

# Course Syllabi

## Department of Civil Engineering

### CEL201 STRENGTH OF MATERIALS (3-2/2-2/2-8)

#### Contents:

Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Bending moment and shear force diagrams for beams. Simple bending theory, flexure and shear stresses, unsymmetrical bending, shear center. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

#### Text Books:

1. Gere, J.M. and Timoshenko, S.P., Mechanics of Materials, 3<sup>rd</sup> ed., CBS Publishers and Distributors Pvt. Ltd., 2012.
2. Beer, F.P., Johnston, E.R., Dewolf, J.T. and Mazurek, D.F., Mechanics of Materials, 5<sup>th</sup> ed., Tata McGraw Hill, 2011.

#### Reference Books:

1. Shames, I.H., Introduction to Solid Mechanics, 3<sup>rd</sup> Ed., Prentice Hall India, 2006.
2. Popov, E.P., Engineering Mechanics of Solids, 2<sup>nd</sup> Ed., Prentice Hall India, 2012.

### CEL202 FLUID MECHANICS AND HYDRAULICS (3-2/2-2/2-8)

#### Contents:

Properties of fluids, Hydrostatic forces on submerged bodies, Fundamentals of fluid flow, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Types of open channels, Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles, and specific speed of pumps and turbines.

#### Text Books:

1. Som, S.K. and Biswas, G., Fluid Mechanics and Fluid Mechanics, Tata McGraw Hill, 2013.
2. Subramanya, K., Flow in Open Channels, Tata McGraw Hill, 2008.

#### Reference Books:

1. Fox, R.W. and McDonald, A.T., Introduction to Fluid Mechanics, John Wiley and Sons, 2013.
2. Garde, R.J. and Mirajgaoker, A.G., Engineering Fluid Mechanics, Nem Chand and Bros, 2002.
3. Srivastava, R., Flow through Open Channels, Oxford University Press, 2010.

### CEL203 ENGINEERING GEOLOGY (2-0-2-6)

#### Contents:

Introduction: Earth and its interior, role of engineering geology in planning, Design construction and post construction aspects of river valley projects and other civil engineering objects. Minerals and Rocks: Essential rock forming minerals, identification of common minerals in hand specimen. Types of rocks, texture and structures, importance in planning for construction in hills.

Geological structures: Strike and dip of beds, Description and types of folds, joints, faults and shear zones as well as their importance in planning for civil structures. Weathering and soil formation: Types and agents of weathering – Mechanical and chemical weathering, impact of weathering on strength of slope materials, different soil types, soil map in India. Geological hazards: Earthquake and Landslides. River Valley Projects: Engineering geological considerations in river valley projects. Small hydro-electric projects.

Roads and bridges in hills: Engineering geological investigations in selection of hill roads alignments, stability of cuts slopes, types of bridges, slope stability of abutment foundation.

#### Text Books:

1. Bell, F. G., Fundamentals of Engineering Geology, Elsevier, 2007.
2. Waltham, T., Foundations of Engineering Geology, Spon Press, 2009.

#### Reference Books:

1. Anbalagam, R., Singh B., Chakarborthy, D. and Kohli, A., A Field Manual for Landslide Investigation, DST, Government of India, New Delhi.
2. Singh, P., Engineering and General Geology, S.K. Kataria and Sons, 2012.
3. Krynine, D.P. and Judd, W.R., Principles of Engineering Geology and Geotechnics, Tata McGraw Hill, 2001.

### CEL204 BUILDING MATERIALS AND CONSTRUCTION TECHNOLOGY (3-0-2-8)

#### Contents:

Properties of construction materials and their evaluation (creep, elastic modulus, fatigue, impact, etc.); test methods and specifications; Cement – chemical composition, properties such as setting, strength, fineness, hydration; Aggregates – sources, properties, chemical reactivity; Concrete – constituents, proportioning, properties in fresh and hardened state, characteristic strength, quality control (sampling, acceptance, etc.), transportation and placing, porosity; Admixtures – chemical, mineral; Basics of concrete mix design. Steel – properties, types of steel, steel in civil engineering; Bricks – manufacture, properties and classification; masonry bonds; Bitumen – source, composition, characterization, various forms, tests on bitumen; Bituminous mix design; Brick masonry; bonds, stone masonry, types of walls, plastering and pointing. Types of roofs, floors and foundations, damp proofing. Doors and windows, stairs, staircases, lifts and escalators. White washing, colour washing, painting, and distempering. Shuttering, Scaffolding and Centering. Expansion and construction joints, sound and fire proof construction, principles of building drawing; preparation of working drawings including reinforcement scheduling in RCC construction.

#### Text Books:

1. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, 2013.
2. Kumar, S., Building Construction, Standard Publishers, 2010.

