., MTech
Ms Dhanalakshmi, MTech
Ms Radhika Bhandary P., MTech
Ms Vidya Dodwad, MTech
Mr Sandeep G. S., MTech
Ms Ashwini P. R., MTech
Ms Sowmya Rao G. S., MTech
Mr Kiran Bhat P., MTech
Mr Ramesh Nayaka, MTech
Mr Praveen Kumar P., MTech
Dr Shreelaxmi Prashanth, Ph.D (NITK, Suratkal)
Mr Sandesh Upadhyaya K., MTech
Ms Ramya R. Pai, MTech
Mr Vishnu Unnikrishnan, MTech
Mr Poornachandra Pandit, MTech
Ms Teena Thomas, MTech
Ms Indu Nair, MTech
Mr Shaurya Rahul Narlanka, MTech
Ms Sheeka Subramani B., MTech
Ms Chaitra M., BE. (on contract)
Mr Udaya Kumar K. S., BE. (on contract)
Mr Deepak Nayak, BE. (on contract)

B Tech in CIVIL ENGINEERING

Year	THIRD SEMESTER							FOURTH SEMESTER							
	Subject Code	Subject Name	L	T	P	C	Subject Code	Subject Name	L	T	P	C			
II	MAT 2104	Engineering Mathematics – III	2	1	0	3	MAT 2204	Engineering Mathematics – IV	2	1	0	3			
	CIE 2101	Fluid Mechanics	3	1	0	4	CIE 2201	Water Resources Engineering	3	1	0	4			
	CIE 2102	Mechanics of Structure	3	1	0	4	CIE 2202	Analysis of Indeterminate Structures	3	1	0	4			
	CIE 2103	Building Science and Technology	4	0	0	4	CIE 2203	Basic Reinforced Concrete Design	3	1	0	4			
	CIE 2104	Basics of Surveying	2	1	0	3	CIE 2204	Applied Surveying	2	1	0	3			
	CIE 2105	Engineering Geology	3	0	0	3	*** **	Open Elective – I	3	0	0	3			
	CIE 2111	Building Design and Drawing	0	0	3	1	CIE 2211	Surveying Practice – I	0	0	3	1			
	CIE 2112	Material Testing Lab – I	0	0	3	1	CIE 2212	Geology Lab	0	0	3	1			
			17	4	6	23			16	5	6	23			
III	FIFTH SEMESTER							SIXTH SEMESTER							
	CIE 3101	Geotechnical Engg.	3	1	0	4	HUM 4002	Engineering Economics and Financial Management	2	1	0	3			
	CIE 3102	Basic Structural Steel Design	3	1	0	4	CIE 3201	Applied Soil Engineering	3	0	0	3			
	CIE 3103	Water Supply Engineering	3	0	0	3	CIE 3202	Waste Water Management	3	0	0	3			
	CIE 3104	Highway Engineering	2	1	0	3	CIE 3203	Railway and Airport Engineering	3	0	0	3			
	CIE ****	Program Elective – I	3	0	0	3	CIE ****	Program Elective – II	3	0	0	3			
	CIE 3105	Elements of Earthquake Engineering	3	0	0	3	*****	Open Elective – II	3	0	0	3			
	CIE 3111	Soil Mechanics Lab	0	0	3	1	CIE 3211	Structural Design and Drawing	1	0	3	2			
	CIE 3112	Fluid Mechanics Lab	0	0	3	1	CIE 3212	Material Testing Lab – II	0	0	3	1			
			17	3	6	22			18	1	9	22			
	IV	SEVENTH SEMESTER							EIGHTH SEMESTER						
		HUM 4001	Essentials of Management	2	1	0	3	CIE 4297	Seminar				1		
CIE 4101		Estimating and Construction Management	3	1	0	4	CIE 4298	Industrial Training				1			
CIE ****		Program Elective – III	3	0	0	3	CIE 4299	Project Work/Practice School				12			
CIE ****		Program Elective – IV	3	0	0	3									
CIE ****		Program Elective – V	3	0	0	3									
CIE ****		Program Elective – VI	3	0	0	3									
CIE 4111		Computer Aided Analysis and Design Lab	0	0	3	1									
CIE 4112		Environmental Engg. Lab	0	0	3	1									
CIE 4113		Estimation and Costing Practice	0	0	3	1									
			17	2	9	22						14			

Minor Specialisations

I. Building Construction and Management

1. CIE 4001: Building Code and Requirements
2. CIE 4002: Precast Technology
3. CIE 4003: Recent Advances in Concrete Technology
4. CIE 4004: Resource Management

II. Environmental Engineering, Hydraulics & Water Resources Engg.

1. CIE 4005: Ground Water Engineering
2. CIE 4006: Hydrological Analysis
3. CIE 4007: Hydraulics and Hydraulic Machines
4. CIE 4008: Industrial Waste Treatment

III. Geotechnical Engineering & Transportation Engineering

1. CIE 4009: Design of Foundation and Earth Retaining Structures
2. CIE 4010: Ground Improvement Techniques
3. CIE 4011: Pavement Material and Design
4. CIE 4012: Soil Reinforcement and Geosynthetics

IV. Structural Engineering

1. CIE 4013: Advanced Design of Steel Structures
2. CIE 4014: Advanced Reinforced Concrete Design
3. CIE 4015: Finite Element Method of Analysis
4. CIE 4016: Pre-stressed Concrete Design

V. Business Management

1. HUM 4011: Financial Management
2. HUM 4012: Human Resource Management
3. HUM 4013: Marketing Management
4. HUM 4014: Operations and Systems Management

Other Programme Electives

1. CIE 4017: Air Pollution and Control
2. CIE 4018: Applied Geology
3. CIE 4019: Bridge Engineering
4. CIE 4020: Coastal Engg
5. CIE 4021: Environmental Impact Assessment and Auditing
6. CIE 4022: Geo-Environmental Engineering
7. CIE 4023: Non Destructive Testing of Materials
8. CIE 4024: Remote Sensing and GIS
9. CIE 4025: Solid Waste Management
10. CIE 4026: Traffic Systems and Engineering
11. CIE 4027: Urban Mass Transportation System
12. CIE 4028: Urban Transportation Planning

Open Electives

1. CIE 3281: Environmental Management
2. CIE 3282: Introduction to Remote Sensing and GIS
3. CIE 3283: Strength of Materials

THIRD SEMESTER

MAT 2104: ENGINEERING MATHEMATICS - III [2 1 0 3]

Gradient, divergence and curl, Line, surface and volume integrals. Green's, divergence and Stoke's theorems. Fourier series of periodic functions. Half range expansions. Harmonic analysis. Fourier integrals. Sine and cosine integrals, Fourier transform, Sine and cosine transforms. Partial differential equation- Basic concepts, solutions of equations involving derivatives with respect to one variable only. solutions by indicated transformations and separation of variables. One-dimensional wave equation, one dimensional heat equation and their solutions. Introduction to probability: finite sample space, conditional probability and independence. Bayes' theorem, One dim. random variables: Mean, Variance. Two and higher dimensional random variables: mean, variance, correlation coefficient and regression.

References:

1. Murray R. Spiegel, "*Vector Analysis*", Schaum Publishing Co., 1959.
2. Erwin Kreyszig, "*Advanced Engg. Mathematics*", Wiley Eastern.
3. P. L. Meyer, "*Introduction to Probability and Statistical Applications*".
4. B. S. Grewal, "*Higher Engg. Mathematics*", 2014.

