

M.Tech. in Civil Engineering (2018-19)
(with specialization in Structural Engineering / Construction Technology)

Semester	Course Name						Skill Development Program/Module courses	Lecture Courses	L	T	P	Contact hours per week	Credits
I	CEL513 Civil Engineering Materials & Composites 2-0-2(3)	CEL515 Construction Methods & Equipment 2-0-2(3)	CEL505 Green Building Design and Rating 2-0-2 (3)	CEL507 Rehabilitation & retrofitting of structures 2-0-2 (3)	CEL509 Safety and Reliability Analysis 2-0-2 (3)	CEC501 Seminar & General Proficiency 0-0-2(1)	Soft-skill development program 0-0-4(2)	5	10	0	16	26	18
II	OE-I 2-0-2(3)	PE-1 2-0-2(3)	PE-2 2-0-2(3)	PE-3 2-0-2 (3)	PE-4 2-0-2 (3)	MAL616 Introduction to Research Methodology 2-1-0 (3)		6	12	1	10	23	18
Summer Internship/Software training/Mini-Project													02
III	OE-II 2-0-2(3)	PE-5 2-0-2 (3)				CED601 Dissertation Part-I 0-0-8(4)	Laboratory Teaching Training 4hrs/week 0-0-4(2)	2	4	0	16	20	12
IV						CED602 Dissertation Part-II 0-0-16(8)		0	0	0	16	8	08
						Total							58

Programme Core (PC)

S.No.	Course Code	Title	L-T-P	Credits
	CEL513	Civil Engineering Materials & Composites	2-0-2	3
	CEL515	Construction Methods & Equipment	2-0-2	3
	CEL505	Green Building Design and Rating	2-0-2	3
	CEL507	Rehabilitation & retrofitting of structures	2-0-2	3
	CEL509	Safety and Reliability Analysis	2-0-2	3
	MAL616	Introduction to Research Methodology	2-1-0	3
	CEC501	Seminar & General proficiency	0-0-2	1
	CEP502	Soft-skill development program	0-0-4	2
	CEP503	Laboratory Teaching Training	0-0-4	2
	CED524	Minor Project	0-0-0	2
	CED601	Dissertation Phase - I	0-0-8	4
	CED602	Dissertation Phase - II	0-0-16	8
		Total Credits		37

Programme Elective (PE)

Sl. No.	Course Code	Title	L-T-P	Credits	Remark
PEI					
1.	CEL502	Prestressed Concrete Structures	2-0-2	3	SE
2.	CEL504	Smart Material and Smart Structures	2-0-2	3	
3.	CEL506	Finite Element Analysis	2-0-2	3	
4.	CEL522	Construction and Contract Management	2-0-2	3	CT&M
5.	CEL524	Infrastructure Development and Management.	2-0-2	3	
6.	CEL526	Functional Planning, Building Services and Management			
PEII					
1.	CEL508	Structural Dynamics	2-0-2	3	SE
2.	CEL510	Principles of Bridge Engineering	2-0-2	3	
3.	CEL512	Theory of Elasticity and Plasticity	2-0-2	3	
4.	CEL528	Resource Management and Control in Construction	2-0-2	3	CT&M
5.	CEL530	Construction Economics & Finance	2-0-2	3	
6.	CEL532	Shoring, Scaffolding and Formwork	2-0-2	3	
PEIII					
1.	CEL601	Earthquake Resistant Design of Structures	2-0-2	3	SE
2.	CEL603	Prefabricated Structures	2-0-2	3	
3.	CEL605	Theory of plates and shells	2-0-2	3	
4.	CEL611	Flexible Systems Management	2-0-2	3	CT&M
5.	CEL613	Organization Management	2-0-2	3	
6.	CEL615	Strategic Technology Management	2-0-2	3	
PEIV					
1.	CEL607	Matrix Methods of Structural Analysis	2-0-2	3	SE
2.	CEL609	Design of Tall Structures	2-0-2	3	
3.	CEL617	System Reliability, Safety and Maintenance Management	2-0-2	3	CT&M
4.	CEL619	Advanced Methods for management research	2-0-2	3	
PEV					
1.	CEL602	Design of Industrial structures	2-0-2	3	SE
2.	CEL604	Advanced Steel-Concrete Composite Structures	2-0-2	3	
3.	CEL606	Project Planning and Control	2-0-2	3	CT&M
4.	CEL608	Quality And Safety in Construction	2-0-2	3	

Master of Technology in Civil Engineering
Department of Civil and Environmental Engineering

CEL513 Civil Engineering Materials & Composites

3 Credits (2-0-2)

Principles of concrete mix design, testing of concrete. Special Concretes Light weight concrete, Fiber reinforced concrete, Polymer concrete, Super plasticized concrete, Papercrete, Properties and applications, Foams and light-weight materials. High strength concrete. Ferro-cement, material and properties. Polymers in Civil Engineering Polymers, Architectural use and aesthetics of composites, glass, acoustics, fibers, waste materials.