#### Reference Books:

1. Neville, A.M. and Brooks, J.J., Concrete Technology, ELBS Ed., Longman Ltd., 2013.
2. Taylor, G.D., Materials of Construction, Prentice Hall, 2012.
3. Dayaratnam, P., Brick and Reinforced Brick Structures, Oxford and IBH Publication, 2012
4. Khanna, P.N., Indian Practical Civil Engineering Handbook, Engineers Publishers, 1988.

### CEL205 ENVIRONMENTAL ENGINEERING (3-0-2-8)

#### Contents:

Water supply: Sources, Water demand and forecasting. Quality of water, water borne diseases, standards, water quality index. Unit Processes: Systems and unit processes of water purification. Water distribution networks. Wastewater Engineering: Sewage treatment and sewerage system, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge treatment and disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater.

#### Text Books:

1. Hammer, M.J. and Hammer, M.J., Water and Wastewater Technology, 4<sup>th</sup> ed., Prentice Hall of India, 2008.
2. McGhee, T.J., Water Supply and Sewerage, McGraw Hill, 1991.

#### Reference Books:

1. Davis, M.L. and Cornwell, D.A., Introduction to Environmental Engineering, McGraw Hill, 2012.
2. Peavy, H.S., Rowe, D.R. and Tehobanoglous, G., Environmental Engineering, McGraw Hill, 1985.
3. Kenneth, W., Warner, F.C. and Davis, W.T., Air Pollution its Origin and Control, Prentice Hall, 1997.
4. Mishra, P.C., Fundamental of Air and Water Pollution, South Asia Books, 1990.
5. Masters, G. Introduction to Environmental Engineering and Science. Prentice Hall, 2004.

### CEL206 TRANSPORTATION ENGINEERING (3-0-2-8)

#### Contents:

Historical Development, road patterns, master plans, road development plans, engineering survey for highway projects. Testing of road materials like soil, aggregates and bitumen. Highway Cross section elements, camber, super elevation, sight distances, horizontal and vertical alignment, summit and valley curves. Flexible pavements and their design, review of old methods, CBR method, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method. Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements, Hot Mix Plants, Construction of Rigid Pavements. Traffic characteristics, road user and vehicular characteristics, traffic studies, road traffic safety, traffic operations, traffic control devices, intelligent transport systems, pollution due to traffic.

**Text Books:**

1. Khanna, S.K. and Justo, C.E.G., Highway Engineering, Nem Chand and Bros, 2011.
2. Kadiyali, L.R., Traffic Engineering and Transportation Planning, Khanna Publishers, 2012.

**Reference Books:**

1. Sharma, S.K., Principles and Design of Highway Engineering, S. Chand and Co., 2012.
2. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall, 2008.
3. JotinKhisty, C. and Kent Lall, B., Transportation Engineering: An Introduction, Prentice Hall, 2008.
4. Khanna, S.K. and Justo, C.E.G., Highway Material Pavement Testing Manual, Nem Chand and Bros., 2013.
5. Roess, R.P., Prassas, E.S. and McShane, W.R., Traffic Engineering, Pearson, 2013.

**CEL207 SURVEYING (3-0-2-8)****Contents:**

Importance of Surveying to engineering projects, basic principles; Type of maps, scales and uses, Plotting accuracy, map sheet numbering, Coordinate and map projection; Surveying equipment: levels, compass, theodolites, tachometer, EDM, Total Stations and other instruments; Measurement of angles, directions and distance; Determination of elevation: Spirit leveling, trigonometrical leveling, and tachometric surveying, Contouring; Methods of control establishment; Traversing, triangulation, trilateration; Adjustment of survey measurements, computation of coordinates; Plane table surveys and mapping; Curve layout, Horizontal, transition and vertical curves.

**Text Books:**

1. Arora, K.R., Surveying, Vols. I, II and III, Standard Book House, 2013.
2. Chandra, A.M., Surveying, New Age International Publishers, 2010.

**Reference Books:**

1. Anderson, J.M. and Mikhail, E.M., Surveying: Theory and Practice, McGraw Hill, 1988.
2. Schofield, W. and Breach M., Engineering Surveying, 6th ed., Butterworth-Heinemann, 2007..

**CEL301 STRUCTURAL ANALYSIS – I****(3-2/2-2/2-8)**

Pre-requisite: CEL201

**Contents:**

Introduction to structures, loading and modeling. Internal forces in statically determinate structures – trusses, beams, frames, arches. Deflection of statically determinate structures moment area method, conjugate beam method, unit load method. Strain energy method for slopes and deflections. virtual work method. Static and Kinematic indeterminacy of structures. Castigliano's theorems, theory of least work.

**Text Books:**

1. Hibbeler, R.C., Structural Analysis, Pearson Press, 2013.
2. Reddy, C.S., Basic Structural Analysis, Tata McGraw Hill, 2012.

**Reference Books:**

1. William, F. R. et al., Mechanics of Materials, John Wiley and Sons. 2006.
2. Norris, C. H., Wilbur, J. B. and Utku, S., Elementary Structural Analysis, Tata McGraw Hill. 1991.
3. West, H.H., Analysis of Structures, John Wiley and Sons, 2002.
4. Wang, C.K., Intermediate structural Analysis Structures, Tata McGraw Hill, 2010.