CIE 2101: FLUID MECHANICS - I [3 1 0 4]

Introduction, Fluid Properties and Classification of Fluid, Pressure and its Measurement, Hydrostatics, Kinematics of Fluid Motion, Dynamics of Fluid Motion, Ideal Fluid Flow, Laminar Flow Through Pipes, Turbulent Flow Through Pipes, Flow Measurement, Flow in open Channels

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 2102: MECHANICS OF STRUCTURE [3 1 0 4]

Introduction, Analysis of Determinate Trusses, Bending and shear stresses, Torsion of circular, Stability of columns, Stress on inclined planes, Analysis of Arches and suspension bridge, Strain Energy, Deflection, Rolling Loads and Influence Lines

References:

1. Timoshenko, "*Strength of Materials Vol. I & Vol. II* ", CBS Publishers & Distributers, New Delhi.

2. James M Gere & Stephen P Timoshenko, "*Mechanics of Materials*", CBS Publishers & Distributors, New Delhi.
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, 1989.

CIE 2103: BUILDING SCIENCE & TECHNOLOGY [4 0 0 4]

Masonry elements, Stone masonry, Joints in masonry, Hollow block construction. Load bearing and partition walls, Plastering, Painting and Flooring, Roofs, Shoring, Underpinning, and Scaffolding, Bricks, Tiles, Lime, Timber, plywood, Tar, Bitumen and Asphalt, Modern Building Materials, Corrosion, Cement, Concrete, Micro Structure of Concrete, Mix design proportion, curing, Introduction to Alternative Concretes, Adhesives and sealants.

References:

1. "*Handbook on Masonry design and construction*", SP20-1991
2. "*Nomograms for thickness of masonry walls*", SP10-1975, (First reprint September 1991)
3. "*Handbook on Building Construction Practices*", SP:62 (S&T) :1997
4. "*National Building Code*", BIS, New Delhi, (1988)
5. "*Sushil Kumar, Building Construction*", Standard Publication (1976)

CIE 2104: BASIC SURVEYING [2 1 0 3]

Introduction, Compass Survey, Plane Table survey, Levelling, Simple levelling, Differential leveling, Errors in Levelling, Reciprocal Levelling, Contours, Application and uses, Methods in Contouring, Characteristics of contours, Theodolite Survey, Repetition and Reiteration methods Temporary adjustments of the theodolite, Trigonometric levelling using height and distance formulae

References:

1. Punmia B. C., "*Surveying and levelling, Vol I and II*", Lakshmi Publishers, New Delhi, 2005.
2. Arora K. R., "*Surveying, Vol I*", Standard Book house, New Delhi, 1993.
3. Kanetkar T. P, Kulkarni S. V., "*Surveying and levelling Vol. I and Vol. II*", Pune, Vidyarthi Griha Prakashan., 1996.
4. Thomas Norman, "*Surveying*", Edward Arnold Publishers (ELBS), Budapest.
5. Duggal S.K., "*Surveying Vol. I*", Tata McGraw Hill Publishing Co.Ltd, New Delhi, 1996.

CIE 2105: ENGINEERING GEOLOGY [3 0 0 3]

Introduction, Geology and Civil Engineering, Seismology: Earthquakes and tsunamis, Case studies, Physical Geology, Weathering

(deterioration) of rocks, Structural Geology, Petrology, crystallography, Minerals, Rock as building material, Engineering Geology, Remote sensing and GIS, Geological considerations in selection of sites for dams & reservoirs, tunnels, bridges & highways and Landslides.

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.

CIE 2111: BUILDING DESIGN AND DRAWING [0 0 3 1]

Introduction to AutoCAD, Foundations and Footings, Doors and Windows, Designing and Drawing of Residential Buildings, Designing and Drawing of Public Buildings:

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. Rangawala S. C., "*Elementary and advanced building Construction*", Charotar Publishing House Pvt. Limited, 2009.
5. *IS National Building Code*, 1970.

CIE 2112: MATERIAL TESTING LAB - I [0 0 3 1]

Determination of specific gravity of fine and coarse aggregate, grading of coarse aggregate and fine aggregate, Bulking of sand, Aggregate impact value and abrasion value (Los Angeles Test). Cement - determination of specific gravity, Fineness, Standard consistency, Setting times, Soundness and Strength. Concrete - Determination of workability, Mix Design as per IS 10262-1982, Compressive strength and tensile strength, flexural strength and modulus of elasticity, Permeability of concrete.

References:

1. Shetty M. S., "*Concrete Technology*", S. Chand and Co., 2006.
2. Neville and Brooks, "*Concrete Technology*", Pearson Education, 2003.
3. Singh Gurucharan, "*Materials of Construction*", Standard Publishers. (1988)
4. *Relevant IS Codes*

FOURTH SEMESTER

MAT 2205: 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. Introduction to Tensor Analysis, 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. Optimization Techniques: Introduction to Linear programming, Formation of Linear Programming problem, solution by graphical method, Simplex method. Two phase simplex method, Transportation problems

References:

1. Rajasekaran S., "Numerical methods for Science and Engineering", Wheeler and Co. Pvt. Ltd., 1992.
2. Allahabad Sastry S. S., "Introductory methods of Numerical Analysis", Prentice Hall of India, New Delhi, 2005.
3. A. R. Mitchel and R. Wait, "Finite Element Methods in Partial Differential Equations", John Wiley, 1997.
1. P. L. Meyer, "Introduction to probability and Statistical Applications".

CIE 2201: WATER RESOURCES ENGINEERING [3 1 0 4]

Introduction, Hydrology, Irrigation engineering, Reservoir planning, Hydraulic structures- Dams, Diversion head works-components; Bligh's Creep Theory, Canal masonry works- Falls, Regulators, Cross Drainage Works, Flood studies: Importance, estimation of flood magnitude, flood routing, flood control measures. River training works.

References:

1. Viessman and Knapp, "Introduction to Hydrology", Harper and Row Publishers, Singapore, 1989.
2. H. M. Raghunath, "Hydrology", Wiley Eastern publications, 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 2102: ANALYSIS OF INDETERMINATE STRUCTURES [3 1 0 4]

Analysis of two hinged parabolic arches, Analysis of Simple Statically Indeterminate Beams, Analysis of statically indeterminate beams, bents and frames, Kani's method of Analysis, Influence Lines for Bridge Trusses and Statically Indeterminate Beams, 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.

References:

1. Hibbeler, R. C., "Structural analysis", Pearson Education.
2. Daniel L Schodak, "Structures", Pearson Education.
3. Reddy C.S., "Basic structural Analysis", Tata McGraw Hill, New Delhi, 2004.
4. Ramamrutham, "Theory of Structures".
5. Rao Prakash D.S., "Structural Analysis", Universities Press, India. 1996.

CIE 2203: BASIC REINFORCED CONCRETE DESIGN [3 1 0 4]

Role of reinforcement, behavior of RCC section, Straight line Theory, Determination of Crack width, Limit state method, Design of rectangular beams (singly and doubly reinforced), flanged beams, Design for Shear and Torsion, Design of slabs for various boundary conditions, 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, Design of square and rectangular column footings.

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. Unnikrishna Pillai, Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Code books:

1. IS:456 2000, "Code of practice for plain and Reinforced concrete", Bureau of Indian Standards, New Delhi.
2. SP-16 1984, "Design Aids for Reinforced concrete IS 456. Bureau of Indian Standards", New Delhi.

CIE 2204: APPLIED SURVEYING [2 1 0 3]

Tacheometry, Curves- simple curve, compound curve, reverse curve, transition curve, Lemniscate curve and vertical curve, Construction Surveying, Photogrammetric Surveying, Aerial Photogrammetry, Under Ground Surveys, Hydrographic Survey, Electronic Distance Measurement, Total station Instruments - computing distance from the phase differences.

