

**AC 4-3-2014
Item No. 4.54**

UNIVERSITY OF MUMBAI



**Syllabus for the
Program: M.E.
Course: Civil Engineering
Construction Engineering & Management
(As per Credit Based Semester and Grading System with
effect from the academic year 2014–2015)**

University of Mumbai
Program Structure for Master of Engineering
ME Civil Engineering
(Construction Engineering and Management)
(With Effect from 2014-2015)

SEMESTER I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
CEM 101	Probability & Statistics	04	--	--	04	--	--	04	
CEM 102	Management and Project Planning In Construction	04	--	--	04	--	--	04	
CEM 103	Advanced Construction Technology	04	--	--	04	--	--	04	
CEM 101X	Elective I	04	--	--	04	--	--	04	
CEM 102X	Elective II	04	--	--	04	--	--	04	
CEM 101L	Laboratory I	--	02	--	--	01	--	01	
CEM 102L	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. Duraton (in Hrs)			
		Test1	Test2	Avg					
CEM 101	Probability & Statistics	20	20	20	80	03	--	--	100
CEM 102	Management and Project Planning In Construction	20	20	20	80	03	--	--	100
CEM 103	Advanced Construction Technology	20	20	20	80	03	--	--	100
CEM 101X	Elective I	20	20	20	80	03	--	--	100
CEM 102X	Elective II	20	20	20	80	03	--	--	100
CEM 101L	Laboratory I	--	--	--	--	--	25	25	50

CEM 102L	Laboratory II	--	--	--	--	--	25	25	50
Total		100	100	100	400	--	50	50	600

SEMESTER II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
CEM 201	Construction Contracts, Administration And Management	04	--	--	04	--	--	04	
CEM 202	Operations Research	04	--	--	04	--	--	04	
CEM 203	Project Economics & Financial Management	04		--	04	--	--	04	
CEM 201X	Elective III	04	--	--	04	--	--	04	
CEM 202X	Elective IV	04	--	--	04	--	--	04	
CEM 201L	Laboratory III	--	02	--	--	01	--	01	
CEM 202L	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	Test2	Avg					
CEM 201	Construction Contracts, Administration and Management	20	20	20	80	03	--	--	100
CEM 202	Operations Research	20	20	20	80	03	--	--	100
CEM 203	Project Economics & Financial Management	20	20	20	80	03	--	--	100
CEM 201X	Elective III	20	20	20	80	03	--	--	100
CEM 202X	Elective IV	20	20	20	80	03	--	--	100
CEM 201L	Laboratory III	--	--	--	--	--	25	25	50
CEM 202L	Laboratory IV	--	--	--	--	--	25	25	50

Total	100	100	100	400	--	50	50	600
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SEMESTER - III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
CEMS301	Seminar	--	06	--	--	03	--	03	
CEMD301	Dissertation I	--	24	--	--	12	--	12	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory				End sem Exam	Term Work	Pract /oral	Total
		Internal Assessment			Test1				
		Test1	Test2	Avg					
CEMS301	Seminar	--	--	--	--	50	50	100	
CEMD301	Dissertation I	--	--	--	--	100	--	100	
Total						150	50	200	

SEMESTER - IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Practical	Tutorial	Theor y	Practical	Tutorial	Total	
CEMD401	Dissertation-II	--	30	--	--	15	--	15	
Total		--	30	--	--	15	--	15	
Subject Code	Subject Name	Examination Scheme							
		Theory				End sem Exam	Term Work	Pract /oral	Total
		Internal Assessment			Test1				
		Test1	Test2	Avg					
CEMD401	Dissertation-II	--	--	--	--	100	100	200	
Total						100	100	200	

Elective I (Any One)	Elective II (Any One)
Advanced Construction Materials	Resources Management
Disaster Management	Total Quality Management in Construction
Repairs, Rehabilitation & Retrofitting Of Structures	Value Engineering
Construction Safety	Project Risk Analysis And Mitigation Techniques

Elective - III (Any One)	Elective - IV (Any one)
Advanced Construction Technology	Principles of Sustainable Development
Infrastructure Development	Energy Conservation techniques in Building Construction
International Contracting	Principles of Architecture & Landscaping

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
CEM101	PROBABILITY & STATISTICS	04