**CEL307 DESIGN OF RCC STRUCTURES****(3-2/2-2/2-8)**

Pre-requisite: CEL201, CEL301, CEL305

**Contents:**

Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, working stress design for common flexural members. Design of R.C. beam Sections in flexure, shear, torsion and bond by limit state design; Design for serviceability; Design of one way and two way R.C. Slabs; Design of R.C. short and long columns; Design of R.C. footings. Basic elements of prestressed concrete.

**Text Books:**

1. Pillai, S.U. and Menon, D., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Jain, A.K., "Reinforced Concrete" Nem Chand and Bros, 2012.

**Reference Books:**

1. Sinha, S.N., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Gambhir, M.L., Fundamentals of Reinforced Concrete Design, Prentice Hall of India, 2012.
3. Shah, V.L. et. al., Limit State Theory and Design of Reinforced Concrete, Structures Publications, 2007.

4. Varghese, P.C., Limit State Design of Reinforced Concrete, Prentice-Hall, 2011.

5. Park, R. and Pauley, T., Reinforced Concrete Structures, John Wiley and Sons, 2010.

**CEL308 DESIGN OF STEEL STRUCTURES****(3-2/2-2/2-8)**

Pre-requisite: CEL201, CEL301, CEL305

**Contents:**

Introduction, properties of structural steel, I.S. rolled sections, I.S. specifications. Design approach, elastic method, limit state design. Connections, simple and moment resistant riveted, bolted and welded connections. Tension members. Compression members, struts and columns. Roof trusses, roof and side coverings, design loads, purlins, members, end bearings. Built-up columns, beams, stability of flange and web, built-up sections. Plate-girders including stiffeners, splices and curtailment of flange plates. Beam column, stability consideration, interaction formulae, column bases, slab base, gusseted base and grillage footings.

**Text Books:**

1. Subramanian, N. Design of Steel Structures, Oxford University Press, 2012.
2. Duggal, S.K., Design of Steel Structures, Tata McGraw-Hill, 2012.

**Reference Books:**

1. Arya, A.S. and Ajmani, J.L., Design of Steel Structures, Nem Chand and Bros, 2007.
2. Bhavikatti, S. S., Design of Steel Structures by Limit State Method as Per IS: 800—2007, IK International, 2012.

**CEL401 GROUND IMPROVEMENT****TECHNIQUES (3-0-0-6)**

Pre-requisite: CEL302

**Contents:**

Role of ground improvement in foundation engineering- methods of ground improvement-Geotechnical problems in alluvial, lateritic and black cotton soils -Selection of suitable ground improvement techniques based on soil condition. Drainage techniques - Well points - Vacuum and electro-osmotic methods - Seepage analysis for two dimensional flow-fully and partially penetrating slots in homogenous deposits (Simple cases only). In-situ densification of cohesionless and consolidation of cohesive soils -Dynamic compaction and consolidation - Vibrofloatation - Sand pile compaction - Preloading with sand drains and fabric drains – Stone columns – Lime piles- Installation techniques only - relative merits of various methods and their limitations. Concept of reinforcement - Types of reinforcement material - Applications of reinforced earth – use of GeoTextiles for filtration, drainage and separation in road and other works. Types of grouts - Grouting equipment and machinery - Injection methods - Grout monitoring – Stabilisation with cement, lime and chemicals - Stabilisation of expansive soils.

**Text Books:**

1. Moseley, M.P., Ground Improvement Blockie Academic and Professional, Chapman and Hall, Glasgow, 1993.
2. Jones J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1995.

**Reference Books:**

1. Koerner, R.M., Design with Geosynthetics, 3rd ed. Prentice Hall, New Jersey, 2002.
2. Jewell, R.A., Soil Reinforcement with GeoTextiles, CIRIA special publication, London, 1996.
3. Das, B.M., Principles of Foundation Engineering, Thomson Books/Cole, 2003.

**CEL402 TRANSPORTATION ENGINEERING-****II (3-0-0-6)****Contents:**

History of Indian Railways, universal scenario and Indian railways, railway track development, component parts, gauge, wheel and axle arrangement. Various resistances and their evaluation, hauling capacity, tractive effort, locomotives and their classification, stresses in the track and its components. Rails and their requirements, creep and wear in rails, rail joints, long welding rails and short welded rails, types of sleepers and their merits and demerits, requirements of ballast, design of ballast section, track fastenings, check rails and guard rails, railway cross-section, various types of gradients, design of horizontal curves, transition curves and vertical curves, existing provisions on IR. Working and design of a turnout, types of track junctions, design of crossover and diamond crossing, types of signals and their functions, interlocking, advanced methods of train control. High speed rails. Scenario of air transport in India, national and international agencies, aircraft characteristics, site selection, airport obstructions, imaginary surfaces. Runway orientation, geometric design of runway, taxiway, exit taxiway, apron, holding apron, runway configuration, visual aids.