References:

1. Kanetkar T. P. and Kulkarni S. V., "Surveying and leveling, Part I and II", Pune Vidyarthi Griha Prakashana Pune, 1989.
2. Arora K. R., "Surveying, Vol. I and II", Standard Book House, New Delhi, 1993.

3. Punmia B.C, "Surveying, Vol. I and II", Lakshmi Publications, New Delhi, 2005.
4. David Clark, "Plane and Geodetic Surveying for Engineers", Vol I and II, CBS Publication and Distributors, New Delhi, 1983.
5. Norman Thomas, "Surveying", Edward Arnold Publishers (ELBS) London, 1963.

CIE 2211: SURVEYING PRACTICE - I [0 0 3 1]

Chain survey, Compass Survey, Distance between two inaccessible points, Plane table surveying- Radiation and intersection methods, Solving three point problem by Bessel's solution, Plane table traversing, Levelling- Simple and reciprocal, Theodolite -Single plane method, Double plane method, Distance between inaccessible points

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.

CIE 2212: GEOLOGY LAB [0 0 3 1]

Identification and description of Rock forming Minerals: Quartz group, Ore minerals, Megascopic study of texture, structure, and engineering importance, Interpretation of geologic maps with horizontal inclined, folded, faulted and unconformity, Determination of thickness of strata on horizontal ground, Dip and strike problems, Borehole problems and their uses in dams, tunnels and reservoir site.

References:

1. Muruthesha Reddy M. T., "Engineering Geology Practicals", New age International Publishers, New Delhi, 2002.
2. Gurappa K.M., "Structural Geology maps and problems", 1975.
3. Gokhale W., "Manual of Geological maps", CBS publications, New Delhi, 1987.

FIFTH SEMESTER

CIE 3101: GEOTECHNICAL ENGINEERING [3 1 0 4]

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.

References:

1. Terzaghi K., and Peck R. B., "Soil Mechanics in Engineering Practice", (2e), Wiley International Edition, New York, 1967.
2. Taylor D. W., "Fundamentals of Soil mechanics", (2e), Asia Publishing house Bombay, 1960.

3. Ramiah B.K. and Chickanagappa L. S., "Hand Book of Soil Mechanics and Foundation Engg.", Oxford and IBH, 1990.
4. Lambe T. W. and Whitman R. V., "Soil Mechanics", SI Version, John Wiley and Sons, 1987.
5. Gopal Ranjan and. Rao A. S. R, "Basic and Applied Soil Mechanics", (2e), New Age International Pvt. Limited, Publishers, 2000

CIE 3102: BASIC STRUCTURAL STEEL DESIGN [3 1 0 4]

Introduction, Limit state method of design and Allowable stress design, Structural fasteners and joints, Design of Tension members, Compression member, Design of flexural members, Welded Plate, Roof Trusses

References:

1. Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi.
2. Duggal S.K., "Limit State method of design of steel structures", Tata McGraw-Hill, New Delhi, 2010.
3. Martin L.H and Purkiss J.A., "Structural Design of Steelworks to BS 5950", Edward Arnold, London, 1992.
4. Bhavikatti S. S., "Design of Steel structures", I. K. International Publishing House, New Delhi, 2010.

Code books:

1. "IS 800-2007: General construction in steel-Code of practice" (third revision), Bureau of Indian Standards, New Delhi.
2. "IS 875-1987 (Part III): Code of practice for design loads (other than earthquake) for building structures", Bureau of Indian Standards, New Delhi.
3. "BS 5950 (part 1) - 1985: Structural use of steelwork in buildings", British Standards Institution, London.
4. "SP: (6)-1964: Hand book for Structural Engineers", Bureau of Indian Standards, New Delhi.

CIE 3103: WATER SUPPLY ENGINEERING [3 0 0 3]

Introduction, Quantity of water, Sources of water, Quality of water, Treatment of water, Filtration, Other treatment methods, Distribution of water, Pipe appurtenances, wastage of water - Leakage detection & prevention, corrosion and its prevention.

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. Modi and Seth, "Water Supply and Sanitary Engg.", Dhanpath Rai and Sons, New Delhi.
5. Fair and Gayer, "Water Supply and Sanitary Engg.", Dhanpath Rai and Sons, New Delhi.

CIE 3104: HIGHWAY ENGINEERING [2 1 0 3]

Introduction, Traffic Engineering, Geometric Design, Horizontal curve, Extra widening, Super elevation, Transition curve, Vertical curves-Summit and Valley Curves, Pavements Design, Flexible and Rigid pavements- IRC method, Highway Economics and Finance, Highway Drainage System

References:

1. Khanna S. K and Justo C. E. G., (8e), "Highway Engineering", Nemchand and Bros., Roorkee, 2001.
2. Kadiyali L. R., "Traffic Engineering and Transportation Planning", (6e), Khanna Publisher, New Delhi, 2000.
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 3105: ELEMENTS OF EARTHQUAKE ENGINEERING [3 0 0 3]

Introduction, seismic zoning map of India, seismic waves, seismograms, earthquake magnitude and intensity, Introduction to theory of vibrations, Primary and secondary effects of earthquake, Lesson learnt from the past earthquakes, Equivalent static method (IS 1893, Ductile detailing of RC frames as per IS 13920 (1993), Restoration and retrofitting of existing structures.

References:

1. Pankaj Agarwal and Manish Shrikhande., "Earthquake Resistant Design of Structures", Prentice-Hall of India Private Limited, New Delhi, 2006.
2. C. V. R. Murty, "Earthquake Tips- Learning Earthquake Design and Construction", National Information Centre of Earthquake Engineering, IIT Kanpur, 2005.
3. P. C. Varghese, "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.

Code books:

1. IS:1893 (part 1)- 2002, "Criteria for earthquake resistant design of structures", Bureau of Indian Standards, New Delhi.
2. IS: 13920 1993, "Ductile detailing of reinforced concrete structures subjected to seismic forces - code of practice", Bureau of Indian Standards, New Delhi.

CIE 3111: SOIL MECHANICS LABORATORY [0 0 3 1]

Determination of moisture content, specific gravity, Atterberg's 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 load test, Cone penetration test, Modified compaction test and hydrometer analysis.

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.

CIE 3112: FLUID MECHANICS LAB [0 0 3 1]

Calibration of Triangular Notch, Rectangular Notch, Cippoletti Notch, Venturimeter, Orifices, Mouth pieces, Orifice meter, Broad crested weir, Curved weir, Ogee weir, Plug Sluice, Determination of Friction factor of pipes, Experiment on Venturi flume, Standing wave flume, Demonstration of Parshall Flume.

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.

SIXTH SEMESTER

HUM 4002: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

Nature and significance, Micro & macro differences, Law of demand and supply, Elasticity & equilibrium of demand & supply. Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of single, Uniform gradient cash flow. 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, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, Declining balance method of depreciation, Sum-of-the-years digits method of depreciation, Sinking fund and service output methods, Costing and its types Job costing and Process costing, Introduction to balance sheet and profit & loss statement. Ratio analysis - Financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios

References:

1. Blank Leland T. Tarquin Anthony J., "Engineering Economy", McGraw Hill, New Delhi, 2002.
2. Chan S. Park, "Contemporary Engineering Economics", Pearson Education, Inc., 2010.

- Raman B. S (1993), *“Advanced accountancy”*, United publications, Bangalore.
- T. Ramachandran (2001), *“Accounting and Financial Management”*, Scitech Publications Pvt. Ltd. India.
- Thuesen G. J & Thuesen H. G., *“Engineering Economics”*, Prentice Hall of India, New Delhi, 2005.

