

UNIVERSITY OF MUMBAI



Syllabus for ME Civil Engineering

Programme : M.E.

**Course : Civil Engineering
(Construction Management subjects)**

(As per Credit Based Semester and Grading System with
effect from the academic year 2012–2013)

ME Civil Engineering with Construction Management subjects) Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract	Tut	Theory	Pract.	Tut	Total	
CMC101	Principles and Practices of Management	04	--	--	04	--	--	04	
CMC102	Project Accounting and Economics	04	--	--	04	--	--	04	
CMC103	Project Planning and Scheduling	04	--	--	04	--	--	04	
CME101X	Elective I	04	--	--	04	--	--	04	
CME102X	Elective II	04	--	--	04	--	--	04	
CML101	Laboratory I	--	02	--	--	01	--	01	
CML102	Laboratory II	--	02	--	--	01	--	01	
Total		20	04	--	20	02	--	22	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
CMC101	Principles and Practices of Management	20	20	20	80	03	--	--	100
CMC102	Project Accounting and Economics	20	20	20	80	03	--	--	100
CMC103	Project Planning and Scheduling	20	20	20	80	03	--	--	100
CME101X	Elective I	20	20	20	80	03	--	--	100
CME102X	Elective II	20	20	20	80	03	--	--	100
CML101	Laboratory I	--	--	--	--	--	25	25	50
CML102	Laboratory II	--	--	--	--	--	25	25	50
Total		100	100	100	400	--	50	50	600

ME Civil Engineering with Construction Management subjects) Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CMC201	Project Monitoring and Control	04	--	--	04	--	--	04	
CMC202	Management of Construction Resources	04	--	--	04	--	--	04	
CMC203	Quantitative Techniques for Construction Managers	04	--	--	04	--	--	04	
CME201X	Elective III	04	--	--	04	--	--	04	
CME202X	Elective IV	04	--	--	04	--	--	04	
CML201	Laboratory III	--	02	--	--	01	--	01	
CML202	Laboratory IV	--	02	--	--	01	--	01	
Total		20	04	--	20	02	--	22	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
CMC201	Project Monitoring and Control	20	20	20	80	03	--	--	100
CMC202	Management of Construction Resources	20	20	20	80	03	--	--	100
CMC203	Quantitative Techniques for Construction Managers	20	20	20	80	03	--	--	100
CME201X	Elective III	20	20	20	80	03	--	--	100
CME202X	Elective IV	20	20	20	80	03	--	--	100
CML201	Laboratory III	--	--	--	--	--	25	25	50
CML202	Laboratory IV	--	--	--	--	--	25	25	50
Total		100	100	100	400	--	50	50	600

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CMS301	Seminar	--	06	--	--	03	--	03	
CMD301	Dissertation I	--	24	--	--	12	--	12	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
CMS301	Seminar	--	--	--	--	50	50	100	
CMD301	Dissertation I	--	--	--	--	100	--	100	
Total		--	--	--	--	150	50	200	

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CMD401	Dissertation II	--	30	--	--	15	--	15	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test 2	Avg.					
CMD401	Dissertation II	--	--	--	--	100	100	200	
Total		--	--	--	--	100	100	200	

Elective – I (Any One)	Elective – II (Any One)
Advanced Construction techniques	Sustainable Construction Materials
Value Engineering	Building Services
Total Quality Management	Repairs, Rehabilitation and Retrofitting Techniques

Elective – III (Any One)	Elective – IV (Any One)
Applied Statistics and Research Methodology	International Contracting
Safety Management	Risk Management
Construction Marketing	Management of Infrastructure Services

Note:

- In case of Seminar, 01 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation I, 02 Hour / week / student should be considered for the calculation of load of a teacher
- In case of Dissertation II, 02 Hour / week / student should be considered for the calculation of load of a teacher

- **End Semester Examination:** In all six questions to be set, each of 20 marks, out of these any four questions to be attempted by students. Each question will comprise of mixed questions from different units of the subjects.

Semester I

Subject Code	Subject Name	Credits
CMC101	Principles and Practices of Management	04

Detailed Syllabus

Module	Description
1	Management Need, what is it, systems approach, and emergence of management thought, contributions of Fredrick Taylor, Henry Fayol, emergence of behavioural sciences, and that of the modern management thought.
2	Construction Management Need, nature of construction industry, scope and functions of construction management.
3	Planning Planning process, objectives, strategies and policies, making planning effective.
4	Organizing Nature and purpose, types of organizations, organizational behaviour, informal organizations, organizational climate, group decision making , making organizing effective
5	Staffing Nature and purpose, selection, appraisal, organizational development
6	Leading Managing and human factor, motivation, leadership, team development, communication, managing conflicts, qualities of project manager
7	Controlling Process of controlling, direct and indirect control.