**Text Books:**

1. Chandra, S. and Agarwal, M.M., Railway Engineering, Oxford University Press, New Delhi, 2013.
2. Arora, S. P. and Saxena, S.C, A Text book on Railway Engineering, Dhanpat Rai Publications Pvt. Ltd., New Delhi, 2006.
3. Saxena, S. C., Airport Engineering: Planning and Design, CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2008.

**Reference Books:**

1. Mundrey, J. S., Railway Track Engineering, Tata McGraw Hill Publishing, 2009.
2. Khanna, S. K., Arora, S. P. and Jain, S. S., Airport Planning and Design, Nem Chand and Bros, Roorkee, 1999.

**CEL403 DESIGN OF HYDRAULIC STRUCTURES (3-0-0-6)****Contents:**

Canal layout, regime Canal design, design concepts for irrigation structures on permeable foundations, Canal control structures; Canal Falls, Canal regulators, Canal outlets, Canal Escapes, energy dissipation devices, design of diversion works, cross drainage works, Canal falls.

**Text Books:**

1. Asawa, G. L., Irrigation and Water Resources Engineering, New Age International Publishers, 2013.
2. Varshney, R. S., Gupta S.C. and Gupta R.L., Theory and Design of Irrigation Structures, Vol. I and II, Nem Chand and Bros. 2007.

**Reference Books:**

1. Modi, P.N., Introduction to Water Resources and Waterpower Engineering, Standard Publication, Delhi, 2013.
2. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2013.

**CEL404 ROCK ENGINEERING (3-0-0-6)**

Pre-requisite: CEL203

**Contents:**

Rock forming minerals and rock types, rock mass, classification systems for rocks and rock masses: RMR, Q, GSI systems, strength and deformation behaviour of rocks, strength and failure criteria for rocks and rock masses, strength of rock joints, laboratory and field testing of rocks, measurement of in-situ stresses. Foundations on rocks: bearing capacity theories, IS code methods, Foundation treatment for dams, barrages, bridge piers etc.. Stability of rock slopes: Stereographic projections, modes of failure, stability of plane, wedge and toppling failures, protection measures. Stress distribution around circular tunnels, various support systems.

**Text Books:**

1. Ramamurthy, T., Engineering for rocks: Foundations, Slopes and Tunnels, IBH Publication, 2003.
2. Goodman P.E., Introduction to Rock Mechanics, John Wiley and Sons, 1999.

**Reference Books:**

1. Brow, E.T., Rock Characterisation Testing and Monitoring, Pergaman Press, 1991.
2. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering, Oxford and IBH Publication, 1991.
3. Hock, E. and Bray, J., Rock Slope Engineering, Institute of Mining and Metallurgy, 1991.

**CEL405 INDUSTRIAL WASTE MANAGEMENT (3-0-0-6)**

Pre-requisite: CEL205, CEL304

**Contents:**

Nature and characteristics of industrial wastes; Control and removal of specific pollutants in industrial wastewaters, i.e., oil and grease, cyanide, Fluoride, Toxic Organics, Heavy metals. Recent trends in industrial waste management; Prevention versus control of industrial pollution; Linkage between technology and pollution prevention; Tools for clean production, reuse, recycle, recovery, source reduction, raw material substitution, toxic use reduction and process modifications; Point, and area source: dispersion modeling of industrial air pollutants. Source reduction and control of industrial air pollution; Minimization of industrial solid and hazardous waste; Waste management case studies from various Industries.

**Text Books:**

1. Rao, M.N. and Dutta, A.K., Wastewater Treatment, Oxford-IBH Publication, 1995.
2. Freeman, H.M., Industrial Pollution Prevention Hand Book, McGraw Hill Inc., New Delhi, 1995.

**Reference Books:**

1. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw Hill Book Company, New Delhi, 2000.
2. Shen, T.T., Industrial Pollution Prevention, Springer, 1999.

3. Stephenson, R.L. and Blackburn, J.B., Industrial Wastewater Systems Hand Book, Lewis Publishers, New York, 1998.

4. Bishop, P.L., Pollution Prevention: Fundamental and Practice, Tata McGrawHill, 2000.

**CEL406 FINITE ELEMENTS METHODS****(3-2-0-8)**

Pre-requisite: CEL201

**Contents:**

Introduction - Overview of different methods, background of finite element method, general steps, advantages and disadvantages; One-dimensional analysis - Linear spring, truss, beam, plane frame, grid, torsion, steady state heat conduction, flow through porous media, flow through pipes; Two-dimensional analysis - two dimensional flow through porous media, stress analysis, review of theory of elasticity, plane stress analysis, plane strain analysis, axisymmetric analysis, Isoparametric formulation, numerical integration; Computer implementation of finite element method - solution of large set of equations, use of symmetry and anti-symmetry conditions, sub-structuring, application of boundary conditions.