Detailed Syllabus

Module	Description
01	Probability theory and its importance: Definition of probability, Rules of Probability, The Baye's theorem. Random variable. Probability distribution. Mean or Expectation of Random variable. Properties of Mean of Expectation.
02	Theoretical probability Distributions: Binomial Distribution, Poisson Distribution. Normal Distribution, Exponential Distribution, Beta, Gamma.
03	Sampling and sampling distribution: Probability samples, Non-probability samples, sample Random sampling, Other sampling schemes, sampling distribution and standard error, some Sampling and Quality control. Use of concepts of standard deviation, coefficient of variance, range in quality control of concreting and similar such activities.
04	Correlation and Regression and Multivariate Analysis: Bivariate Frequency Distribution Scatter Diagram, Correlation Analysis, Multiple Regression Analysis-Non linear Regression. Use of regression analysis in resources management.
05	Simulation: Types, case studies in construction using simulation techniques, simulation softwares used.
06	Use of mathematical models based on probabilistic and statistical methods, simulation in risk identification, analysis and mitigation of project risks.

Reference Books

1. Probability and Statistics for Engineers –Miller, Freund-Hall, Prentice India Ltd.
2. Applied Mathematics for Engineers and Physicists-pipes and Harvill. McGraw Hill International Edition.
3. Sampling techniques-Cochran, Wiley Series.
4. Statistics-Concepts and Controversies-David S. Moore-Freeman Company, New York.
5. Reliability Principles and practices-Calabro-McGraw Hill Book Company.

Semester - I

Subject Code	Subject Name	Credits
CEM102	MANAGEMENT AND PROJECT PLANNING IN CONSTRUCTION	04

Detailed Syllabus

Module	Description
01	<p>General Management: Comparison between traditional management and modern scientific management, roles of Taylor, Fayol, Mayo and Megregor. Management functions, Management styles.</p>
02	<p>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.</p>
03	<p>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 softwares in Construction scheduling (MSP, primavera, Construction manager).</p>
04	<p>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 Management Information Systems to construction, monitoring and control mechanisms, Training of Construction Managers.</p>
05	<p>Work Study: Definition. Objective, basic procedure, method study and work measurement work study applications in Civil Engineering. Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams.</p>
06	<p>Work Measurement: Time and motion studies, Concept of standard time and various allowance, time study equipment performance rating. Activity sampling time-lapse photography technique. Analytical production studies. Administration of Incentive Schemes –</p>

	Necessity, Merit rating, job evaluation, installation, modification and maintaining and incentive scheme based on implementation experience.
07	Minimum 2 case studies covering the above contents.

Reference Books

1. Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication.
2. Project Management – K Nagrajan – New age International Ltd.
3. Work study – Currie.
4. Professional Construction Management barrie-Paulson-McGraw Hill Institute Edition.
5. Project Management – Ahuja H.N. – John Wiely, New York.
6. Construction Project Management Planning, Scheduling and Controlling-Tata McGraw Hill, New Delhi
7. Construction Management – Roy, Pilcher
8. Construction Management – O'Brien.

Semester - I

Subject Code	Subject Name	Credits
CEM103	ADVANCED CONSTRUCTION TECHNOLOGY	04

Detailed Syllabus

Module	Description
01	Underground and underwater construction: Tunnel-Shaft sinking, Tunnel driving in hard and soft strata, bedding of conduits. Under water construction – Problems, encountered. Underwater drilling, blasting, concreting. Construction of under deep water-concrete diaphragm walls.
02	Concrete: Various methods of shuttering, Ready Mix Concrete, Pumped Concrete
03	Grouting Methods: Cement grouting, colgrout, colcrete process, pre-packed concrete, intrusion grout. Alluvial grouting, various types of clay grouting. Chemical grouting – grouts for injection of fine sands. Resin grouting. Polymerisation technique. Field procedure, applications and limitations.
04	Dewatering: Dewatering of shallow and deep open excavations. Effect of ground water movement. Methods of groundwater control. Shallow and deep well points. Horizontal drainage, vacuum dewatering by electro-osmosis, single and multiple well system, group of wells. Draw down factors, vertical sand drains, pressure relief beneath excavation, well point pumps, headers discharge lines control of surface water. Installation and operation of well point system.
05	Piling: Behaviour of single pile and a group piles during driving, under loads-ultimate loads on driven and cast in Situ piles. Construction details of precast piles, pre-stressed piles, and steel piles, friction piles. Driven and bored piles, large diameter piles, negative and positive skin friction, multiple under reamed piles, raker piles, sand piles, Anchor piles, load on piles – Static. Vibrating loads, cyclic loading, safe bearing load, methods of pile driving by vibration above and under water through different strata, micro piles.
06	Coffer dams and Caisson: Cofferdams – types, design and construction of single, double wall. Cofferdam. Sheet pile cofferdams, concrete wall movable cofferdam, land cofferdams, soldier construction method. Cofferdam wall by ICOS method, caissons, details, design and construction..
07	Formworks: Slip formwork, False work for bridges, Special types of form works.
08	Minimum 1 Case study in each topic covered above

Reference Books

1. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
2. Construction Equipment Planning and Applications – Dr. Mahesh Verma
3. Brochures Published by various agencies associated with construction.
4. Journals such as CE & CR. Construction world, International Construction.
Document Reports of actual major works executed.
5. (INDIAN CONCRETE JOURNAL).