Recommended Books:

- (1) Koontz, O'Donnel & Wehrich, Management, McGraw Hill
- (2) Dharwadkar P P, Management in Construction Industry, Oxford & IBH
- (3) Luthans, Organization Behavior, McGraw Hill

Semester I

Subject Code	Subject Name	Credits
CMC102	Project Accounting and Economics	04

Detailed Syllabus

Module	Description
1	Basic accounting mechanics Generally accepted accounting principles, books of original entry.
2	Preparation of financial statements Income statement, balance sheet.
3	Techniques of financial analysis Statement of changes in financial position (working capital / cash flow / total resources basis) Ratio analysis.
4	Project financing Means, norms, and policies of financial institutions.
5	Long term investment decisions Cash flow estimates, evaluating techniques, alternative selection, basic concepts of analysis of risk & uncertainty, cost of capital, lease financing.
6	Management of current assets Planning, financing and control of working capital, management of cash, receivables management, inventory management.
7	Principles of Economics Importance of the economic background to measurement, objectives of business firm. Factors bearing on size of firms. Motives to growth. Obstacles to growth of firms, Study of present economy.
8	Economic Analysis Cost implication to different forms of construction and maintenance and maintenance and replacement lives of material, Installation and running cost of services, Capital investment in project, Cost analysis by traders and by functional element, Cost planning techniques, Cost control during design and Construction, Depreciation, Various Appraisal Criteria Methods. Break-even analysis, Cash flow analysis, Risk Analysis and Management Practice, Role of Lender's Engineer.

Recommended Books:-

- (1) Prasanna Chandra, 'Projects planning, Analysis Selection, Implementation and Review. Tata McGraw Hill, New Delhi.
- (2) Singh H. 'Construction Management and Accounts', Tata McGraw Hill, New Delhi.
- (3) Cormican D. 'Construction Management : "Planning and finance"', Construction press,
- (4) Leland T. Blank. Anthony Tarquin. 'Engineering Economy' McGraw Hill.
- (5) David Bedworth, Sabah Randhawa. 'Engineering Economics' McGraw Hill.
- (6) Bruggeman. Fishr 'Real Estate, Finance and investment' McGraw Hill.
- (7) Block Hirt. 'Foundations of Financial Management' McGraw Hill.
- (8) Bhattacharya & Dearden, 'Accounting for management', Vani Educational Books
- (9) Prasanna Chandra, 'Financial Management'.

Semester I

Subject Code	Subject Name	Credits
CMC103	Project Planning and Scheduling	04

Detailed Syllabus

Module	Description
1	Project Management Basic forms of organization with emphasis on Project and matrix structures; project life cycle, planning for achieving time, cost, quality, safety requirements of projects, project feasibility reports based on socio-techno-economic-environmental impact analysis, project clearance procedures and necessary documentation for major works like dam, multi-storeyed structures, ports, tunnel, Qualities. Role, responsibility of projects Manager, Role of PMC (Project Management Consultants) on major projects, Web based project management.
2	Construction Scheduling Work break down structure, activity cost and time estimation in CPM, PERT, RPM (Repetitive Project Modelling) techniques. LOB technique Mass haul diagrams. Precedence Network Analysis, AOA and AON diagrams, single and over-lapping relationships, time chainage chart, resource allocation, leveling and smoothing, time cost tradeoff: simple & complex, Preparing project plans, schedules and budgets, master networkssoftwares in Construction scheduling (MSP, prima vera, Construction manager).
3	Construction Management Site mobilization – demobilization aspects, various Resources management based on funds availability, organizing and monitoring of the construction work with respect to cost-time schedules, co-ordinating – communicating- reporting technique Application of MIS to construction, monitoring and control mechanisms, Training of Construction Managers.

Recommended Books:

- (1) Harris R B, Precedence & arrow networking techniques for construction, Wiley.
- (2) Antill & Woodhead, Critical path methods in construction practice, John Wiley.
- (3) Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication.
- (4) Project Management – K Nagrajan – New Age International Ltd.
- (5) Professional Construction Management barrie-Paulson-McGraw Hill Institute Edition.
- (6) Project Management – Ahuja H.N. – John Wiely, New York.
- (7) Construction Project Management Planning, Scheduling and Controlling-Tata McGraw Hill, New Delhi.
- (8) Construction Management – Roy, Pilcher.
- (9) Construction Management – O'Brien.

Semester I

Subject Code	Subject Name	Credits
CME101X	Advanced Construction Techniques (Elective-I)	04

Detailed Syllabus

Module	Description
1	Method statement for large and heavy Engineering projects:- Method statement for major activities like excavation, concreting, steel fabrication and erection for projects like earthen dams, tunnels, composite structure hydropower projects, nuclear power plant, refineries and other industrial projects like cooling tower, silos, and Chimney
2	Concrete construction for heavy Engineering projects:- Selection of equipments for batching , mixing, transporting, placing and compacting for various types of jobs, safety measures during concreting, special concretes and mortars, preplaced aggregate concrete, roller compacted concrete, concreting under water, concreting in different weather condition.
3	Prefabricated Construction: Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measure during erection.
4	Steel Construction:- Planning for field operation, selection of equipment and erection tools and methods of welding, tools and methods of cutting and joining, safety measures during fabrication and erection.
5	Bridge Construction: - Launching of bridges by incremental launching, using false work, and balanced cantilever construction method.
6	Ground Improvement Techniques:- Soil distribution in India, Reclaimed Soils, selection for field compaction procedures, compaction quality control, stone column, sand drain, diaphragm wall, soil reinforcement, thermal methods, improving rock stability and quality.
7	Formwork: Requirement of formwork, loads carried by formwork, types of formwork such as timber formwork, Steel formwork, patent formwork, modular shuttering, slip forms, steel scaffolding.
8	Intelligent Buildings: Historical Context, High technology: - Energy efficiency, life safety systems, Telecommunications systems, workplace automation and typical services.
9	Case Studies for heavy Construction Projects