CIE 3201: APPLIED SOIL ENGINEERING [3 0 0 3]

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 by dynamic formulae, static formula, Group action and Negative skin friction, under-reamed piles and Bored compaction piles.

References:

- Bowels J. E., *“Foundation Analysis and Design”*, McGraw-Hills Book Company 4th Edition, 1998.
- Shashi K Gulati and Manoj Datta, *“Geotechnical Engineering”*, TataMcGraw-Hill Publishing company limited, New Delhi, 2005.
- Hsai Yang Fang, *“Foundation Engg.”, Hand Book*, CBS. Publishers and Distributors, 2nd Edition, New Delhi, 2001
- Arora K.R., *“Soil Mechanics and Foundation Engineering”*, (7e), Standard, Publishers and Distributors, 2008.
- Gopal Ranjan and Rao A. S. R., *“Basic and Applied Soil Mechanics”*, (2e), New Age International (P) Limited, Publishers, 2000.

CIE 3202: WASTE WATER MANAGEMENT [3 0 0 3]

Introduction, Unit Operations, Unit Processes, Stabilization Ponds Aerobic, Facultative & Anaerobic Lagoons, Septic tanks and their Design Aspects, Sludge Treatment, Sludge Digestion- Aerobic and Anaerobic, Energy recovery from digesters, Operation and Maintenance of treatment units, Disposal of wastes from various units.

References:

- S. C. Rangwala., *“Water Supply and Sanitary Engineering”*, Charotar Publishing House, 1990.
- S. K. Garg., *“Environmental Engineering Vol.I& II”*, Khanna Publishers, 2004.
- B C Punmia., *“Waste Water Engineering”*, (2e), Laxmi Publications, 1998.
- George Tchobanoglous, Franklin Louis Burton, H. David Stensel, *“Wastewater Engineering - Treatment and Reuse”*, McGraw-Hill Education, 2003.
- Metcalf and Eddy, *“Wastewater Engineering: treatment disposal reuse”*, McGraw-Hill, 1979.

CIE 3203: RAILWAY ENGINEERING AND AIRPORT PLANNING [3 0 0 3]

Railway Engineering- Tractive resistance, Permanent way, Alignment Details, Points and crossing, Track Junctions, Miscellaneous Topics- Railway Station and Yards Triangle, Turn Table, Scotch Block, Fouling marks, Buffer Stops. Signals Airport Engineering- Factors to be considered in Airport Planning, Geometric Design, Airport Capacity and Designing of Terminal Area, Visual aids and Air traffic control system

References:

- Saxena S.C. and Arora S.P., *“A Text Book of Railway Engineering”*, Dhanpat Rai & Sons, 1981.
- Khanna S.K., Arora M.G. and Jain S.S., *“Airport Planning and Design”*, Nemchand and Brothers, 2008.
- Horenjeff, R. and McKelvey, F., *“Planning and Design of Airports”*, (4e), McGraw Hill Company, New York, 1994.
- Ashford, N. and Wright, P.H., *“Airport Engineering”*, (3e), John Wiley and Sons, New York, 1992.

CIE 3211: STRUCTURAL DESIGN AND DRAWING [1 0 3 2]

Detailing of rectangular beams (singly and doubly reinforced, Detailing of flanged beam, Detailing of one way slabs, Detailing of Two way slabs, Detailing of Isolated footing, Detailing of Isolated footing with uniaxial moment, Design and detailing of continuous beam, Dog legged staircase.

References:

- Duggal S.K., *“Limit State Design of Steel Structures”*, Tata McGraw Hill education private Limited New Delhi, 2008.
- Krishna Raju N., *“Structural Design and Drawing”*, Universities Press, India, 2009.
- Shah M. G. and Kale C. M., *“RCC Theory and Design”*, Mcmillan India Ltd., 1991.
- Verghese P.P., *“Limit State Design of Reinforced Concrete”*, Prentice Hall of India, New Delhi, 2005.
- Punmia B. C., *“Limit State Design of reinforced concrete”*, Laxmi Publications, Limited, 2007.

Code books:

- IS 456 2000, *“Plain and reinforced concrete code of practice”*, Bureau of Indian Standards, New Delhi.
- IS 800 2007, *“General construction in Steel-code of Practice”*, Bureau of Indian Standards, New Delhi.
- SP-16--1984, *“Design Aids for Reinforced Concrete to IS:456-1978”*, Bureau of Indian Standards, New Delhi.
- IS 3370 Part II & IV, *“Code of Practice for Concrete Structures for the Storage of Liquids”*, Bureau of Indian Standards, New Delhi

CIE 3212: MATERIAL TESTING LAB - II [0 0 3 1]

Tension test on mild steel, Compression test on cast iron, timber and Shear test on mild steel specimen, Torsion test on mild steel specimen and Rockwell hardness test, Brinell's Hardness test and bending test on wood, Impact tests: a) Izod b) Charpy and Fatigue test (Demonstration), Test on Bricks, Tests on Flooring and Roofing Tiles, Tests on Bitumen, Compressive strength of Laterite Stone.

References:

- Suryanarayana A. V. K., *“Testing of Metallic Materials”*, Prentice Hall of India, New Delhi, 1990.
- 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 IS Codes*.

CIE 3213: SURVEYING PRACTICE - II [0 0 3 1]

Tacheometric surveying, Curve Surveying: (Using Chain and Tape), Setting out simple curves, Curve Surveying (Using theodolite), Setting out a compound curve, reverse curve, transition curve (Bernoullis Lemniscate), combined curve, Total Station Method, Study of Instruments: Hand level, Clinometers, Abney level, Use of Planimeter, Box sextants, Nautical sextants, Ceylonthat tracer.

References:

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

SEVENTH SEMESTER

HUM 4001: ESSENTIALS OF MANAGEMENT [2 1 0 3]

Definition of management and systems approach, Nature & scope, The functions of managers, Corporate social responsibility. Planning: Types of plans, Steps in planning, Process of MBO, How to set objectives, Strategies, Policies & planning premises, Strategic planning process and tools. Nature & purpose of organising, Span of management, factors determining the span, Basic departmentalization, Line & staff concepts, Functional authority, Art of delegation, Decentralisation of authority. HR planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership - leadership behaviour & styles, Managerial grid. Basic Control Process, Critical Control Points & Standards, Budgets, Non-budgetary control devices. Profit & loss control, Control through ROI, Direct, Preventive control. Managerial practices in Japan & USA & application of Theory Z. The nature & purpose of international business & multinational corporations, unified global theory of management. Entrepreneurial traits, Creativity, Innovation management, Market analysis, Business plan concepts, Development of financial projections

References:

1. Koontz D., "*Essentials of Management*", Mc Graw Hill, New York, 2004.
2. Peter Drucker, "*Management, Task and Responsibility*", Allied Publishers, 2006.

3. Peter Drucker, "*The practice of management*", Butterworth Hein Mann, 2003.

CIE 4101: ESTIMATION AND CONSTRUCTION MANAGEMENT [3 1 0 4]

Estimation, Quantity Estimation- Center Line and Long Wall Short Wall Methods, Rate Analysis, Contract, Valuation, Project Management Construction, Planning for Construction Projects, Scheduling, Network Analysis, Pert Analysis, CPM analysis, Cost Analysis, Project updating, Construction organisation Management of Construction equipment Introduction to construction equipment

References:

1. M. Chakraborti., "*Estimating, Costing, Specification & Valuation in Civil Engineering*", Published by the Author, Sixteenth edition, 2003.
2. B. N. Dutta., "*Estimating and Costing in Civil Engineering*", UBS Publishers' Distributors Ltd. Sixteenth reprint, 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*".
5. Seetharaman. S., "*Construction Engg. and Management*", Umesh Publication, 1997.