Semester - I

Subject Code	Subject Name	Credits
CEM 101X	(Elective I) ADVANCED CONSTRUCTION MATERIALS	04

Detailed Syllabus

Module	Description
01	Material composition and properties, production, storage, distribution, testing, acceptance criteria applications, limitations of use, economic consideration, recent development related to the following materials to be studied.
02	Various construction chemicals/admixtures.
03	Fly ash and its use in concrete
04	Silica fume concrete
05	Self compacting concrete
06	Fibre Reinforced plastics and concrete
07	High performance concrete
08	Smart materials
09	Materials used in nuclear-containment structures
10	Glenium Concrete
11	Crumb modified bitumen Rubber

Reference Books

1. Concrete Technology by Neville
2. Concrete Technology by M.S.Shetty
3. Building Materials by Ghosh
4. New Building Materials and Construction World magazine
5. Civil Engineering and Construction Review magazine.
6. Concrete Tech: M L Gambhir.
7. Concrete Tech: Santhakumar (Prof, IIT MADRAS)

Semester - I

Subject Code	Subject Name	Credits
CEM 101X	(Elective I) DISASTER MANAGEMENT	04

Detailed Syllabus

Module	Description
01	Disasters: Natures and extent of disasters, natural calamities such as earthquake, floods, drought volcanoes, forest fires, coasts hazards, landslides etc. Manmade disasters such as chemical and industrial hazards, nuclear hazards, fire hazards etc.
02	Disaster Management: Financing relief expenditure, legal aspects, rescue operations. Casualty management, risk management.
03	Emergency Management programme: Administrative setup and organization. Hazard analysis, training of personnel, information management, emergency facilities and equipment necessary public awareness creation, preparation and execution of the emergency management programme.

Reference Books

1. RedR and Red Cross Publications
2. Humanitarian Charter and Minimum Standards in Disaster Response (The Sphere Project)
3. nidm.gov.in
4. Different sites on internet on disaster management

Semester - I

Subject Code	Subject Name	Credits
CEM 101X	(Elective I) REPAIRS, REHABILITATION & RETROFITTING OF STRUCTURES	04

Detailed Syllabus

Module	Description
01	Importance of rehabilitation as a part of construction engineering.
02	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. .
03	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
04	Repairs to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering, wear, fire, leakage, marine exposure
05	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)

Reference 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.
2. HANDBOOK ON REPAIR & REHABILITATION OF RC BUILDINGS BY CPWD.
3. MATERIAL AVAILABLE ON GOOGLE FOR GENERAL RETROFIT & SEISMIC RETROFIT.

Semester - I

Subject Code	Subject Name	Credits
CEM 101X	(Elective I) CONSTRUCTION SAFETY	04

Detailed Syllabus

Module	Description
01	Construction Safety Management: Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety checklists and inspection reports.
02	Safety in construction operations: Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures.
03	Safety in use of construction equipment: Vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms. Safety while using electrical appliances. Explosives
04	Various safety equipment and gear used on site. First aid on site.
06	Labour laws, legal requirement and cost aspects of accidents on site.
07	Study of safety policies , methods, equipment, training provided on any ISO approved construction company.

Reference Books

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

Semester - I

Subject Code	Subject Name	Credits
CEM 102X	(Elective II) RESOURCES MANAGEMENT	04

Detailed Syllabus

Module	Description
01	<p>Materials Management:</p> <p>1. Importance of material management and its role in construction industry-scope, objectives and functions, Integrated approach to materials management, Role of materials manager.</p> <p>2. Classification and Codification of materials of construction. ABC analysis-Procedure and its use, Standardization in materials and their management, Procurement, identification of sources of procurement, vendor analysis, concept of Material Requirement Planning(MRP), purchase procedure, legal aspects.</p> <p>3. Inventory Management – Inventory Control techniques. EOQ, Advantages and limitations of use of EOQ, Periodic ordering, order point control, safety stock, stock outs, application of AC analysis in inventory control, concept of (JIT)- Just in time management, Indices used for assessment of effectiveness of inventory management.</p> <p>4. Stores Management: Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.</p> <p>5. Quality Control – Conventional methods of quality control of Construction materials. Statistical method of quality control, sampling techniques quality control in process. Quality management and its economics.</p> <p>6. Use of (MMS) – Materials Management Systems in materials planning, procurement, inventory, control, cost control etc.</p>
02	<p>Equipment Management:</p> <p>Working out number of construction equipment required based on the individual equipment work cycle, and based on the total time available and quantum of work. Working out the total hourly cost and the cost per unit of item for various construction machinery. Concept of equipment log book. Concept of equipment selection based on optimal used.</p>
03	<p>Human Resource Management:</p> <p>Need for development of human resource, flow diagram of human resource development and human resource management. Training, competency development, capacity building of resources required at grass root level and at the managerial level in construction. OLDES programme of CIDC – IGNOU</p>