Recommended Books:

- (1) Thomas Baron, Erection of steel structures.
- (2) Stubbs, handbook of heavy Construction.
- (3) Mahesh Verma, Construction Equipment and its planning & applications.
- (4) R.L. Purify & Ledbetter, Construction Equipment and planning, McGraw Hill.
- (5) Wadell, Concrete Construction Handbook.
- (6) Dr. P. Purushothamma Raj, Ground Improvement Techniques, Laxmi Publications
- (7) Punnoswami, Bridge Construction
- (8) Journals of Civil Engineering and Construction Engineering

Semester I

Subject Code	Subject Name	Credits
CME101X	Value Engineering (Elective-I)	04

Detailed Syllabus

Module	Description
1	Introduction Definitions: Value, value engineering, value analysis, value management, Habits, Roadblocks & attitudes and their relation to value engineering
2	Function Analysis Function & its role in achieving value, function in terms of its cost & worth, Graphical function analysis, function analysis system technique
3	Creative thinking creative people, creative processes, conducting creative session
4	Life cycle costing purpose& implications, economic principles for life cycle costing, types of life cycle costs.
5	Energy Energy resources & consumption, energy cost escalation, sources of energy supply, end use of energy, energy embodiment of construction materials, buildings, infrastructures facilities & energy systems, energy models, factors affecting energy consumption

Recommended Books:

- (1) Value Engineering; L.W. Zimmerman, G.D.Hart, CBS publishers & distributor
- (2) Value analysis in design & Construction, O'Brian, J J, McGraw Hill
- (3) Techniques of Value Analysis & Engineering; L.D. Miles; McGraw Hill

Semester I

Subject Code	Subject Name	Credits
CME101X	Total Quality Management (Elective-I)	04

Detailed Syllabus

Module	Description
1	Quality Necessity for improving Quality in the context of Global Challenges.
2	Concept of Quality Control, Quality Assurance, Quality Management and Total Quality Management (TQM)
3	Study of various Quality Standards in Construction: Related to building materials and other inputs for construction processes, methods and techniques for construction outputs, products and services, such as BIS, BS, Indian standard, British, American, German & Japanese standards, Managing Quality in various projects stages from concept to completion by building quality into design of structures, Inspection of incoming material and machinery In process quality inspections and tests.
4	Statistical Quality Control Introduction, c chart, p chart X Chart
5	Designing of quality manuals , checklists and inspection reports, installing the quality assurance system, monitoring and control.
6	Quality Assurance Department and quality control responsibilities of the line organization. Quality in foundations and piling work, structural work. Concreting, electrical system building facilities, waste recycling and maintenance.
7	Developing quality culture in the organization: Training of people, Bench – marking quality. Quality circles.
8	Study of ISO 9000, ISO 14000 and QS 9000 standards and certification procedures.

Recommended Books:

- (1) Duncan, Thorpe & Summer, Quality assurance in construction, Gower

Semester I

Subject Code	Subject Name	Credits
CME102X	Sustainable Construction Materials (Elective-II)	04

Detailed Syllabus

Module	Description
1	Types and properties of construction materials and components. And corresponding experimental work. Aggregates types, sources and quality. Inorganic cements. Concrete mix design, admixtures and quality control. Asphalt cement, asphalt concrete mix design and quality control. Steel in construction. Masonry materials, timber, insulation materials and coatings.
2	Various types of advanced concrete, metals, and highway materials. Examples are - concrete admixtures, light weight aggregates, polymers, prestressed concrete, high strength, high durability and corrosion resistant materials - soil stabilizers, - bituminous materials and 'Superpav' - high strength low alloy steels, special construction alloys, - special concretes, soil stabilizers, and and high strength low alloy steels.
3	Environmental-friendly use of materials and incorporation of waste materials.
4	Advanced quality control techniques. Laboratory experiments are conducted for demonstration purposes
5	Advanced mechanics of components incorporating innovative materials. Environmental-friendly use of materials and recycling of solid waste.
6	Effect of material properties on design. Effect of manufacturing processes on design. Failure and reliability of components in service. Economics of materials and manufacturing processes. Decision making and the selection process. Integration of design and economic analysis with materials and process selection.