CEL 515 Construction Methods & Equipment

3 Credits (2-0-2)

Planning Process for Equipment and Methods; Cost of Owning and Operating Construction Equipment - Ownership cost, Depreciation, Operating cost, and Ownership and operating costs calculation methods; Equipment Life and Replacement Procedures - Physical, profit and economic life, Replacement analysis; Engineering Fundamentals of Moving Earth - Rolling resistance, Effect of grade on tractive effort, Effect of altitude on performance of IC engines; Earthmoving, Excavating, and Lifting Equipment Selection - Bulldozers, Front-end Loaders, Scrapers, Trucks, Excavators, Backhoes, Factors affecting selection of equipment - technical and economic, construction engineering fundamentals, Analysis of production outputs and costs, Characteristics and performances of equipment for Earth moving, Erection, Material transport, Pile driving, Dewatering, Concrete construction (including batching, mixing, transport, and placement) and Tunneling

CEL505 Green Building Design and Rating

3 Credits (2-0-2)

Background terms; Smart Growth, smart city and New Urbanism and the Resistance to Change; Green Building Assessment; Green Building Index; Life Cycle Costing; The Setting/Green Roofs, Case Study; Energy and Buildings; Energy And Hydrologic Systems; Materials/Specifications; Interior Environments (lighting, air), GRIHA, LEEDs rating system, BEE Standards and guidelines.

CEL507 Rehabilitation & retrofitting of structures

3 credits (2-0-2)

Quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, materials for repair, techniques for repairing of structures.

CEL 509 Safety and Reliability Analysis

3 credits (2-0-2)

Fundamentals of set theory and probability, probability distribution, regression analysis, hypothesis testing. Stochastic process and its moments and distributions, Concepts of safety factors, Safety, reliability and risk analysis, first order and second order reliability methods, simulation based methods, confidence limits and baysean revision of reliability, reliability based design, examples of reliability analysis of structures.

MAL 616 Research Methodology

3 credits (2-1-0)

Foundations of Research, Scientific Research, Motivation, Research Objectives, Research Designs, Research Processes, Understanding Feasibility of Objectives and Processes, Qualitative and Quantitative Research Methods, Data Collection Processes, Biases in Data Collection, Data Pre-processing, Sampling Distribution and Confidence Intervals, Hypothesis Testing, Interpretation of Results, Literature Review, Technical Writing, Citations, Reference management software, Plagiarism, Software for Detection of Plagiarism.

CED 601 Dissertation Phase - I

4 credits (0-0-8)

Part-I of the project will cover the problem identification along with the assigned supervisor in the area of specialization followed by literature review, data collections and data generations and identification of the tool of analysis, simulation and modeling and hypothesis for the problem solving.

CED 602 Dissertation Phase – II

8credits (0-0-16)

Part-II of the project will cover the actual simulation, modeling, result generation and reaching to the desired goal set in Part-I

CEL 502 Prestressed Concrete Structures

3 credits (2-0-2)

Theory and behavior – basic concept, methods of pre stressing,, loss of pre stress, Analysis of prestress, calculations of deflections , crack width; design concepts – procedures as per codes, stress distributions, limit state design criteria; design of pre stressed concrete, Analysis and design of indeterminate prestress members, tanks, pipes and composites construction and elementary idea of pre stressed concrete bridge.

CEL 504 Smart Material and Smart Structures

3 credits (2-0-2)

Introduction to passive and active systems – need for active systems – smart systems – definitions and implications - active control and adaptive control systems – examples. Components of smart systems– system features and interpretation of sensor data – pro-active and reactive systems – demo example in component level – system level complexity Materials used in smart systems – characteristics of sensors – different types smart materials – characteristics and behaviour of smart materials – modelling smart materials – examples. Control Systems – features – active systems – adaptive systems – electronic, thermal and hydraulic type actuators – characteristics of control systems – application examples. Integration of sensors and control systems – modelling features – sensor-response integration – processing for proactive and reactive components – FE models –examples.