04	Two case studies involving major construction projects to study their equipment management.
05	Two case studies of haphazardly managed projects.

Reference Books

1. Purchasing and Inventory Control- by K.S.Menon, Wheeler Publication.
2. Construction equipment planning and applications-Dr.Mahesh Verma
3. Construction planning, equipment and methods-Peurifoy-Tata McGraw Hill publication.
4. Human Resource Management by Biswajeet Pattanayak
5. Managing Human Resources by Bohlander & Snell

Semester - I

Subject Code	Subject Name	Credits
CEM 102X	(Elective II) Total Quality Management in Construction	04

Detailed Syllabus

Module	Description
01	Quality: Necessity for improving Quality in the context of Global Challenges.
02	Concept of Quality Control, Quality Assurance, Quality Management and Total Quality Management (TQM)
03	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 standards, 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.
04	Designing of quality manuals, checklists and inspection reports, installing the quality assurance system, monitoring and control.
06	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..
07	Developing quality culture in the organization: Training of people, Bench – marking quality. Quality circles.
08	Study of ISO 9000, ISO 14000 and QS 9000 standards and certification procedures

Reference Books

1. Quality Planning and Analysis - J M Juran and Frank Gryna
2. Managerial Breakthrough - J M Juran
3. Total Quality Control - A V Fiegenbaum
4. The Six Sigma Way - Peter Pande and others
5. Quality is Free - Phil Crosby
6. "The 20 Keys to Workplace Improvement" by Iwao Kobayashi

7. The Toyota Way Fieldbook
8. Five Frogs on a Log: A CEO's Field Guide to Accelerating the Transition in Mergers, Acquisitions And Gut Wrenching Change
9. The Five Pillars of TQM by Bill Creech, the father of TQM.

Semester - I

Subject Code	Subject Name	Credits
CEM 102X	(Elective II) VALUE ENGINEERING	04

Detailed Syllabus

Module	Description
01	Value: Meaning of value, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, economic, identifying reasons or unnecessary costs.
02	Value Analysis: 10 Commandments of value analysis; value analysis team; principles of value analysis, elements of a job plan viz. orientation, Information, presentation. Implementation, follow up action, benefits of value analysis, various applications; assessing effectiveness of value analysis.
03	Life cycle costing: Forecasting of Capital as well as operating & maintenance costs, time value, present worth analysis, Discounted Cash Flow methods, Rate Of Return analysis, sensitivity analysis.

Reference Books:

1. Lean Thinking : Banish Waste and Create Wealth in Your Corporation, James P. Womack, Daniel T. Jones (Contributor), Simon & Schuster, 1996
2. Cooper, R. and Slagmulder, R. (1997): *Target Costing and Value Engineering*.
3. "Value Engineering - Concepts, Techniques and Applications by Anil Kumar Mukhopadhyaya"
4. "Value Engineering Mastermind - From Concept to Value Engineering Certification by Anil Kumar Mukhopadhyaya"
5. "Value Optimization for Project and Performance Management by Robert B. Stewart, CVS-Life, FSAVE, PMP"

Semester - I

Subject Code	Subject Name	Credits
CEM 102X	(Elective II) PROJECT RISK ANALYSIS AND MITIGATION TECHNIQUES	04

Detailed Syllabus

Module	Description
01	General: Importance of Risk, types of risks, quantifiable and unquantified risks. 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. Sensitivity analysis, 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.
02	Risk Mitigation: By elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, mitigation of unquantified 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). Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy.
03	Case Study of construction projects based on risk analysis and mitigation

Reference 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 manufactuaries-Thomas Telford publishing, London.
3. Construction Engineering and Management – Seetharaman.
4. Projects Planning analysis selection implementation and Review – Prasanna Chandra.