CIE 4111: COMPUTER AIDED ANALYSIS AND DESIGN LAB [0 0 3 1]

Introduction to STAAD software package. Analysis of continuous beams using STAAD, Analysis of plane trusses, plane frames, and space frames using STAAD, Design of frames using STAAD package, Introduction and application of ETABS

References:

1. *STAAD Pro software tutorial*.
2. *ETABS software tutorial*.

CIE 4112: ENVIRONMENTAL ENGINEERING LAB [0 0 3 1]

Determination of solids, Turbidity determination and Jar test, Determination of Alkalinity, Acidity and Ph, Calcium, Magnesium and total Hardness, Chlorides, dissolved oxygen and BOD, Residual chlorine and chlorine demand, Determination of Iron and Fluorides, Determination of C.O.D., Ammonical Nitrogen and Nitrates, Demonstration of High volume sample and sound lever meter, determination of oil, grease and Sulphates.

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, "*Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry*", IIT New Delhi, 1964.
4. *Drinking water Standards IS 10500-2004*.

CIE 4113: ESTIMATION AND COSTING PRACTICE [0 0 3 1]

Definition, types, principles, detailed specification for different components of building, Quantity estimation of Foundation, Masonry work, Doors, Windows, RCC work and different types of roofs, Rate analysis for different items of work, Quantity and cost estimation of buildings, Measurement of earth work using leveling data, Quantity and cost estimation of roads and culverts

EIGHTH SEMESTER

CIE 4297: SEMINAR

- ▶ Each student has to present a seminar individually, on any technical topic of current interest / latest advancement / topics not covered in the syllabus.
- ▶ The topic has to be approved by the Department and a report of the same has to be submitted a week before the day of the presentation.

CIE 4298: INDUSTRIAL TRAINING

- ▶ 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

- ▶ 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 SPECIALIZATION

I. BUILDING CONSTRUCTION AND MANAGEMENT

CIE 4001: BUILDING CODE AND REQUIREMENTS [3 0 0 3]

General building requirements, Fire and Safety: fire prevention, life safety, fire protection, Soil and foundation, Types of foundations, settlement, depth and thickness of foundation, flexible foundations, determination of modulus of elasticity of soil, Earth quake resistant of masonry wall, Lighting and ventilation, Water supply, drainage and sanitation, Plumbing system, Building Repairs and Maintenances.

References:

National Building Code of India 2005

CIE 4002: PRECAST TECHNOLOGY [3 0 0 3]

Introduction, Suitability of precast construction, Advantages and Limitations, Materials Used.

Preliminary Design Consideration, General Design Principles, Structural Integrity, Loads on Stability Elements, Connections, Force Transfer Mechanism, Earthquake Design, Modular Consideration and Standardization, Types of Frames and Components, Bearing Walls, Typical Bearing Walls, Modulation, Design for Cantilever and Shear Wall Action, Precast Floor, Precast Concrete Beams and Column, Composite reinforced Beams, Precast concrete Column, Column Design.

References:

1. Kim S. Elliott, *"Precast Concrete Structures"*, Butterworth-Heinemann, An imprint of Elsevier Science, www.bh.com, 2002.
2. *"FIP Planning and Design Handbook on Precast Building Structures"*, Published by SETO Ltd., 1994.
3. Hubert Bachmann & Alfred Steinle, *"Precast Concrete Structures"*, Published by Ernst & Sohn GmbH & Co. KG., 2011.

CIE 4003: RECENT ADVANCES IN CONCRETE TECHNOLOGY [3 0 0 3]

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 4004: RESOURCE MANAGEMENT [3 0 0 3]

Integrated material Management: Meaning, Functions, and Advantages. Selective Control, Codification and Standardization. Material planning budgeting and procuring. Price forecasting, Purchasing under uncertainties, Purchasing Capital equipment. Source selection.

Foundations of Total Quality Management: Understanding quality, TQM philosophy: Concept of Ishikawa, Taguchi, Shingo philosophies. Models and frame works. TQM Tools: An overview of Flowcharts, Check sheets, Histogram, Cause and effect diagrams, Pareto diagram, Scatter diagram and Control charts. ISO 9000 quality systems. ISO 14001 quality systems.

References:

1. GopalKrishnanan 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. Bhat Sridhara K., *"Total Quality Management"*, Himalaya Publication House, Mumbai. (2007)
5. Oakland John S *TQM, Text with cases*, Butterworth- Heinemann, Oxford.(2006)

II. ENVIRONMENTAL ENGINEERING AND HYDRAULICS & WATER RESOURCES ENGINEERING

CIE 4005: GROUND WATER ENGINEERING [3 0 0 3]

Fundamentals of Groundwater flow, Mechanics of well flow, Aquifer Parameters, Wells, Groundwater Management, Quality of Groundwater: Standards for different uses of groundwater, Dangerous effects of groundwater, Remedial measures.

References:

1. Todd D. K., *"Groundwater Engineering"*, John Wiley, New York, 1980.
2. Walton W. C., *"Groundwater Resources"*, Mc-Graw-Hill co. New York, 1970.
3. Bouwer H., *"Groundwater Hydrology"*, Mc-Graw-Hill co. New York, 1978.
4. Raghunath H. M. *"Groundwater"*, Wiley Eastern Ltd., New Delhi, 1987.
5. Karanth K. R., *"Groundwater Assessment"*, Tata Mc-Graw Hill, New Delhi, 1980.

CIE 4006: HYDROLOGICAL ANALYSIS [3 0 0 3]

Introduction, Hydrological cycle, Analysis of precipitation data, Abstractions, Runoff, Hydrographs, Unit hydrograph, S-curve, Synthetic unit hydrograph-Synder's method, Floods, Empirical methods, rational method, Envelope curves, Flood frequency methods, Flood routing.

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 publications, Delhi, 1985.
5. W. Viessman & J. Knapp *"Introduction to hydrology"*, Harper & Row publishers, 1989.

CIE 4007: HYDRAULICS & HYDRAULIC MACHINES [3 0 0 3]

Fundamentals of Open Channel Flow, Gradually Varied Flow, Rapidly Varied flow, Design of Stable Channels, Impulse Momentum Principle And Its Applications, Hydraulic turbines, hydro power plants, classification of turbines, general Principles of working of Pelton, Francis and Kaplan turbines, Hydraulic Pumps, Classification, work done and

efficiencies, pumps in series and pumps in parallel, specific speed, Reciprocating Pumps.

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 4008: INDUSTRIAL WASTE TREATMENT [3 0 0 3]

Introduction, cleaner production, Waste management Approach, Waste Audit, Streeter Phelp Equation, self - purifying capacity of river, DO sag curve, Pollution from major industries, Textiles, Tanneries, Electroplating industries, Dairy, Sugar, Paper, distilleries, Fishery Industry, Refineries, thermal power plants, Treatment Technologies, Aerobic and anaerobic processes, Hazardous Waste Management, Hazardous wastes, Characteristics, Physico chemical treatment, solidification, incineration.

References:

1. Nelson Nemeru, *"Industrial waste water Management"*.
2. A. D. Patwardhan, *"Industrial Waste treatment"*.
3. S C Bhatia, *"Environmental Pollution control in chemical process industries"*, Khanna Publishers.
4. Mahajan, *"Pollution control in process industries"*.
5. M. N. Rao & A. K. Dutta, *"Wastewater Treatment"*, Oxford - IBH Publication, 1995.