Recommended Books

- (1) Various standards and handbooks detailing properties, acceptance criteria for various purposes of use and test procedures

Semester I

Subject Code	Subject Name	Credits
CME102X	Building Services (Elective-II)	04

Detailed Syllabus

Module	Description
1	Water and Sanitation Water quality, Purification and treatment- water supply systems-distribution systems in small towns -types of pipes used- laying jointing ,testing-testing for water tightness plumbing system for building-internal supply in buildings- municipal bye laws and regulations - Rain Water Harvesting - Sanitation in buildings-arrangement of sewerage systems in housing -pipe systems- storm water drainage from buildings -septic and sewage treatment plant - collection, conveyance and disposal of town refuse systems.
2	Electrical Systems Types of wires , wiring systems and their choice -planning electrical wiring for building - main and distribution boards -transformers and switch gears -modern theory of light and colour -synthesis of light -luminous flux -candela- lans of illumination-lighting design-design for modern lighting.
3	HVAC Ventilation and its importance-natural and artificial systems-Window type and packaged air-conditioners-chilled water plant -fan coil systems-water piping -cooling load -air conditioning systems for different types of buildings -protection against fire to be caused by A.C.Systems.
4	Fire Systems Causes of fire in buildings-safety regulations-NBC-planning considerations in buildings like Non-combustible materials, construction, staircases and A.C. systems, special features required for physically handicapped and elderly in building types-heat and smoke detectors-dry and wet risers-Automatic sprinklers - Capacity determination of OHT and UGT for fire fighting needs.. Intelligent buildings-Building automation-Smart buildings- Building services in high rise buildings.

Reference Books:

- (1) G.M.Fair, J.C.Geyer and D.Okun, Water and waste Engineering, Vol.II, John Wiley &sons, Inc., New York. 1968.
- (2) R. G. Hopkinson and J.D.Kay, The Lighting of buildings, Faber and Faber, London, 1969.
- (3) Hand book for Building Engineers in Metric systems, NBC, New Delhi, 1968.
- (4) Philips Lighting in Architecture Designs, McGraw Hill, New York, 1964.
- (5) Time saver Standards for Architecture Design Data, Callendar JH, McGraw Hill, 1974.
- (6) William H. Severns and Julian R.Fellows, Air conditioning and refrigeration, John Wily and sons, London, 1988.

Semester I

Subject Code	Subject Name	Credits
CME102X	Repairs, Rehabilitation and Retrofitting Techniques (Elective-II)	04

Detailed Syllabus

Module	Description
1	Maintenance and repairs strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Importance of rehabilitation as a part of construction engineering. Preventive measures on various aspects, Inspection, Assessment procedure for evaluating a damaged structure cause of deterioration, testing techniques. Engineered demolition techniques for Dilapidated structures
2	Rehabilitation studies of buildings, underground construction, bridges, streets and highways, sewage treatment plants – masonry work, R.C.C. works, steel structures- types of distress. Numerical condition surveys for foundation, structural and functional deterioration, design criteria, materials and techniques.
3	Materials for repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, fiber reinforced concrete.
4	Techniques for repair: rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and shotcrete Epoxy injection, mortar repair for cracks, shoring and underpinning.
5	Repairs to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering, wear, fire, leakage, marine exposure
6	Predictive performance models , evaluating alternatives based on technical, commercial, management, financial feasibilities, data collection and database management, maintenance of rehabilitated structures. Procedure adopted by BIFR (Board of Industrial and Financial Reconstruction)
7	Earthquake damages of buildings, their retrofitting, restoration, effects of earthquakes, response of buildings to earthquake motion, factors related to building damages due to earthquake, methods of seismic retrofitting, restoration of buildings.

Recommended Books:

- (1) Published books in the relevant areas to be supplemented by latest journal articles and papers, seminar and conference proceedings, in-house publications, monographs etc.

Semester I

Subject Code	Subject Name	Credits
CMEL101	Laboratory Practice - I	02

Detailed Syllabus

Module	Description
1	Speaking Skill: Voice Modulation, Good Pronunciation, Speaking without fear, Extempore & Prepared speaking, Body Language, Telephone Etiquette/ Mobile /Video conferences.
2	Listening Skill Barriers to listening, Listening & Note making.
3	Writing Skill Building Vocabulary, Effective Sentences & paragraphs, Organizational Techniques & patterns, Summarizing.
4	Types of Writing: Letters, memo, Reports/ Proposals/ Research Paper/ Conference Paper/ E-mails/ Sharing Documents Online.
5	Interview: Pre-Interview Preparation, Interview Question Answer, Resume & Job Application, Group Discussion, Telephone Interviews.
6	Presentation Skills: Planning, preparing, Organizing, Delivery, Feed Back.
7	Seminar Presentation on the following Topics: (1) Time Management (2) Motivation (3) Negotiation & Conflict Management (4) Stress Management (5) IPR (6) Transactional Analysis (7) Leadership (8) Presentation Through Video conferences

Recommended Books:

- (1) Effective Technical Communication- M .Ashraf Rizvi (McGraw Hill)

Semester I

Subject Code	Subject Name	Credits
CML101	Laboratory Practice - II	02

Detailed Syllabus

Module	Description
1	This will be based on the syllabi of theory subjects [MCEM-C101, MCEM -C102, MCEM -C103, MCEM -E101X, MCEM -E102X] It shall consist of the assignments based on the syllabus of the respective subjects. The assignments should be given in such a manner that it will cover the contents of the syllabus evenly.
	The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.
	At least one site visit and preparation of study report of various case studies for actual field/ practice oriented problems for each of the above subjects and/ or the, students may be asked to perform few practical of the related subject and submit the report thereof.