**Text Books:**

1. Bathe, K.J., Finite Element Procedures, Prentice Hall of India, 2010.
2. Krishnamoorthy, C.S., Finite Element Analysis: Theory and Programming, Tata McGraw Hill, New Delhi, 1987.

**Reference Books:**

1. Reddy, J. N., An Introduction to Finite Element Method, 3<sup>rd</sup> ed., McGraw Hill Company, 2012.
2. Trupathi, R. C. and Belegundu, A.D., Introduction of Finite Elements in Engineering, 3<sup>rd</sup> ed., Prentice Hall of India, 2012.
3. Seshu, P., Text book of Finite Element Analysis, Prentice Hall of India, 2012.
4. Zienkiewicz, O.C., Taylor, R.L. and Zhu, J.Z., Finite Element Method: Its Basis and Fundamentals, 6th ed., Elsevier Butterworth Heinemann, Oxford, 2005.
5. Desai, Y. M., Eldho, T. I. and Shah, A. H., Finite Element Method with Applications in Engineering, Pearson, 2011.

**CEL407 TRANSPORTATION PLANING****(3-0-0-6)**

Pre-requisite: CEL206

**Contents:**

Overview of transportation systems, nature of traffic problems in cities, Transportation modes and comparison, Role of transportation: Economic, Social, Political, Environmental; Goals and objectives of Transportation planning. Survey Methodology Design, Data types and sources, Revealed and Stated Preference Data, Data collection techniques (Household and non-household based) to collect revealed and stated preference data, Sample size, and sampling techniques. Transportation demand and supply, Transportation cost analysis, consumer surplus, Elasticity, Trips, trip classification, Four-stage sequential travel demand modeling: Trip generation (Regression and category analysis), Trip distribution (Growth factor and Gravity Models), Modal split including behavioural analysis based on Random Utility Theory, Analysis of Networks, Shortest travel path algorithms, and Trip assignment (Single and multi-path route assignments). Planning for pedestrians, bicyclists and public transport systems.

**Text Book:**

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, 6th ed., Khanna Publishers, 2012.

**Reference Books:**

1. Ortuzar, J.D. and Willumsen, L.G., Modelling Transport, 4<sup>th</sup> ed., John Wiley and Sons, 2011.
2. Morlok, E.K., Introduction to Transportation Engineering and Planning, Tata McGraw Hill, 1978.
3. Hutchinson, B. G., Principles of Urban Transport Systems Planning, Scripta Book Co., Washington, 1974.

**CEL408 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT (3-0-0-6)**

Pre-requisite: CEL205, CEL304

**Contents:**

Introduction and scope, utility of the EIA Process, expended and narrowed scope of EIA, Impacts of development activities, planning and management of impact studies. Environment attributes, environmental indices and indicators, environmental assessment, methods and techniques, matrices, network and checklist methods. Prediction technique for quality of environmental attributes. Impact evaluation, assessment of impact on air, water, soil and ground water, noise, biological environment. Assessment of impact on socio-economic environment, evaluation methods, mitigation measures. Health risk assessment, hazard identification toxicology and dose response characterization, exposure characterization, risk characterization, uncertainty in estimates. Risk evaluation, risk acceptance, basic principles of health risk management.

**Text Book:**

1. Jain, P. K., Environment Impact Assessment, John Wiley and Sons, 1978.
2. Paustenbach, D.A., Risk Assessment: A Text Book of Case Studies, John Wiley and Sons, 1992.

**Reference Books:**

1. Kenneth, W., Warner, F.C. and Davis, W.T., Air Pollution its Origin and Control, Prentice Hall, 1997.
2. Mishra, P.C., Fundamental of Air and Water Pollution, South Asia Books, 1990.
3. Masters, G, Introduction to Environmental Engineering and Science, Prentice Hall, 2004.

**CEL409 ADVANCED CONCRETE DESIGN (3-2-0-8)**

Pre-requisite: CEL307

**Contents:**

Design of Reinforced Cement Concrete (RCC) Structures – Building frames static and dynamic analysis and component design, provisions of ductile detailing. Liquid retaining structures, Earth retaining walls, Flat slabs, Design of bridge, standard specifications and general design considerations.

**Text Books:**

1. Pillai, S.U. and Menon, D., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Jain, A. K., Reinforced Concrete, Nem Chand and Bros, 2012.

**Reference Books:**

1. Sinha, S.N., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Shah, V.L. et.al., Limit State Theory and Design of Reinforced Concrete, Structures Publications, 2007.
3. Nilson, A.H., and Winter, G., Design of Concrete Structures, McGraw Hill, New Delhi, 1983.
4. Victor D.J, Essential of Bridge Engineering, Oxford and IBH Publication, 2007.