CEL506 Finite Element Analysis

3 credits (2-0-2)

Introduction to Finite Element Method. Brief History of the Development. Advantages & Disadvantages of Finite Element Method. Finite Element Method- The Displacement Approach. Foundations of the FEM Energy Principles.

One Dimensional Finite Element. Stiffness Matrix for the basic Bar & Beam Element. Element Stresses. Shape Functions & Interpolation Polynomials. Finite Elements for Two Dimensional Planar Bodies. Triangular Elements for Plane Stress or Strain Conditions. Rectangular Elements for Plane Stress or Strain Conditions. Finite Elements for Three Dimensional Analysis. Tetrahedral Elements. The Isoparametric Concept. Properties of Isoparametric Elements. Numerical Integration. Finite Elements For Plate Bending Analysis. Applications of FEA to field problems.

CEL522 Construction and Contract Management

3 credits (2-0-2)

Project cost estimation, rate analysis, overhead charges, bidding models and bidding strategies. Qualification of bidders, Owner's and contractor's estimate. Tendering and contractual procedures, Indian Contract Act1872, Definition of Contract and its applicability, Types of contracts, International contracts, FIDIC, Conditions and specifications of contract. Contract administration, Claims, compensation and disputes, Dispute resolution techniques, Arbitration and Conciliation Act 1996, Arbitration case studies, Professional ethics, Duties and responsibilities of parties. Management Information systems

CEL524 Infrastructure Development and Management.

3 credits (2-0-2)

Infrastructure overview. Private involvement in infrastructure - The Benefits and problems of Infrastructure Privatization. Challenges in Privatization – case study. Challenges to Successful Infrastructure Planning and Implementation- Mapping and Facing the Landscape of Risks in Infrastructure Projects.

Strategies for Successful Infrastructure Project Implementation - Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modelling and Life Cycle Analysis Techniques.

CEL526 Functional Planning, Building Services and Management

3 credits (2-0-2)

Building Services- Water supply systems, water services to multistory buildings, building drainage and refuse collection, types of fixtures and fittings, Air Conditioning, Heating & Ventilation, lifts and acoustics, traffic analysis and selection of lifts, selection of acoustical materials, acoustics of auditorium, schools, Functional planning and maintenance of services

CEL508 Structural Dynamics

3 credits (2-0-2)

Free and forced vibration of single degree of freedom (SDOF) system, response to harmonic, periodic, impulsive and general dynamic loading, response of SDOF to earthquake, Free vibration of lumped multidegree of freedom system, Approximate methods for obtaining natural frequencies and mode shapes, Frequency domain analysis of lumped multi-degree of freedom system using normal mode theory, Time domain analysis using numerical integration scheme, Free and forced vibration of continuous systems, Introduction to the dynamics of soil structure interaction problems.

CEL510 Principles of Bridge Engineering

3 credits (2-0-2)

Introduction- Definition, components of bridge, classification of bridges, selection of site, economical span, aesthetics consideration, necessary investigations and essential design data; Standard specifications for roads and railways bridges: Indian Road Congress Bridge Code for specifications and loads.; Various types of R.C.C. bridges (brief description of each type), Design Consideration for R.C.C.Bridges and culverts.: Design of Tee beam bridge, Various types of steel bridges (brief description of each), Design Consideration for Steel Bridges design of plate girder bridges. Hydraulic & Structural Design of piers, abutments, wing wall and approaches: Brief descriptions of bearings, joints, articulation and other details. Bridge foundation-Variety types, necessary investigations and design criteria of well foundation.

CEL 512 Theory of Elasticity and Plasticity

3 credits (2-0-2)

Concept of Elasticity - plane stress and plane strain analysis, two dimensional problems in rectangular coordinates - solution by polynomials - Saint- Venant's principle-determination of displacements-bending of simple beams: application of fourier series for two dimensional problems - gravity loading- Two dimensional problems in polar, analysis of stress and strain in three dimensions - differential equations of equilibrium - principle of super position - uniqueness of solution - the reciprocal theorem, torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - bending of prismatic bars, theory of plasticity - introduction concepts and assumptions - yield criterions.