Semester II

Subject Code	Subject Name	Credits
CMC201	Project Monitoring and Control	04

Detailed Syllabus

Module	Description
1	Project monitoring Progress reporting,, review meetings, updating plans
2	Schedule control Common causes of schedule delays, measuring productivity, methods of enhancing productivity
3	Cost control Cost codification, earned value concept, variance analysis, alarm reports, control measures,client and contractor point of view
4	Quality management Concept of quality, aspects of quality, quality control and assurance, inspection, preparation of manuals and checklists
5	Safety management Types of accidents on construction work sites and their common causes, direct and indirectcosts of accidents, occupational health hazards, general precautions to be followed foravoiding accidents, safety campaign, training for safety
6	Integrated approach to project control Project management information systems, computer networking

Recommended Books:

- (1) Kerzner, Project Management, CBS Publishers
- (2) Pilcher R, Project cost control in construction, Collins
- (3) King & Hudson, Construction Hazard & Safety Handbook, Butterworth's
- (4) Dulkan, Thorpe & Summer, Quality assurance in construction, Gower

Semester II

Subject Code	Subject Name	Credits
CMC202	Management of Construction Resources	04

Detailed Syllabus

Module	Description
1	Human Resources Management Staffing, recruiting, orientation and training, performance evaluating, merit rating Labour Management: Strikes and lockouts, collective bargaining, grievances and grievance settling procedure, labour welfare
2	Equipment Management Mechanization on construction projects, selection of major and minor equipment, production estimating, sizing and matching of equipment Sources of construction equipment: purchase, rent and lease, old and new equipment Economics of equipment, useful / economic life of equipment, equipment operation and service, maintenance, depreciation, obsolescence and replacement Equipment management systems, organizations, record keeping, training to operators
3	Materials Management Importance, Estimation of materials, Classification and codification, ABC analysis Purchase function: legal aspects of purchase, inventory control, concept of EOQ Stores management, , minimizing wastageMaterial management systems, Organizations, record keeping

Recommended Books:

- (1) Varma Mahesh, Construction Equipment, its Planning & Application, Metropolitan & Co
- (2) Gopalkrishnan, Materials Management
- (3) Nunnally, Managing construction equipment, Prentice Hall

Semester II

Subject Code	Subject Name	Credits
CMC202	Quantitative Techniques for Construction Managers	04

Detailed Syllabus

Module	Description
1	Management Decision Making Management decision making, art of modelling, systems approach, concept of optimization, attitudes of decision maker
2	Decision theory and games Decisions under uncertainty and risk: decision trees, game theory
3	Linear programming LP formulation, solution by graphical method, simplex method, duality, sensitivity and parametric analysis, transportation model, assignment model,
4	Integer programming branch and bound algorithm
5	Network model Network definition, shortest route problem, maximal flow problem
6	Waiting Lines Basic structure of queuing models, M/M/1 model
7	Dynamic programming Formulation of model and recursive equations, and applications
8	Group decision making Behaviour of a decision maker as an individual and in a group, compromise and consensus decision making
9	Simulation Monte Carlo method, applications

Recommended Books:

- (1) Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley
- (2) Taha Hamdy, Operations Research, An Introduction
- (3) Rao S S, Optimization: Theory and applications

Semester II

Subject Code	Subject Name	Credits
CME201X	Applied Statistics and Research Methodology (ELECTIVE - III)	04

Detailed Syllabus

Module	Description
1	Review of basic statistics and probability
2	Probability Distributions: Theoretical, binomial, Poisson, normal, exponential, hyper geometric, uniform
3	Sampling and Sampling Distributions: Probability and non-probability samples, sampling and non-sampling errors, sample size, sampling distributions : t, F and c ² distributions
4	Hypothesis Testing: Type I and II error, testing of mean, proportion, tests for equality of mean and variances of two populations, confidence interval, c ² test for goodness of fit, ANOVA (one way classification), Non parametric tests : sign test, U test
5	Correlation and Regression: Karl Pearson's and Rank Correlation coefficient, simple linear regression : least squares method
6	Introduction to “research” and its significance, meaning of research. ,Types of research, areas of research, qualitative and quantitative paradigms. Research Design: Components of research design – formulating the research questions, hypothesis, choosing the sample, methods of data collection, analyzing the data and inferring from the data. Concepts of dependent and independent variables, unit of analysis. Defining the scope and limitations of a research plan, significance of the research outcome. Preparing time schedule & budget for a research plan. Literature Study and Research: Significance of literature study in research, different sources of information such as books, journals, newspapers, internet, magazines, audio-recordings, etc. Referencing and documenting the bibliography.
7	Methods of Research: Interview Techniques: Questionnaires /Face to face Interviews / Internet survey. Designing a Questionnaire / Interview schedule. Visual Techniques: Observations (participant / non-participant / direct), activity mapping, accession/erosion trace observations, cognitive maps, etc. Content Analysis: Secondary data analysis: Understanding the relative advantages, disadvantages and application of various methods mentioned above and choosing a method appropriate for a research to achieve its objectives.
8	Data Documentation and Analysis: Understanding the nature of data collected and methods of analysis suitable for that data (graphical / numerical / descriptive). Converting data into numerical form for data analysis. Introduction to the Statistics Introduction to the simple statistical methods of analyzing numerical data – frequencies / percentages, mean / median / mode, correlation, chi square test – inferring from the data and interpreting the meaning of those inferences. Use of MS Excel for statistical data analysis.