**CEL410 RIVER MECHANICS (3-0-0-6)**

Pre-requisite:CEL202

**Contents:**

Introduction, River morphology, drainage patterns, stream order. Properties of mixture of sediment and water, Incipient motion and quantitative approach to incipient motion, channel degradation and armoring. Bed forms and resistance to flow, various approaches for bed load transport, suspended load profile and suspended load equations, total load transport including total load transport equations. Comparison and evaluation of sediment transport equations. Stable Channel design with critical tractive force theory.

**Text Book:**

1. Garde, R.J. and Ranga, Raju K., Mechanics of Sediment Transportation and Alluvial Stream Problems, New Age International Publishers, 2000.

**Reference Books:**

1. Yang, C. T., Sediment Transport: Theory and Practice, Tata McGraw Hill, New Delhi, 1996.
2. Henderson, F. M., Open Channel Flow, MacMillan, New York, 1996.
3. Chang, H. H., Fluvial Processes in River Engineering, John Wiley and Sons, 1988.
4. Simons, D. B. and Senturk, F., Sediment Transport Technology, Water Resources Publications, Fort Collins, Colorado, 1977.

**CEL411 TRAFFIC ENGINEERING (3-0-0-6)**

Pre-requisite: CEL206

**Contents:**

Traffic Engineering: Definition, Elements of traffic engineering, traffic engineering problems, Issues for traffic engineer, Components of traffic system – Road User and vehicle characteristics, travel demand and patterns. Traffic Stream Characteristics: Lane and directional systems, Traffic flow characteristics - Speed, Flow and Density, Other flow characteristics – Headways, Occupancy, Flow rate, Capacity, traffic demand v/s volume v/s capacity, Relationships of flow characteristics- Greenshield, Greenburg, Underwood, Edie, multi-regime relationships. Traffic Studies: Type of studies, Traffic Volume Study – Applications, Methods of data collection, Volume data analysis, Peak Hour concept, Volume to capacity ratio, concepts and application of AADT, DDHV, Temporal expansion factors, Passenger Car Units, Volume data presentation; Traffic Speed Study - Applications, Methods of data collection, Time and Space Mean Speeds, Speed characteristics based on frequency and density functions, Fit of Normal distribution to the data, Before and After study; Capacity Analysis – Service volumes and saturation flows, Factors affecting lane capacity, Design service volume of urban and rural roads; Parking Study – Parking characteristics, Parking Accumulation analysis, Parking demand and supply analysis, Parking Duration analysis, Parking angles and estimation of parking spaces; Accident Study and Analysis – Causes of accidents, Collision and Condition diagrams, Safety Audit and Remedial measures. Traffic Calming Techniques, Traffic Volume and Speed calming, Road pricing, Regulations related to road users.

**Text Books:**

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, 6th ed., Khanna Publishers, 2012.

**Reference Books:**

1. McShane, W.R. and Roess, R.P., Traffic Engineering, Prentice Hall, 2010.
2. Papacostas, C. S. and Prevedouros, P.D., Fundamentals of Transportation Engineering, Prentice Hall, 2001.

**CEL412 CONSTRUCTION PLANING AND MANAGEMENT (3-0-0-6)****Contents:**

Engineering Economics :Cash flow diagram, Tune value of money, Inflation, Interest, Depreciation, Present worth and capitalized cost, Equivalent uniform annual cost and rate of return evaluations, Benefit cost analysis, Analysis of variable costs, Types of capital financing, Valuation. Tendering and Contract: Organisational structure, Methods of tendering, Specifications, Conditions of contract, Contract law, Disputes and Arbitrations. Construction Planning and Management: Time, Cost and Research management of projects for planning, Scheduling, Control and forecasting using networks with CPM/PERT. Personnel, Material and Finance Management, Safety Engineering. Construction Equipments: Selection, Planning and Cost, Equipments, Earthmoving, Excavating, Hauling, Compacting, Drilling and Blasting, Grouting, Conveying and Dewatering Equipments. Aggregate Cement Concrete and Asphatt Concrete Plants.

**Text Books:**

1. Srinath, L.S., PERT and CPM: Principles and Applications, East West Press, New Delhi, 2013.
2. Sengupta, B. and Guha, H., Construction Management and Planning, Tata McGraw Hill, New Delhi, 1998.

**Reference Books:**

1. Moder, J.J. and Phillips, C.R., Project Management with CPM and PERT, Van Nostrand Reinhold, 1983.
2. Pilcher, R., Appraisal and Control of Project Cost, 1973.
3. Jebson, J., Cost and Optimisation Engineering, Tata McGraw Hill, New York.

**CEL413 ADVANCED FOUNDATION ENGINEERING (3-0-0-6)**

Pre-requisite: CEL302, CEL306

**Contents:**

Shallow Foundations: Design criteria, Bearing Capacity theories, Empirical methods, Layered soils, Foundations under eccentric and inclined loads, Foundations on or near slopes, Limit state design principles; Deep Foundations: Pile Foundations: Types and their selection, Ultimate load of individual piles under compressive, uplift, and lateral loading, Pile load tests, Downdrag, Pile groups. Caissons/Well foundations– bearing capacity theories; Construction methods, Machine Foundations: Principles of Vibrations, Types of machine foundations, Design criteria, Design of block foundations; Earth Retaining Structures including RC Cantilever, RC Counterfort Type Structures, Sheet piles etc.