III. GEOTECHNICAL ENGINEERING & TRANSPORTATION ENGINEERING

CIE 4009: 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, Retaining walls- cantilever, counterfort and soil reinforced retaining walls, Soil nailing, Well Foundation-Bearing capacity, Lateral stability - Terzaghi's method and IRC method, Foundations in expansive soils, Cofferdams, Machine Foundations.

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"*, VanNostand Reinhold Company, New York, 1991.
3. Teng W. C., *"Foundation Design, Prentice Hall of India"*, New Delhi, 1981.

- Swami Saran, *“Design of Substructures”*, Oxford and IBH Publishers.
- Srinivasalu P and Vaidyanathan C. V., *“Hand Book of Machine Foundations”*, Tata McGraw Hill, 1987.

CIE 4010: GROUND IMPROVEMENT TECHNIQUES [3 0 0 3]

Introduction, Mechanical modification, Hydraulic modification, Physical and chemical modification, Thermal modification, Modification by inclusions, Case studies of ground improvement projects in India.

References:

- Koerner R. M., *“Construction and Geotechnical methods in Foundation Engineering”*, McGraw Hill, 1994.
- M. R. Hausmann, *“Engineering Principles of Ground Modifications”*, McGraw Hill Publishing Co., 1990.
- Alam Singh, *“International Overviews Current Practices in Geotechnical Engineering”*, IBT Publishers and Distributors, New Delhi, 1988.
- Kuberan R., Nakul Dev and Govindan K. K., *“Geotechnical Engineering, Indian Experiences, A Compilation of IGS Annual Lectures- 1978 - 1992”*, Edition Indian Geotechnical Society.
- Purushotham Raj, *“Ground Improvement Techniques”*, Laxmi Publications, New Delhi.

CIE 4011: PAVEMENT MATERIALS AND DESIGN [3 0 0 3]

Introduction, Types, Design wheel load, Soil classification, Design of Flexible pavement, IRC and AASHTO methods, Bituminous Materials, Design of Rigid pavement, Design of cement concrete mixes, Soil Stabilisation Roads, Mechanical Stabilisation, Combining material to obtain required gradation, Soil-Lime, Lime-Cement-Soil, Soil-Cement and Soil Bitumen stabilization. Design of Runway Pavement, Pavement Failure and Evaluation, Structural evaluation of Flexible and rigid pavement.

References:

- Khanna S.K and Justo C.E.G., *“Highway Engineering”*, (8e), Nemchand and Bros., Roorkee, 2001.
- Dr Kadiyali L.R and Dr Lal N.B, *“Principles and Practices of Highway Engineering”*, (4e), Khanna Publisher, New Delhi, 2003.
- E.J. Yoder, *“Principles of Pavement Design”*, (2e), John Wiley & Sons, Inc. New York, 1975.
- Yang H. Huang, *“Pavement Analysis and Design”*, Prentice Hall, 2003.

CIE 4012: SOIL REINFORCEMENT AND GEOSYNTHETICS [3 0 0 3]

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.

References:

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

IV. STRUCTURAL ENGINEERING

CIE 4013: ADVANCED DESIGN OF STEEL STRUCTURES [3 0 0 3]

Introduction, Unsymmetrical bending, Design of welded plate girders, Design of Gantry Girders, Compression member: Design of compression member subjected combined axial & uniaxial bending, combined axial & biaxial bending, Eccentric and Moment connections, Composite beams and columns, Light gauge steel members

References:

- Subramanian N., *“Design of Steel Structures”*, Oxford University press, New Delhi.
- Duggal S. K., *“Limit State method of design of steel structures”*, Tata McGraw-Hill, New Delhi, 2010.
- Martin L. H and Purkiss J. A., *“Structural Design of Steelworks to BS 5950”*, Edward Arnold, London, 1992.
- Bhavikatti S. S., *“Design of Steel structures”*, I.K. International Publishing House, New Delhi, 2010.

Code books:

- IS 800-2007: *General construction in steel-Code of practice* (third revision), Bureau of Indian Standards, New Delhi.
- IS 875-1987 (Part III): *Code of practice for design loads (other than earthquake) for building structures*, Bureau of Indian Standards, New Delhi.
- BS 5950 (part I) 1985: *Structural use of steelwork in buildings*, British Standards Institution, London.
- SP 6: Part1-1964: *Hand book for Structural Engineers*, Bureau of Indian Standards, New Delhi.
- SP 6 : Part 5 : 1980 *Handbook for structural engineers - Cold-formed, light gauge steel structures*, Bureau of Indian Standards, New Delhi
- IS 801: 1975 *Code of practice for use of cold formed light gauge steel structural members in general building construction*, Bureau of Indian Standards, New Delhi
- IS 811: 1987 *Cold formed light gauge structural steel sections*, Bureau of Indian Standards, New Delhi

CIE 4014: ADVANCED REINFORCED CONCRETE DESIGN [3 0 0 3]

Flat slabs, Retaining walls, Design of grid floors and portal frame, Water Tanks: Design of water tanks as per IS 3370 code, Rectangular and circular tanks resting on ground, Overhead tanks - Intze type with supporting structures, Silos and Bunkers, Shells and Folded plates

References:

1. Krishnaraju N, "Advanced Reinforced Concrete Design", CBI Publishers, New Delhi, 2004.
2. Punmia B. C, "Reinforced Concrete Structures", (8e), Lakshmi Publications Pvt. Ltd., New Delhi, 1992.
3. Verghese P. C., "Advanced Reinforced Concrete", Prentice HI New Delhi, 2005.
4. Unnikrishna Pillai., Devadas Menon., "Reinforced concrete Design", Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Code books:

1. IS:456 2000, "Code of practice for plain and Reinforced concrete", Bureau of Indian Standards, New Delhi.
2. SP-16 1984, "Design Aids for Reinforced concrete IS 456", Bureau of Indian Standards, New Delhi.
3. IS: 3370-Part II & Part IV, "Code of practice for Concrete Structures for The Storage of Liquids", Bureau of Indian Standards, New Delhi.

CIE 4015: FINITE ELEMENT METHOD OF ANALYSIS [3 0 0 3]

Brief general description of the method, theory of elasticity, Concept of an element, displacement models, Variational method of formulation, Application of Finite element method to pin jointed and rigid jointed structures, Application to plane stress and plane strain problems.

References:

1. Zinkiewicz 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", 1st Indian Edition, 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 4016: PRESTRESSED CONCRETE DESIGN [3 0 0 3]

Basic Concepts of Prestressing, Basic principles of prestressing, Losses of prestress, Analysis of sections for flexure, Camber and deflections, Limit state of collapse and serviceability, Transmission of pre-stress in pre-tensioned members, Design of pre-tensioned and post-tensioned.

References:

1. Krishna Raju N., "Pre-stressed Concrete", Tata McGraw Hill, New Delhi.
2. Dayaratnam P., "Pre-stressed Concrete Structures", Oxford and IBH Publications, New Delhi.

3. Mallick S. K. and Gupta A. P., "Pre-stressed Concrete", 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.

Code books:

1. IS:1343-1980, "Code of Practice For Prestressed concrete", Bureau of Indian Standards, New Delhi, 1981.

V. BUSINESS MANAGEMENT

HUM 4011: FINANCIAL MANAGEMENT [2 1 0 3]

Introduction to financial management, Principle of accountancy, Sources of long term finance, Valuation of securities, Leverages, Working capital management, Capital budgeting, Cost of capital, Cash management, and Dividend decisions.