CEL 528 Resource Management and Control in Construction

3 credits (2-0-2)

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control. Labour management-Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour,

Classes of Labour, Cost of Labour, Labour schedule, optimum use. Material and equipment- Time of purchase, quantity of material, sources, Transportation, Time Management-Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control. Resource allocation and levelling Cumulative cost – Value Management.

CEL530 Construction Economics & Finance

3 credits (2-0-2)

Benefit-cost analysis, Replacement analysis, Break even analysis. Risks and uncertainties and management decision in capital budgeting. Taxation and inflation. Work pricing. Working capital management, financial plan and multiple source of finance. International finance, Budgeting and budgetary control, Practical problems and case studies, Project cash flow, Methods, Practice, Role of Lender's Engineer. Financial Planning, Budget – Budgetary control system.

CEL532 Shoring, Scaffolding and Formwork

3 credits (2-0-2)

Planning of construction work, site equipment required, Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme – Costing. Materials accessories proprietary products – finish materials, scaffolding material, design of forms – analysis of forces, building and erection of formwork, formwork for domes, tunnels etc.

CEL601 Earthquake Resistant Design of Structures

3 credits (2-0-2)

characteristics of earthquake, measurement of earthquake, dynamics of single degree of freedom system, earthquake response to single degree of freedom system, response spectrum, earthquake resistant design concepts, response reduction factor, stiffness and building configuration, lateral loads, IS 1893 provisions for buildings, active and passive vibration control, dampers.

CEL603 Prefabricated Structures

3 credits (2-0-2)

Types of prefabrication, prefabrication systems and structural schemes- Disuniting of structures- Structural behaviour of precast structures. Handling and erection stresses - Application of prestressing of roof members; floor systems two way load bearing slabs, Wall panels, hipped plate and shell structures. Dimensioning and detailing of joints for different structural connections; construction and expansion joints. Production, Transportation & erection- Shuttering and mould design Dimensional tolerances- Erection of R.C. Structures, Total prefabricated buildings. Designing and detailing prefabricated units for 1) industrial structures 2) Multistorey buildings and 3) Water tanks, silos bunkers etc., 4) Application of prestressed concrete in prefabrication

CEL605 Theory of plates and shells

3 credits (2-0-2)

Bending theory of flat plates: thin plates, Kirchoff theory - strain displacement relations, stresses and stress resultants, constitutive equations, equilibrium equations, boundary conditions, derivation of theory from principle of virtual work, rectangular plates-solution by double Fourier series, circular plates Classical theory of shells – Membrane theory of shells: equilibrium equations, applications to shells of revolution under axisymmetric loads, applications to cylindrical shells under asymmetric loads, strain-displacement relations, application in calculation of displacements; Bending theory of shells: kinematic assumptions and strain-displacement relations, stress measures and equilibrium

CEL611 Flexible Systems Management

3 credits (2-0-2)

Emerging management paradigms: Total Quality Management, Business Process Reengineering, Learning Organisation, World Class Organisation, Flexibility in Management. Concept of systemic flexibility. Liberalisation, Globalisation and change. New Organisation forms. Concept and dimensions of Systemic flexibility. Managing paradoxes. Methodology and tools of flexible systems management. Underlying values, and guiding principles, Case Analysis using SAPLAP framework. SAP-LAP models and linkages

CEL613 Organization Management

3 credits (2-0-2)

Manpower planning, organizing, staffing, directing. Organization -span of control, organization chart, development and operation of human resource, managerial staffing, recruitment, selection, placement, training. Human behavior – basic individual psychology, managing groups at work, leadership, behavioural aspects of decision making and communication for people management. Welfare measures – compensation, safety and health, GPF, EPF, group insurance,. Management and development methods

CEL615 Strategic Technology Management

3 credits (2-0-2)

Emerging technology-strategy relationship in the large corporation. Global technology comparison. Technology Information. Criticality of technology for growth, core competencies, R&D productivity, Generic competitive technology strategies. Corporate R&D, Strategic technology management process, relationship between technology strategy and corporate strategy. Strategic shifts and resource commitments, technology leadership. SWOT analysis for technology, Matching Business Portfolio and Technology Portfolio, Technology- Market matrix. Innovation and entry strategy.