**Text Books:**

1. Craig, R.F., Craig's Soil Mechanics., 2004, Taylor and Francis, New York, 2010.
2. Ranjan, G. and Rao, A.S.R., Basic and Applied Soil Mechanics, New Age International Publishers, 2014.
3. Bowles, J.E., Foundation Analysis and Design, 1997, Tata McGraw Hill, 2013.

**Reference Books:**

1. Das BM., Principles of Geotechnical Engineering., Thomson, India, 2007.
2. Som, N.N. and Das, S.C., Theory and Practice of Foundation Design, Prentice Hall, 2006.
3. Couduto, Donald P., Geotechnical Engineering: Principles and Practices, Prentice Hall, 2010.
4. Peck, R.B., Hanson, W.E. and Thornburn, T.H., Foundation Engineering, John Wiley and Sons, 1974.
5. Saran, S., Soil Dynamics and Machine Foundations, Galgotia Publication, 1979.

**CEL414 GEOMATICS ENGINEERING (3-0-2-8)**

Pre-requisite: CEL207

**Contents:**

Introduction of Geomatics Engineering; Photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement, Stereoscopy, Measurement of parallax and height determination; Basic remote sensing, interaction mechanism with atmospheric and earth surface, platforms and sensors, remote sensing data products, visual data interpretation for information extraction; Digital Image, introduction to digital image processing, pre-processing, enhancement, classification; Introduction of Geographic Information System (GIS), GIS database, raster and vector data structure, digital elevation model; Introduction to GPS surveys, space, control and user segments,

GPS receivers; Applications of Geomatics to various projects.

#### **Text Books:**

1. Agarwal, C.S. and Garg, P.K. Remote Sensing in Natural Resources Monitoring and Management, Wheeler Publishing House, New Delhi, 2000.
2. Lillesand, T.L., and Kiefer, R.W., Remote Sensing and Image Interpretation, 4th ed., John Wiley and Sons, 2005.

#### **Reference Books:**

1. Ghilani, C.D. and Wolf, P.R. Elementary Surveying: an Introduction to Geomatics, Pearson, 2012.
2. Bossler, J.D. Manual of Geospatial Science and Technology, Taylor and Francis, London, 2002.
3. Burrough, P.A. and McDonnell, R.A. Principles of Geographic Information System, Oxford University Press, 2000.
4. Chandra, A.M. and Ghosh, S.K. Remote Sensing and Geographical Information Systems, Alpha Science, Oxford U.K., 2005.
5. Gopi, S. Global Positioning System: Principles and Applications, Tata McGraw Hill, 2005.
6. Lo, C.P. and Yeung, A.K.W. Concepts and Techniques of Geographical Information System, Prentice Hall, India, 2002.

### **CEL415 NON-DESTRUCTIVE TESTING OF MATERIALS (3-0-2-8)**

Pre-requisite: CEL204

#### **Contents:**

Types of materials, tests and the variables involved, destructive and non-destructive testing correlation of properties obtained by NDT with the basic structure of matter and other properties; NDT of different materials by various techniques such as radiographic, sonic and ultrasonic, electrical and magnetic, soleoroscopic, microwave, eddy current penetrant, thermal optical, holographic etc., practical applications and advances in NDT.

#### **Text Books:**

1. Bungey, S., Lillard, G. and Grantham, M.G. Testing of Concrete in Structures, 4<sup>th</sup> Ed. Taylor and Francis, London.
2. Malhotra, V.M. and Carino, N.J., Handbook on Non-Destructive Testing of Concrete, 2<sup>nd</sup> Ed., Taylor and Francis, London.

#### **Reference Books:**

1. Krautkramer, H., Ultrasonic Testing of Materials, Springer-Verlag, 1969.
2. Novgoresky, M.A., Testing of Building Materials and Structures, Mir Publishers, 1973.
3. American Society of Metals: Handbook, Vol. II, Destructive Inspection and Quality Control, 1976.

### **CEL416 DESIGN OF PRESTRESSED CONCRETE AND INDUSTRIAL STRUCTURES (3-0-2-8)**

Pre-requisite: CEL307

#### **Contents:**

Prestressed Concrete Structures – Fundamentals of prestressing, Prestressing technology, Analysis of prestressed members, Prestress losses, Design for Flexure, Design for shear and torsion, Design of anchorage Zones in post-tensioned members. Industrial Structures. Analysis and design of Cylindrical shell structures, Folded plates, Chimneys, Silos, Bunkers.

#### **Text Books:**

1. Jain, A.K., Reinforced Concrete, Limit State Design, 5th ed., Nem Chand and Bros. 2012.
2. Raju, N. Krishna, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2013.