References:

1. Prasanna Chandra, "Fundamentals of Financial Management", Tata McGraw Hill, Delhi, 2006.
2. IM Pandey, "Financial Management", Vikas Publishing house, Delhi, 2007.
3. Subir Kumar Banerjee, "Financial Management", Sultan Chand & Co., Delhi, 1999.
4. ICFAI, "Corporate Financial Management", ICFAI, Hyderabad, 2003.
5. Maheshwari S. N., "Financial Management", Sultan Chand & Co., Delhi, 2002.

HUM 4012: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

Evolution and development, HRD Organization and responsibilities. Evolution of HRM, Theories of HRM. Human resource planning, Human Resources Inventory, Forecast, Job analysis, Job description, Job specification, Job evaluation, Employment stability. Human Resource Planning and Recruiting, Induction, & socialization, Training and development, Performance management and appraisal.

References:

1. T.V. Rao and Pereira D.F., "Recent experiences in Human Resources Development", Oxford and IBH Publishing, 1986.
2. Subbrao A., "Essentials of Human Resource Management and industrial Relations", Himalaya Publishing House, 1999.
3. N G Nair and Latha Nair, "Personnel Management and Industrial Relations", S. Chand Company, 1995.
4. Virmani B R; Rao Kala, "Economic restructuring technology transfer and human resource development", Response books, 1997.
5. Pareek Udai et al., "Human Resource Development in Asia: Trends and Challenges", Oxford and IBH Publishing, 2002.

HUM 4013: MARKETING MANAGEMENT [2 1 0 3]

Understanding marketing management, Assessing market opportunities and customer value, Adapting marketing to the New Economy, Building Customer Satisfaction, Value, and Retention, Market Demand, Scanning the Marketing Environment, Consumer Markets, Business Markets, Dealing with the Competition, Market Segments, Product Life Cycle, New Market Offerings, Designing and Managing Services, Price Strategies, Retailing, Wholesaling, Integrated Marketing Communications.

References:

1. Philip Kotler, *"Marketing Management Analysis, Planning, Implementation and Control"*, Prentice Hall of India Private Limited, New Delhi, 2000.
2. ICFAI, *"Marketing Management"*, ICFAI, Hyderabad, 2003.
3. Varshney R.L. and Gupta S.L., *"Marketing Management"*, Sultan Chand & Sons, New Delhi, 2004.
4. Adrian Palmer, *"Principles of Marketing"*, Oxford University Press, New York, 2000.

HUM 4014: OPERATIONS AND SYSTEMS MANAGEMENT [2 1 0 3]

Types of production activities, Production consumption cycle, Functions of production and operations management, Importance and uses of forecasting, Product development and design: Product life cycle, Process design, Process charts, Flow diagrams and Man machine charts, Capacity planning, Aggregate planning, Scheduling, Operations strategy, Operation performance Frontier and productivity, Systems thinking, Systems engineering and its management, Systems decision process. Systems thinking, structure, classification, boundaries, visibility, System life cycle models, System dynamics and its importance in system thinking. System dynamics modeling process.

References:

1. Monks Joseph G., *"Operations Management"*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2004.
2. Krajewski Lee J. and Ritzman Larry P., *"Operations Management"*, Pearson Education (Singapore) Pte. Ltd., Delhi, 2005.
3. Mieghem J., *"Operations Strategy: Principles and Practices, Dynamic Ideas"*, ISBN: 0-9759146-6-9, 2008.
4. Stermann J.D., *"Business Dynamics - Systems Thinking and Modeling for A Complex World"*, McGraw Hill, International Edition, 2004.
5. Senge Peter, *"The Fifth Discipline"*, Currency Doubleday, New York, 1990.

OTHER PROGRAM ELECTIVES

CIE 4017: AIR POLLUTION AND CONTROL [3 0 0 3]

Air pollution, Meteorology variables, primary and secondary pollutants, Effects of air pollution on - human health, animals, plants and materials, Industrial plant location and planning, Ambient and stack sampling, Air

pollution control devices, Global effects of air pollution - Acid rain, Green house effect, Ozone layer depletion, Air quality and emission standards, Air pollution index, Air pollution act.

References:

1. Rao C. S., *"Environmental Pollution control"*, Wiley Eastern Ltd. Delhi, 1995.
2. Rao H.V.N. and Rao M.N., *"Air pollution"*, Tata McGraw Hill, New Delhi, 1989.
3. *"Air Pollution - Sampling and Analysis"*, APHA.

CIE 4018: APPLIED GEOLOGY [3 0 0 3]

Introduction, interior of the earth, geological processes, geological hazards, natural resources, minerals, rocks, water, soil, engineering properties of rocks, structural geology, stratigraphy, hydrogeology, artificial recharge structures, rain water harvesting, ground water exploration, geophysical exploration, remote sensing and GIS applications, economic geology, process of formation of mineral deposits, ore genesis, ore dressing, Indian mineral deposits, environmental geology, application of geology in Civil Engineering projects like Dams, tunnels, bridges etc.

References:

1. Blyth, F. G. H & De Freitas M. H., *"Engineering Geology"*, (7e), ELBS, 1984.
2. Robert F. Legget, *"Geology and Engineering"*, McGraw Hill.

CIE 4019: BRIDGE ENGINEERING [3 0 0 3]

Investigation for bridge, Site selection, data drawing, design discharge linear water way, Standard specification for Road Bridge, IRC Bridge code, Culverts, Concrete Bridges, Types, components, Tbeam reinforced concrete bridges, Pre-stressed concrete bridges, Continuous bridges, cantilever bridges, Sub structure, Piers and Abutments, Caissons, scour, bridge bearings, wing walls, Liquefaction assessment of bridge site.

References:

1. T R Jagadeesh, M A Jayaram, *"Design of Bridge Structures"*, PHI Learning Private Limited, 2009.
2. Ponnusamy S., *"Bridge Engineering"*, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Whitney, C. S., *"Bridges"*, Greenwich House, 1983.
4. N. K. Raju, *"Design of bridges"*, Oxford & IBH Publishing Co. Pvt. Ltd.
5. *Indian Road Congress Codes No. 5, 6, 18, 21, 24*, Jamnagar House, Shah Jahan Road, New Delhi.

CIE 4020: COASTAL ENGINEERING [3 0 0 3]

Coastal process, Origin of coasts, wind, waves, Coastal erosion and Coastal protection work erosion, littoral drift, Sea walls and bulkheads, Groins, Jetties, off-shore breakwaters, artificial beach nourishment, Environmental impact assessment, Port Planning, Harbour structures: Berthing structures, Breakwaters: types.

References:

1. S. Narasimhan, S. Kathirolu, Nagendra Kumar B., Editors, *“Harbour and coastal Engineering, Volume I & II”*, National Institute of Ocean Technology, NIOT, Chennai, Ocean and Coastal Engineering Publications, 2002.
2. Coastal Structures, *“Proceedings of short term course”*, Department of Ocean Engineering, I.I.T. Madras, Chennai, India, 2002.
3. *“Coastal Erosion Areas Protection and Management”*, Proceedings of short term course by the Dept. of Applied Mechanics and Hydraulics, N.I.T.K. Surathkal, India, 2003.
4. *“Coastal Engineering Manual”*, (CEM), U. S. Army Corps of Engineer, Vicksburg, Miss., 2006.
5. Brunn P., *“Port Engineering”*, Gulf publishing Company, 1981.

CIE 4021: ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING [3 0 0 3]

Environmental Impact Assessment, Impact identification, Prediction and assessment of impacts on air, surface water, soil, noise, biological, cultural and socio-economic environment, Public participation in environmental decision making, Environmental monitoring and its importance, EIA case study on a developmental project / activity, Environmental audit - meaning, benefits, procedure and case studies.