9	Presentation & Reporting: Presentation of the Data: Techniques of presenting the numerical data – graphical (pie charts, bar charts, line graphs etc.), tabulations, verbal qualitative data, architectural drawings / maps. Reporting the Research : Different sections of a research report, technical writing and language (tense, voice, etc.), formatting of a report.
----------	--

Recommended Books:

- (1) Shrivatava, Shenoy & Sharma, Quantitative Techniques for Manegerial Decision, Weiley.
- (2) Kothari C R, Reasearch methodology, Weily Eastern
- (3) Goode W J & Hatt P K, Methods in social reaserch, McGraw Hill.

Semester II

Subject Code	Subject Name	Credits
CME201X	Safety Management (ELECTIVE - III)	04

Detailed Syllabus

Module	Description
1	Construction Safety Management Role of various parties, duties and responsibilities of topmanagement, site managers, supervisors etc. role of safety officers, responsibilities of generalemployees, safety committee, safety training, incentives and monitoring. Writing safetymanuals, preparing safety checklists and inspection reports.
2	Safety in construction operations Safety of accidents on various construction sites such asbuildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction.Prevention of accidents. Safety measures.
3	Safety in use of construction equipment e.g. vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms. Safety while using electrical appliances. Explosives
4	Various safety equipment and gear used on site. First aid on site.
5	Labour laws , legal requirement and cost aspects of accidents on site.
6	Study of safety policies , methods, equipment, training provided on any ISO approved construction company.

Recommended Books:

- (1) Construction safety manual published by National Safety Commission of India.
- (2) "Safety Management in Construction Industry" – A manual for project managers.
- (3) NICMAR Mumbai.
- (4) Construction Safety Handbook – Davies V.S.Thomasin K, Thomas Telford,
- (5) London.
- (6) "ISI for safety in Construction – Bureau of Indian Standards.
- (7) "Safety management" –Garibaldi and Simonds, AITBS, New Delhi.

Semester II

Subject Code	Subject Name	Credits
CME201X	Construction Marketing (ELECTIVE - III)	04

Detailed Syllabus

Module	Description
1	Marketing environment: impact of internal and external environment, socio-economic, demographic, political, technological and legal environment, nature and impact of competition, marketing strategy
2	Basics of marketing: features of marketing of consumer goods, industrial products and services, product and marketing, marketing organization structures, societal role of marketing
3	Marketing projects: characteristics of construction projects, sources of information, pre-qualification documents, bid preparation – estimating, provision for overheads and profit, bidding models, bidding strategy, pre-bid meetings, negotiation, legal aspects, impact of joint ventures, collaborations and alliances, impact of globalization and privatization, strategies for project export
4	Marketing real estate: characteristics of real estate, demand and supply relationship, segmentation, product mix, pricing strategies, advertising strategies, legal aspects
5	Marketing products for construction: characteristics of construction materials and equipment, strategies for marketing of materials and equipment for construction, demand surveys, advertising strategies, communication, exhibitions and product demonstrations, pricing strategies, financing arrangements

Recommended Books

- (1) Published books in the relevant areas to be supplemented by latest journal articles and papers, seminar and conference proceedings, in-house publications, monographs etc.

Semester II

Subject Code	Subject Name	Credits
CME202X	International Contracting (ELECTIVE - IV)	04

Detailed Syllabus

Module	Description
1	International contracting – meaning, scope, nature, present status of the International construction market, role of Asia- Pacific region countries in the present construction Development. Impact of WTO/GATS on the Indian Construction Sector as regards domestic market and export sector.
2	Study and application of various conditions of contract under the FIDIC document Development of regulatory framework. Project exports from India.
3	International financing: Various institution such as WB, IMF, ADB. African bank etc. and their role, rules – regulations in funding various projects, forming alliance, bilateral and multilateral funding, trade practices etc.
4	International Projects – Types of BOT systems such as BOT, BOOT, BOO, DBO, BOR, BLT, BRT, BTO & DBGO, MOOT, ROO, ROT, BOLT – Contractual procedures, special features, and methods of handling.
5	Selection of personnel to suit socio-economic-environmental culture in other countries, suitable organisational structure.
6	Disputes Resolving – International Courts, formation of DRB's (Dispute resolving boards) functioning and experiences in India and abroad, Advantages of DRB's
7	CASE studies of any 2 major project executed/functioning under International contracting.

Recommended Books:

- (1) FIDIC documents.
- (2) Construction Contracts & Claims – Simon M.S. McGraw Hill, New York.
- (3) Unified Contract Documents by CIDC.
- (4) Dispute Review Board Manual by Reboert Matays and Mathews.
- (5) International Construction Contracting – K.N.Vaid-NICMAR Publication.