Semester - I

Subject Code	Subject Name	Credits
CEM 101L	Lab Practice – I	03

Detailed Syllabus

Module	Term work should consist of any (six) exercises from the following :
01	Minimum Two site visits to study construction techniques and use of major construction equipment associated with ongoing major construction works. Visit Report to be submitted.
02	Collection of techno-commercial information as regards new construction materials, new construction methods, new type of construction equipment.
03	Performing and reporting on time and motion study work measurement of any one construction activity
04	Field exercise on EOQ and bulk purchase.
05	Preparation, crashing and updating of precedence-network for a major construction work.
06	Exercise on Cash Flow analysis.
07	Preparation of models/charts related to various construction techniques, equipment, organizational structures of existing companies etc. (Group Activity to generate interest and explore creativity-Group of 4 students per model/chart).

Semester - I

Subject Code	Subject Name	Credits
CEM 102L	Lab Practice – II	03

Detailed Syllabus

Module	Description
01	Speaking Skills: Voice Modulation, Good Pronunciation, Speaking without fear, Extempore & Prepared speaking, Body Language, Telephone Etiquette/ Mobile /Video conferences.
02	Listening Skills: Barriers to listening, Listening & Note making.
03	Writing Skills: Building Vocabulary, Effective Sentences & paragraphs, Organizational Techniques & patterns, Summarizing.
04	Types of Writing: Letters, memo, Reports/ Proposals/ Research Paper/ Conference Paper/ E-mails/ Sharing Documents Online. Field exercise on EOQ and bulk purchase.
05	Interview: Pre-Interview Preparation, Interview Question Answer, Resume & Job Application, Group Discussion, Telephone Interviews.
06	Presentation Skills: Planning, preparing, Organizing, Delivery, Feed Back.
07	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 Minimum Two site visits to study construction techniques and use of major construction equipment associated with ongoing major construction works. Visit Report to be submitted.

Reference Books

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

Semester - II

Subject Code	Subject Name	Credits
CEM 201	CONSTRUCTION CONTRACTS, ADMINISTRATION AND MANAGEMENT	04

Detailed Syllabus

Module	Description
01	<p>Contracts Administration: The standard forms of building contracts, the rights of building owners, adjoining owners and third parties. The Indian Contract Act, Sale of Goods Act. Professional ethics, Global tenders and B.O.T. System</p>
02	<p>Arbitration Awards & Dispute Resolving Boards: Indian Arbitration Act, arbitration agreement, conduct of arbitration, power and duties of arbitrator, rules of evidence preparation and publication of awards, methods of enforcement, impeding and award. Limitations of arbitration in the Indian context (DRB's) Dispute resolving boards-necessity, formation, functioning advantages.</p>
03	<p>Industrial Act and Labour Laws: Industrial Dispute Acts, payment of wages act, Minimum Wages Act, Indian Trade Union Act, Limitation Act, Workmen's Compensation Act.</p>
04	<p>Injunctions: Types, Temporary, perpetual, mandatory, when referred.</p>
05	<p>Indemnity and Guarantee: Difference between the two contracts of Guarantee and Indemnity. Consideration for guarantee, surety's liability, discharge of surety.</p>
06	<p>Bailment: Nature of transactions, delivery of bailee, care to be taken, Bailee's responsibility, Termination, Bailment of pledges.</p>

Reference Books

1. Construction contracts and claims – Simon M.S., McGraw Hill, New York
2. Construction contract management-NICMAR publication
3. Handbook of estimating & costing for Quantity Surveyors-P.T.Joglekar
4. Estimates and contracts B.S.Patil

Semester - II

Subject Code	Subject Name	Credits
CEM 202	OPERATIONS RESEARCH	04

Detailed Syllabus

Module	Description
01	System Concepts , system parameters and objectives, system classification, system cycle, open and closed systems. Identification of Civil Engineering, Systems and their methods of analysis. Mathematical representation of a system.
02	Optimization techniques: Various models, objectives functions and constraints, convex and concave functions, regions and sets.
03	Linear programming: Two phase method, method of Big M, dual. Sensitivity analysis. Allocation problems, Transportation problem, Assignment problem.
04	Non-Linear programming: Unconstrained programming, One dimensional search techniques, Dichotomous, Fibonacci and Golden section, Multivariable problems, unconstrained, Gradient techniques, steepest ascent/descent technique, Newton's method, Davidon-Fletcher-Powell method.
06	Constrained Optimization: Lagrangian Multiplier Technique, Kuhn Tucker's conditions. Penalty functions method.
07	Dynamic programming , principle of optimality.
08	Stochastic methods: Queuing theory, simulation, sequencing.
09	Capitalization , Annuity, Selection of project based on Benefit-cost Analysis, Net Present Value , Internal Rate of Return , Pay Back Period etc.
10	Games Theory and its application to Construction Management. Replacement models

Reference Books

1. Operation's Research- Schaum
2. Optimization Techniques –S.S.Rao
3. Quantitative Technique – L.C.Jhamb
4. Operations Research – TAHA
5. Operations Research – J.K.Sharma, Macmillan India Ltd.
6. Modern Production/Operations Management – Buffa Sarin, Wiley Publication
7. Principles of Operation's Research – Wangner.