References:

1. Laury W. Canter, *“Environmental Impact Assessment”*, McGraw Hill International editions, New York, 1996.
2. CIRIA special publication 96, *“Construction Industry”*, Research and Information Association.
3. Mhaskar. A. K, *“Environmental Audit”*, Media Enviro, Pune.

CIE 4022: GEOENVIRONMENTAL ENGINEERING [3 0 0 3]

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.

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 4023: NON DESTRUCTIVE TESTING OF MATERIALS [3 0 0 3]

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, Visual Inspection Technique, Half-Cell Electrical Potential Method, Schmidt Rebound Hammer Test, Carbonation Depth Measurement Test, Penetration Resistance or Windsor Probe Test: - Resistivity Measurement, Electromagnetic Methods of Testing Concrete, Radiographic Testing, Ultrasonic Testing, Ground Penetrating Radar.

References:

1. J .H. Bungey, *“The Testing of Concrete in Structures”*, Surry University Press.
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, Woodhead Publishing Limited.
4. V. M. Malhotra and N. J. Carino, *“Handbook On Nondestructive Testing of Concrete”*, Second Edition, CRC Press.

CIE 4024: REMOTE SENSING AND GIS [3 0 0 3]

Introduction, Basic concepts of Remote sensing, Physics of Remote sensing Orbits, Concept of Spatial, spectral, radiometric and temporal resolution, Remote sensing data product and its purchase, Visual interpretation, 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), Indian satellite program, Launch vehicles, Exercise on Remote sensing and GIS application

References:

1. Lillesand T. M., and Kiefer, R. W., *“Remote Sensing and Image interpretation”*, (6e), 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.

CIE 4025: SOLID WASTE MANAGEMENT [3 0 0 3]

Introduction, Municipal, industrial, special and hazardous wastes, General Aspects, Engineered Systems, Processing Techniques, Material Recovery: Mechanical size alteration, Electromagnetic separation, Drying and dewatering, Hazardous Wastes, Hazardous Solid Waste Management, Case Studies: Major industries and management methods used in typical industries

References:

1. Arcadio Sincero and Gregoria Sincero, *“Environmental Engineering”*, (2e), Prentice - Hall India.
2. George Tchobanoglous, *“Integrated Solid Waste Management : Engineering Principles and Management Issues”*, McGraw-Hill Publication.
3. M La Grega and others, *“Hazardous Waste Management”*, McGraw Hill Publication.

CIE 4026: TRAFFIC SYSTEMS AND ENGINEERING [3 0 0 3]

Traffic Engineering Studies, Speed and Delay study, Traffic volume study, Origin-Destination study, Capacity study, Traffic Congestion study, Traffic Flow Analysis, Design of Traffic Facilities, Grade separated intersection, Rotary, Design of Parking Facilities, Design of Cycling Tracks, Bus Stop Location and Bus Bay Design, Road Accidents Analysis, Design of Traffic Control System, Design of Road Lighting System, Laws of Illumination, Light at Intersections, Rotaries, Bridges and in Tunnels.

References:

1. Papacostas C S., *“Fundamentals of Traffic Engineering”*, Prentice Hall, 1990.
2. Jotinkhistry C and Lall, *“Transportation Engineering”*, Prentice Hall, 2000.
3. McShane W R & Roess R P, *“Traffic Engineering”*, Prentice-Hall, NJ, 2010.
4. L. R. Kadiyali, *“Traffic Engineering and Transport Planning”*, Khanna Publishers.
5. Khanna S K and Justo C E G, *“Highway Engineering”*, NemChand and Bros.

CIE 4027: URBAN MASS TRANSPORTATION SYSTEM [3 0 0 3]

Introduction, Transit, Mass transportation characteristics, Public Transport, travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, Transit Network Planning, transit lines types, geometry and characteristics, Transit Scheduling, marginal ridership, crew scheduling, Terminals and Depot.

References:

1. Kristhi, Lal, *“Transportation Engineering”*, PHI, Delhi, 2008.
2. Hay, W. W., *“An Introduction to Transportation Engineering”*, (2e), John Wiley & Sons, 2001.
3. Dickey, J. W., et. al., *“Metropolitan Transportation Planning”*, TMH edition, 2002.
4. Railis, V. R., *“Inter-city Transport, Engineering and Planning”*, The Macmillan Press, 2003.
5. Vuchic V. R., *“Urban Public Transportation System and Technology”*, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1981.

CIE 4028: URBAN TRANSPORTATION PLANNING [3 0 0 3]

Transportation Planning Process and Surveys, Trip Generation, Trip Distribution, O-D Matrix, Growth Factor, Gravity model, Tanner model, Intervening and Competing opportunities models, Traffic Assignment, All or nothing Assignment, Multiple Route Assignment, Capacity Restraint Assignment, Diversion Curves, Modal Split, Probit and Logit Analysis, Land-use Transport Models, Lowry Derivative Models, Garin-Lowry Model.

References:

1. Kadiyali L. R., *“Traffic Engineering and Transportation Planning”*, (6e), Khanna Publisher, New Delhi.
2. Jotinkhistry C and Kent Lal B, *“Transportation Engineering-An Introduction”*, PHI, New Delhi.
3. Papacostas C S., *“Fundamentals of Traffic Engineering”*, Prentice Hall.
4. M. J. Bruton, *“Introduction to Transportation Planning”*, Hutchinson of London Ltd.
4. B. G. Hutchinson, *“Introduction to Urban System Planning”*, McGraw Hill.

OPEN ELECTIVES**CIE 3281: ENVIRONMENTAL MANAGEMENT [3 0 0 3]**

Environment Management and Sustainable, Environmental Policies, Environmental Protection, EIA (Environmental Impact Assessment), Environmental Audit, Life cycle assessment (LCA) and environmental design (ED), Environmental management system and Techniques, Environmental Safety and ISO 14000 series of standards, Total quality Management (TQM) and Total safety Management (TSM), ISO 9000, and 18000 series of standards.

References:

1. Lohani B. N., *“Environmental Quality Management”*, South Asian Publishers, New Delhi, 1984.
2. MOEF, *“Government of India, Carrying Capacity Based Developmental Planning Studies for the National Capital Region”*, 1995-96.
3. Chanlett, *“Environmental Protection”*, McGraw Hill Publication, New York, 1973.
4. *“Environmental Laws”*, MOEF, Government of India.

CIE 3282: INTRODUCTION TO REMOTE SENSING AND GIS [3 0 0 3]

Introduction, Basic concepts of Remote sensing, Physics of Remote sensing Orbits, Concept of Spatial, spectral, radiometric and temporal resolution, Remote sensing data product and its purchase, Visual interpretation, 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), Indian satellite

program, Launch vehicles, Exercise on Remote sensing and GIS application

References:

1. Lillesand T. M., and Kiefer R. W., "*Remote Sensing and Image interpretation*", VI edition 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.

CIE 3283: STRENGTH OF MATERIALS [3 0 0 3]

Review of Basic Mechanics of Solids, Stresses due to bending, Stresses due to shearing force, Slope and deflection of beams, Torsion, solid and hollow circular shafts, power transmitted by shafts, stepped shafts, Variation of stress at a point, Bi-axial state of stress and strain, Cylinders, Stability of columns, Slenderness ratio, failure by buckling, Euler's formula, Rankine's empirical formula.

References:

1. E. P. Popov, "*Mechanics of Materials*", S.I. Version, PHI, 1993.
2. Pytel and Singer, "*Strength of Materials*", Harper & Collins, 1987.
3. Rajput R. K., "*Strength of Materials*", S Chand & Co., 2004.
4. Bhavikatti S. S., "*Strength of Materials*", Vikas Publishers, 2005.