Semester II

Subject Code	Subject Name	Credits
CME202X	Risk Management (ELECTIVE - IV)	04

Detailed Syllabus

Module	Description
1	Risk analysis and Management for projects (RAMP) – Identifying risk events. Probability distribution. Stages in Investment life-cycle; Determination of NPV and its standard deviation for perfectly co-related, moderately co-related and un-correlated cash flows.
2	Sensitivity analysis
3	scenario analysis simulation, decision tree analysis, risk profile method, certainly equivalent method; risk adjusted discount rate method, certainty index method, 3 point estimated method; use of risk prompts, use of Risk Assessment tables, details of RAMP process, utility of Grading of construction entities for reliable risk assessment.
4	Risk Mitigation – by elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, mitigation of unqualified risk. Coverage of risk through CIDC's MOU with the Actuarial Society of India through risk premium such as (BIP) – Bidding Indemnity Policy (DIMO) – Delay in meeting obligation by client policy, (SOC) – Settlement of claims policy (LOP) - Loss of profit policy (TI).
5	Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy.

Recommended Books:

- (1) Industrial Engineering and Management of manufacturing systems.- Dr. Surendra Kumar Satya Prakashan
- (2) RAMP Handbook by institution of Civil Engineers and the faculty and Institute of Actuaries Thomas Telford publishing, London.
- (3) Construction Engineering and Management – Seetharaman.
- (4) Projects Planning analysis selection implementation and Review – Prasanna Chandra.

Semester II

Subject Code	Subject Name	Credits
CME202X	Management of Infrastructure Services (ELECTIVE - IV)	04

Detailed Syllabus

Module	Description
1	Infrastructure management Need and concept, expected performance, survey and evaluation of distresses, inspection checklists, organization for rehabilitation, policies, funding
2	Concept of infrastructure upkeep
3	Buildings Post occupancy evaluation of buildings, deformation and common defects in buildings, restoration & rehabilitation measures
4	Buildings Post occupancy evaluation of buildings, deformation and common defects in buildings, restoration & rehabilitation measures
5	Pipelines (water/ sewage/ air/ gas) Purpose and methods of evaluation, evaluation of physical condition, methods of rehabilitation
6	Pavements (roadways / runways) Evaluation and performance surveys, distress evaluation, methods of resurfacing, overlays, restoring and rehabilitation, up-gradation and maintenance of permanent way
7	Bridges Inspection and reporting methods, rehabilitation measures
8	Ports & harbours Maintenance of ports, port buildings, and services

Recommended Books:

- (1) Published books in the relevant areas to be supplemented by latest journal articles and papers, seminar and conference proceedings, in-house publications, monographs etc.

Semester II

Subject Code	Subject Name	Credits
CML201	Laboratory Practice - III	02

Detailed Syllabus

Module	Description
1	<p>Use of spread sheet and data base application software for performing various functions of civil engineers as mentioned below is to be demonstrated</p> <ul style="list-style-type: none">• Quantity Estimation• Rate Analysis• Bid preparation• Material and supplier information• Employee / equipment information etc.
2	<p>The laboratory includes use of project management software to develop a plan with overlapping relationships. The plan shall include</p> <ul style="list-style-type: none">• List of activities• Quantity estimation for activities• Method statement for complex activities• Activity logic sequence table• Estimates of duration (including computations)• Preparation of activity on link and/or activity on node network• Calculation of network duration and float analysis• Application of software shall be demonstrated for• Cash Flow generation• Resource leveling• Updating of networks• Variance analysis

Semester II

Subject Code	Subject Name	Credits
CML201	Laboratory Practice - IV	02

Detailed Syllabus

Module	Description
1	This will be based on the syllabi of theory subjects [MCEM-C201, MCEM –C202, MCEM –C203, MCEM –E201X, MCEM –E202X] It shall consist of the assignments based on the syllabus of the respective subjects. The assignments should be given in such a manner that it will cover the contents of the syllabus evenly.
	The students shall be encouraged to deliver the seminar pertaining to any one of the topics in each above subject heads.
	At least one site visit preferably in each subject and preparation of study report of various case studies for actual field/ practice oriented problems for each of the above subjects and/ or the, students may be asked to perform few practical of the related subject and submit the report thereof.

Semester III		
Subject Code	Subject Name	Credits
CMS301	Seminar	03

Guidelines for Seminar

- Seminar should be based on thrust areas in the Civil/ Construction Engineering, Construction/ Civil Engineering Project Management, Infrastructure Development.
- The objective behind seminar is to equip the student for carrying out literature survey, summarize the findings of the literature and formulate the problem or arrive upon the statement of the problem. Along similar lines, the student can work for their dissertation in the subsequent stages.
- The student in consultation with the Guide/ Supervisor shall settle or finalize / identify the topic of the seminar in the context of the specialization or allied theme. The students shall carry out literature survey pertaining to the topic, various sub-topics/ approaches/ methods falling within the purview of the topic. The student shall use multiple literatures and understand the topic, analyze the literature and summarize the findings. The report shall be compiled in a standard format. The student shall have to present the deliver the seminar/presentation in front of the board of examiners appointed by the Head of the Institution or Head of the Department as the case may be.
- The supervisor may ask the student to author a technical paper based on the seminar report and present it in a seminar or conference of national repute. Publication of paper in an International Conference shall be preferred. The paper could be a review paper.
- The assessment of the seminar shall be assessed in respect of the following points:
 - Quality of Literature survey and Novelty in the topic
 - Relevance to the specialization
 - Understanding of the topic
 - Quality of Written and Oral Presentation
 - Efforts made by the students to author a technical paper (preferably of review nature) and its subsequent publication either in the journal or in the conference proceedings and presentation in the conference.

IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post-Graduate qualification with at least five years' experience in Industries.
2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.
3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

Semester IV

Subject Code	Subject Name	Credits
CMD301 / CMD401	Dissertation (I and II)	12

Guidelines for Dissertation

- Student should carry out the preliminary literature survey and subsequently, identify the problem in broad terms for Dissertation and finalize/ settle it in consultation with Guide/ Supervisor.
- Pursuant to this, the student shall refer multiple literatures pertaining to the theme of the problem and understand the problem and define the problem in the precise terms.
- Student should attempt solution to the problem by analytical/simulation/experimental methods. The solution shall be validated with proper justification. The students shall compile the report in standard format.
- Student should publish at least one paper based on the work in reputed International / National Conference in which papers are blindly reviewed (desirably in Refereed Journal). More weightage shall be given for the journal publication.
- The work to be pursued as a part of the dissertation shall be divided broadly in two parts, namely- Dissertation Stage I and Dissertation Stage II.
- The topic of the Dissertation should be such that it is a value addition for the existing knowledge in the field and has some worthwhile research input.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
 - Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization
 - Clarity of objective and scope
 - Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)/ Data Collection, etc.
- Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

After completion of about 80% of the work (which shall be decided by the Guide/ Supervisor), proposed to be a part of the Dissertation, the student shall deliver a Pre-submission seminar based on the work pursued by him/ her during the second stage. It will be assessed by the panel of internal examiners appointed by the Head of the Department/ Institute of the respective programme, as the case may be.

The student shall take into account the suggestions made by the examiners/s during pre-submission seminar in view of the work pursued by the students and shall try to incorporate it in the work, if the suggestions are worthwhile, consistent with the situation and provided they are such that those can be

accommodated/ included in the work being pursued by the candidate at that point of time.

After the pre-submission seminar, the student shall compile the report in a standard format and written in the systematic manner and chapter wise.

The student shall adhere to the following scheme of chapterization while compiling the final report in general. The Guide/ Supervisor shall ensure the student has written the Dissertation Report in appropriate language (grammatically correct).

1. Introduction: The student shall give the introduction to the theme of the subject chosen as a Dissertation, give further current state of art related to the theme (i.e., brief review of literature), broad problem definition and scope of the work. The student shall also state at the end of this chapter the scheme of chapterization included in his/ her Dissertation.
2. Theoretical Aspects/ Review of Literature: The student is expected to highlight the various theoretical aspects pertaining to the topic chosen, literature (updated) available related to the various aspects of the topic chosen citing the research work carried out by the earlier researchers and summarize the findings of the literature. The student may state the precise the problem definition.
3. Formulation/ Methodology/ Experimental Work: In this chapter, the student is expected to explain the methodology for pursuing his/ her work. In case of analytical work, student may give the Formulation along with validation for assessment of accuracy of the numerical procedure being used/ proposed by him/ her. In respect of experimental work, the student may outline the experimental set up/ procedure. In case of the work in which either approach is involved, the student may appropriately provide the methodology to cover either approach. This chapter may be supported by the Data Collection if the work involves the Collection of the Data and its subsequent processing.
4. Analysis/ Results and Discussion: The student is expected to present the results emerging from the analytical/ theoretical/ experimental study/ studies being pursued by the students. The results shall be discussed properly. The results may be compared with the results published by the earlier researchers if the work being pursued by the student warrants the same. The student may indicate the broad conclusions/ inferences at the end.
5. Summary and Conclusions: Based on the results discussed in the previous chapter, the student shall give in the systematic manner the conclusions/ inferences emerged from the study and summarize it properly. The student shall indicate the scope of the future work which can be extended by any other student/ researcher in the future. The student may point out the limitation/s left out in the work pursued by him/ her while carrying out the work contained in the Dissertation.
6. References: The student shall at the end give the list of the references in the appropriate manner. This part should not be treated as a Chapter. For referencing style, student may refer any standard

journal of national and international repute.

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

Dissertation II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
 - Clarity of Problem definition and Feasibility of problem solution
 - Relevance to the specialization or current Research / Industrial trends
 - Clarity of objective and scope
 - Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)
 - Quality of work attempted
 - Presentation of the results along with the validation of results or part thereof.
 - Quality of Written Report and Oral Presentation
 - Publication of the technical/ research paper by the student in a conference of National/ International repute. Publication of paper in a referred/ peer reviewed journal is highly preferred.
- Dissertation II shall be assessed through a presentation jointly by the Internal Examiner (Guide/ Supervisor) and External Examiner appointed by the University of Mumbai.