Semester - II

Subject Code	Subject Name	Credits
CEM 203	PROJECT ECONOMICS & FINANCIAL MANAGEMENT	04

Detailed Syllabus

Module	Description
01	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.
02	Capital: Analysis of need working capital, Estimation of requirements of working capital, Credit Management, Cash Management, Managing payments to suppliers and outstandings.
03	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 for execution of a major construction project.
04	Financial Planning: Long term finance planning, Stock, Borrowings, Debentures, Loan Capital, Public Deposit, Dividend Policies, Bonus Shares, Market value of shares, Reserves. Over and under capitalisation.
06	Budget: Budgetary control system. Types of budgets, Procedure for master budgets. Budget manual. Cash now forecast.
07	Problems of expansion and merger of companies, Corporate tax planning, Public policies on ICRA grading of exchange, World financial market, Role of financing institutes in Construction, CIDC-IRA grading of construction entities.
08	Construction Accounts: Accounting process, preparation of profit and loss account and balance sheet as per the companies Act, 1956, preparation of contract accounts for each project, methods of recording and reporting site accounts between project office and head office.

Reference 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, London.
4. Brealey R.A. "Principles of Corporate Finance", Tata McGraw Hill, New Delhi.
5. Leland T. Blank. Anthony Tarquin. 'Engineering Economy' McGraw Hill.
6. David Bedworth, Sabah Randhawa. 'Engineering Economics' McGraw Hill.
7. Bruggeman. Fishr 'Real Estate, Finance and investment' McGraw Hill.
8. Block Hirt. 'Foundations of Financial Management' McGraw Hill.
9. Burner 'Case studies in finance'. McGraw Hill
10. DeMello 'Cases in Finance' McGraw
11. Oliver, Lianabel ' The cost management toolbox ; A Managers guide to controlling costs and boosting profits.' Tata McGraw Hill.

Semester - II

Subject Code	Subject Name	Credits
CEM 201X	(Elective III) ADVANCED CONSTRUCTION TECHNOLOGY	04

Detailed Syllabus

Module	Description
01	Construction of power generating structures – Atomic Power stations, Thermal power stations. Windmills, transmission towers.
02	Bridges , types construction of special type of bridges such as cable stayed bridge, suspension and pressurised bridge, construction of foundation and super structure.
03	Off shore structure, types, methods of construction and maintenance.
04	Construction, maintenance of underground railways .
06	Construction of diaphragm walls
07	Principles and construction of machine foundations.
08	Principles, methods of fast track construction projects.
09	Minimum 1 case study to be covered for each of the above topics

Reference Books

1. Same as those for Construction Technique.
2. Manuals brochures publications from construction companies, firms etc.
3. Reports of actual works executed.
4. NICMAR Publications on Construction Engineering.

Semester - II

Subject Code	Subject Name	Credits
CEM 201X	(Elective III) INFRASTRUCTURE DEVELOPMENT	04

Detailed Syllabus

Module	Description
01	Construction Industry: Nature, characteristics, size and structure, role of infrastructure development in employment generation and improving of the National economy. Various agencies associated with infrastructure development in India as regards various sectors.
02	Status of Infrastructure in India: Indian government policy, Roads and buildings, communication, water supply, irrigation, power energy sectors, ports and aviation, health and educational services, rural development.
03	Issues related to infrastructure development: Pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing, funding and managing infrastructure projects, role, responsibility of project management consultants.

Reference Books

1. India Infrastructure Report – Rakesh Mohan
2. Infrastructure Today - Magazine
3. Document of five year plans, published by Govt. of India.

Semester - II

Subject Code	Subject Name	Credits
CEM 201X	(Elective III) INTERNATIONAL CONTRACTING	04

Detailed Syllabus

Module	Description
01	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.
02	Study and application of various conditions of contract under the FIDIC document development of regulatory framework. Project exports from India.
03	International financing: Various institutions such as World Bank, IMF, Asian Development Bank, African Bank etc. and their role, rules – regulations in funding various projects, forming alliance, bilateral and multilateral funding, trade practices etc.
04	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, methods of handling.
06	Selection of personnel to suit socio-economic-environmental culture in other countries, suitable organisational structure.
07	Disputes Resolving: International Courts, formation of DRB's (Dispute resolving boards) functioning and experiences in India and abroad, Advantages of DRB's
08	CASE studies of any 2 major project executed/functioning under International contracting.