#### **Reference Books:**

1. Pillai, S.U. and Menon, D., Reinforced Concrete Design, Tata McGraw Hill, 2013.
2. Krishna, J. and Jain O.P., Plain and Reinforced Concrete, Vol. 2, Nem Chand and Bros, 2002.

### **CEL417 URBAN WATER AND ENVIRONMENTAL MANAGEMENT (3-0-0-6)**

#### **Contents:**

Review of Urban Hydrologic and Hydraulic Principles: Urban hydrologic cycle, rainfall analysis and design storm, hydraulic and hydrodynamic principles Introduction to Drainage Problems in Different Climate: Urbanization - its effects and consequences for drainage, Interaction between urban and peri-urban areas. Planning concepts and System Planning: Objectives of urban drainage and planning criteria, drainage option and system layout, Planning tools and data requirement, Drainage master plan, Drainage structures Calculation Methods and Mathematical Tools: Modeling formulas, Hydrologic models, Hydrodynamic models, Regression analysis, Urban runoff and water quality models Design of Drainage System Elements: Hydraulic fundamentals, Infiltration and on-site detention of storm water, Design of sewerage and drainage channels, design of

apertunances and pumping stations Control of Storm water Pollution: Pollution bid-up and wash off process with reference to urban drainage systems, Source control in commercial and Industrial complexes, Biological and chemical treatment of waste water, Best management practices Operation and Maintenance of Urban Drainage Systems: Maintenance requirements and planning, Cleansing of sewers and drains, repair options Administrative and Legal Aspects and Financing: Administrative, legal and financing aspects, International, national and municipal legal aspects, Administrative structure for drainage planning, Financing for drainage projects.

#### **Text Books:**

1. Akan, A.O., Urban Stormwater Hydrology: A Guide to Engineering Calculations, Lancaster Technomic, 1993.
2. Larry, W.M. Stormwater Collection Systems Design Handbook, Tata McGraw Hill, New York, 2001.

#### **Reference Books:**

1. Strickland, G., Urban Hydrology for Small Watersheds, NTIS, Springfield, 1975.
2. Deb, R., Municipal Stormwater Management, Lewis Publishers, 1995.
3. Hittman Associates, Approaches to Stormwater Management, NTIS, Springer, 1973.
4. Hall, M.J., Urban Hydrology, Elsevier, London, 1984.

### **CEL418 ESTIMATION AND COSTING (3-0-0-6)**

#### **Contents:**

Estimates: Types, complete set of estimate, working drawings, site plan, layout plan, index plan, plinth area administrative approval and Technical Sanction. Estimate of buildings, Estimate of R. C.C. works, Estimate of sloped roof and steel structures, Estimate of water supply and sanitary works, Estimates of roads (a) Earthwork (b) Bridges and culverts c) Pavement, Estimate of Irrigation works. Analysis of Rates: For earthwork, concrete works, D. P. C., Brickwork, stone masonry, plastering, pointing, road work, carriage of materials. Specifications: General specification for different classes of building, detailed specifications for various Civil Engineering Works.

#### **Text Books:**

1. Chakraborti, M., Estimating and Costing, 2002.
2. Dutta, B. N., Estimating and Costing in Civil Engineering, UBS Publishers and Distributors Ltd., New Delhi, 1999.

#### **Reference Books:**

1. Birdie, G.S., Estimating and Costing, Dhanpat Rai and Sons, 1994.
2. Kohli, D. D., Kohli, R.C., Estimating and Costing, S. Chand and Company, New Delhi, 2004.

### **CEL419 SOFTWARE LAB (0-0-6-6)**

#### **Contents:**

Introduction to Auto Cad, Staad Pro, Ansys, Abacus, Matlab, PrimaVira, and Microsoft Project

### **CEL420 STRUCTURAL DYNAMICS (3-0-2-8)**

Pre-requisite: CEL301

#### **Contents:**

SDOF System : Equation of motion; Free vibration; Harmonic load; Evaluation of damping.; Periodic load; General load (time domain, frequency domain); Response spectrum load. MDOF Systems: Structural matrices; Un-damped free vibration; Generation of damping matrix, Mode superposition analysis; Practical considerations. Continuous Systems: Equation of motion; Un-damped free vibration; Forced response. Random Vibrations: Random variables and random recesses; Models of random dynamic loads; Stochastic response of SDOF and MDOF systems.

#### **Text Books:**

1. Chopra, A. K., Dynamics of Structures, Applications to Earthquake Engineering, Prentice Hall, 2000.
2. Clough, R. W. and Penzien, J., Dynamics of Structures, 2nd ed., Tata McGraw Hill, Singapore, 1993.

#### **Reference Books:**

1. Meirovitch, L., Elements of Vibration Analysis, 2nd edition, Tata McGraw Hill, Singapore, 1986.
2. Agarwal, P. and Shrikhande, M., Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., 2006.
3. James, L.S, Manual of Seismic Design, Pearson Education, 2004.