CEL607 Matrix Methods of Structural Analysis

3 credits (2-0-2)

General Introduction. A Few Historical Remarks. Matrix Methods of Analysis of Skeletal Structures. Methods of Analysis. Displacement Method: Stiffness Relationships. The Matrix Displacement Approach, Introduction, Stiffness Matrix of a Bar Element subjected to Axial Force. Co-ordinate Transformations. Global Stiffness Matrix. Application to Pin-Jointed Frames. Stiffness Matrix of a Beam Element. Application to Continuous Beams. Matrix Displacement Analysis of Planar Rigid-Jointed Frames. Neglect of Axial Strain in the Analysis of Planar Rigid-Jointed Frames. Other Kinds of Loading & Other Kinds of Frames. Co-ordinate Transformations. Element Stiffness Matrix & its Application. Matrix Displacement Analysis of Three-Dimensional Structures. Co-ordinate Transformations. Application to Space Trusses & Space Frames.

CEL609 Design of Tall Structures

3 credits (2-0-2)

Design philosophy – Loading - Sequential loading, materials. High risk behaviour, Rigid frames, braced frames, infilled frames, shear walls, coupled shear walls, wall – frames, tubulars, cores, futrigger - braced and hybrid mega system. Approximate Analysis, Accurate Analysis and Reduction Techniques - Analysis of building for member forces - drift and twist - Computerised general three dimensional analysis. Structural elements- design, deflection, cracking, prestressing, shear flow Design for differential movements, creep and shrinkage effects, temperature effects and fire. Overall buckling analysis of frames, wall – frames–second order effects of gravity of loading– simultaneous first order and P-delta analysis Translational - torsional instability, out of plum effects

CEL617 System Reliability, Safety and Maintenance Management

3 credits (2-0-2)

Reliability, Safety, Risk Assessment Perspective, statistical concepts and probability distributions, Maintenance Planning- Maintenance Planning and Scheduling. Issues of Replacement versus reconditioning, Maintenance control- Spare parts Inventory Planning and Control for single and multi-echelon systems, Organizational aspects and a computer aided management information system for reliability, safety and maintenance

CEL619 Advanced Methods for management research

3 credits (2-0-2)

Problem conceptualization and definition. Hypothesis formulation. Selection of Research Methods, Flexible Systems Methodology for preparing research design, Scaling, sampling methods, Managing oral evidence, Questionnaire design, validation and pretesting. Interview design, Case study, Field experiments, Quasi experiments. Qualitative research methods. Statistical techniques and implementation of research plan using statistical packages.

CEL602 Design of Industrial structures

3 credits (2-0-2)

Elementary Plastic Analysis and Design: Introduction, Scope of plastic analysis, ultimate load carrying capacity of tension members and compression members, flexural members, and simple portal frames and design Industrial Buildings- Loads, general arrangement and stability, design considerations, design of roof trusses, industrial building frames, Design of Water Tanks Stacks and Towers.

CEL604 Advanced Steel-Concrete Composite Structures

3 credits (2-0-2)

Design of members subjected to lateral loads and axial loads - Principles of analysis and design of Industrial buildings and bents. Introduction to composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections – composite sections under positive bending – negative bending – propped conditions – un-propped conditions – deflection of composite beams. Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span - Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni-axial and bi-axially loaded columns. Composite shear wall – double skinned composite deck panels – composite trusses – composite frames – composite plate girders.

CEL606 Project Planning and Control

3 credits (2-0-2)

Work study, work break down structure, time estimates, application of CPM/PERT, statical concepts, Man-Material-Machinery-Money optimization, scheduling, monitoring, updating. Cost function, time-cost trade off, resource planning-levelling and allocation. Resources – based network, crashing, master network, interface activities, and dependencies, line of balancing techniques, application of digital computer. Material management- purchase management and inventory control, ABC analysis. Human resource management

CEL608 Quality And Safety in Construction

3 credits (2-0-2)

Introduction to quality management. Planning and control of quality during design of structures. Quality assurance during construction. Inspection of materials and machinery. Preparation of quality manuals, check-list and inspection report.

Establishing quality assurance system. Quality standards/codes in design and construction.

Concept and philosophy of total quality management (TQM). Training in quality and quality management systems (ISO-9000). Concept of safety. Factors affecting safety: Site management with regard to safety recommendations. Training for safety awareness and implementation. Formulation of safety manuals. Safety legislation, standards/codes with regard to construction. Quality vs Safety. Case Studies