Reference 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
CEM 202X	(Elective IV) PRINCIPLES OF SUSTAINABLE DEVELOPMENT	04

Module	Description
01	Concept of Sustainable Development: Environment and Development, Population poverty and pollution, Global and Local environmental issues, Resources degradation, Green house gases, Desertification-industrialization, social insecurity, Globalization and environment, History and emergence of the concept of sustainable development, Objectives of sustainable development
02	Components and dimension of Sustainable Development: Components of Sustainability, Complexity of growth and equity, Social economic and environmental dimensions of sustainable development, Environment-Biodiversity ,Natural Resources, Ecosystem integrity, Clean air and water, Carrying capacity, Equity, Quality of Life, Prevention, Precaution, Preservation and public participation structural and functional linking of developmental dimensions.
03	Framework for Achieving Sustainability : Operational Guidelines, interconnected prerequisites for sustainable development, Empowerment of women, children, Youth, Indigenous People, Non-Governmental Organizations Local authorities, Business and industry- Science and Technology for sustainable development, performance indicators of sustainability and assessment mechanism, Constraints and barriers for Sustainable development.
04	Sustainable Development of Socio Economic Systems : Demographic dynamics of sustainability, Policies for socio- economic development, Strategies for implementing eco- development programmes, Sustainable development through trade, Economic growth, action plan for implementing sustainable development, Urbanization and sustainable Cities, Sustainable Energy and Agriculture, sustainable livelihood.
05	Sustainable Development and International Response: Role of developed countries in the development of developing countries, international summits, Stockholm to Johannesburg, Rio principles, Agenda 21-Conventions, Agreements, Tokyo Declaration, Doubling statement, Trans-boundary issues, integrated approach for resources protection and management

References:

- 1) Sayer J. and Campbell, B. The Science of Sustainable Development: Local Livelihoods and the Global Environment (Biological conservation restoration & Sustainability Cambridge University Press London 2003.

- 2) Kirkby J. O Keefe P. and Timberlake, Sustainable Development, Earthscan Publication London, 1993.
- 3) Mackenthun K, M Concepts in Environmental Management Lewis publications London, 1988.
- 4) Bowers J, Sustainability and Environmental Economics – An Alternative Text Logman London 1997.

Semester - II

Subject Code	Subject Name	Credits
CEM 202X	(Elective IV) ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION	04

Module	Description
01	Introduction : Fundamentals of energy- Energy Production Systems- Heating, Ventilating and Air- Conditioning -Solar Energy and Conservation – Energy Economic Analysis Energy Conservation and audits- Domestic energy consumption – savings – challenges – primary energy use in buildings Residential – Commercial – Institutional and public buildings – Legal requirements for conservation of fuel and power in buildings.
02	Environment : Energy and resource conservation – Design of green buildings – Evaluation tools for building energy- Embodied and operating energy- Peak demand- Comfort and Indoor Air quality – Visual and acoustical quality- Land, water and materials – Airborne emissions and waste management.
03	Design: Natural building design consideration – energy efficient design strategies- Contextual factors – Longevity and process Assessment- Renewable Energy Sources and design – Advanced building Technologies – smart buildings- Economies and cost analysis.
04	Services : Energy in building design – Energy efficient and environment friendly building – Thermal phenomena- thermal comfort- Indoor Air quality – Climate, sun and solar radiation, Psychometrics – passive heating and cooling systems- Energy Analysis – Active HVAC system – Preliminary Investigation – Goals and policies – Energy audit – Types of Energy audit – Analysis of results- Energy flow diagram – Energy consumption / Unit Production – Identification of wastage – Priority of conservation measures – Maintenance of energy management programme
05	Energy Management: Energy management of electrical equipment – improvement of power factor- Management of maximum demand- Energy savings in pumps- Fans-Compressed air Systems – Energy savings in Lighting systems- Air conditioning systems- Applications- Facility operation and maintenance – Facility modifications – Energy recovery dehumidifier – Waste heat recovery – Steam plants and distribution system- Improvement of boiler efficiency – Frequency of blow down – Steam leakage – steam Flash and condense return.

References:

- 1) Moore F., Environmental Control system Tata McGraw- Hill, Inc. 1994
- 2) Brown, GZ, Sun, Wind and light: Architectural design strategies, John Wiley & Sons, 1985.
- 3) Cook , J, Award- Winning passive solar Design, Tata McGraw- Hill, 1984.
- 4) J.R. Waters, Energy conservation in Buildings: A Guide to part L of the Building Regulations, Blackwell Publishing. 2003.

Semester - II

Subject Code	Subject Name	Credits
CEM 202X	(Elective IV) PRINCIPLES OF ARCHITECTURE & LANDSCAPING	04

Module	Description
01	Architecture Design: Architectural Design- an analysis – Integration for function and aesthetics- Introduction to basic elements and principles of design.
02	Climate Responsive Design: Factors that determine climate – Characteristics of climate types- Design for various climate types- Passive and active energy controls.
03	Building Types: Residential, Institutional, Commercial and Industrial – Planning concepts-Application of anthropometry and space standards- Interrelationships of functions – safety standards-Building rules & regulations- Integration of building services.
04	Environmental Design: Surveys- Site analysis- Development control- Zoning regulations- Layout regulations- Urban planning standards- Layout design concepts.
05	Site Planning: Urban renewal- Conservation- Principles of landscape design – Case studies.

References:

1. Francis D. K. Ching, “Architecture: Form, Space & Order”, VNR, N. Y., 1999.
2. Givoni B., “Man, Climate & Architecture”, Applied Science, Barking ESSEX, 1982.
3. Wdward D. Milss, “Planning & Architects Handbook’, Butterworth London, 1995.
4. Galloian B. Arthur & Simon Eisner, “The Urban Pattern- City Planning & Design”.
5. Affiliated Press Pvt. Ltd., New Delhi, 1995.
6. Margaret Roberts, “ An introduction to Town Planning Techniques”, Hutchinson, London, 1990.

Semester - II

Subject Code	Subject Name	Credits
CEM 201L	Lab Practice III	04

Detailed Syllabus

Module	Term work should consist of any (6) exercises from the following
01	Minimum two site visits to study the feasibility aspects, tendering procedures, accounting systems, funds raising and other financial management aspects, billing procedures etc. associated with on-going major construction work-visit report to be submitted
02	Use of spread sheet and data base application software for performing various functions of civil engineers as mentioned below is to be demonstrated <ul style="list-style-type: none"> • Quantity Estimation • Rate Analysis • Bid preparation • Material and supplier information • Employee / equipment information etc.
03	Collection and study of tender notices, tender documents of contract document associated with Civil Engineering works.
04	Exercise on contract document associated with Civil Engineering works.
05	Exercise on Valuation: Valuation of land and building using various methods report to be submitted on prescribed format.
06	Elective 1 : Any 2 assignments
07	Elective 2 : Any 2 assignments
08	Web based project management.
09	M. S. Project: i) Planning & scheduling of multi-storeyed building ii) Planning & scheduling of road construction project iii) Preparation of resource sheet, assigning & levelling the resource iv) Preparing different reports available in MS Project v) Plotting variance graphs for given project
10	STADDPRO: i) Analysis & design of continuous beam with various loading systems. ii) Plane frame with 2 bay & (G+4) stories

Reference Books:

1. MS Project Manual
2. STADD Pro Manual

Semester - II

Subject Code	Subject Name	Credits
CEM 202L	Lab Practice IV	04

Detailed Syllabus

Module	Description
	<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• Updating of networks<ul style="list-style-type: none">• Primavera: Planning & scheduling of Multistoried Building Planning & scheduling of road construction project Prepare the resource sheet, assign & level the resource. Preparing different reports available in Primavera. Plot the variance graphs for given project

Reference Books:

1. PRIMAVERA Manual.
2. www.ESRI.com

Semester - III

Subject Code	Subject Name	Credits
CEMS 301	SEMINAR	03

Detailed Syllabus

Guidelines for Seminar

- Seminar should be based on thrust areas with practical applications in construction engineering and management and its allied subjects including advanced construction technology, project planning and management, construction contracts, operation research etc.
- 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 students can work for their dissertation in the subsequent stages.
- The students in consultation with the 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 students 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 students shall have to present the seminar/presentation in front of the board of examiners (refer note below).
- It is expected by the students to publish technical papers in form of review or state of art in consultation with the supervisor. Paper may be published at reputed national conference or international conference.
- The supervisor may ask the students 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.

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 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.

Subject Code	Subject Name	Credits
CEMD 302 / CEMD401	Dissertation (I and II)	12

Guidelines for Dissertation

- Students 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 precise terms.
- Students 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.
- Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Referred Journals). 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 examiner/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.