M.TECH. DEGREE
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

SYLLABUS
FOR
CREDIT BASED CURRICULUM
(With effect from 2022)

DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620015 INDIA
**Vision of the Institute**
- To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry

**Mission of the Institute**
- To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
- To create a converging learning environment to serve a dynamically evolving society.
- To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
- To be an intellectual ecosystem where human capabilities can develop holistically

**Vision of the Department**
- Shaping infrastructure development with societal focus

**Mission of the Department**
Achieve International Recognition by:
- Developing Professional Civil Engineers
- Offering Continuing Education
- Interacting with Industry with emphasis on R&D
M. Tech. (Construction Technology and Management)

The total minimum credits required for completing the M. Tech. (Construction Technology and Management) course is 64.

### SEMESTER I

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<thead>
<tr>
<th>Code</th>
<th>Course of Study</th>
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<tbody>
<tr>
<td>CE751</td>
<td>Construction Planning &amp; Control</td>
<td>3</td>
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<tr>
<td>CE753</td>
<td>Construction Economics &amp; Finance</td>
<td>3</td>
</tr>
<tr>
<td>CE755</td>
<td>Contracts &amp; Specifications</td>
<td>3</td>
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<tr>
<td>CE757</td>
<td>Construction Personnel Management</td>
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<td></td>
<td>Elective – I</td>
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<td>Elective – II</td>
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<tr>
<td>CE759</td>
<td>Construction Management Software Laboratory</td>
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**Total Credits for Semester I:** 20

### SEMESTER II

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<tr>
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<td>Construction Methods &amp; Equipment</td>
<td>3</td>
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<tr>
<td>CE754</td>
<td>Construction Quality &amp; Safety Management</td>
<td>3</td>
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<tr>
<td>CE756</td>
<td>Organizational Behaviour</td>
<td>3</td>
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<td>Elective – III</td>
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**Total Credits for Semester II:** 20

### SUMMER

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<tr>
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**Total Credits for Summer:** -

### SEMESTER III

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<td>Project Work – Phase I</td>
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### SEMESTER IV

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<td>CE798</td>
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<tr>
<td>1.</td>
<td>CE761</td>
<td>Modern Construction Materials</td>
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<td>2.</td>
<td>CE762</td>
<td>Functional Efficiency of Buildings</td>
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<tr>
<td>3.</td>
<td>CE763</td>
<td>Advanced Concrete Technology</td>
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<td>4.</td>
<td>CE764</td>
<td>Disaster Mitigation and Management</td>
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<td>5.</td>
<td>CE765</td>
<td>Construction Supply Chain Management</td>
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<td>6.</td>
<td>CE766</td>
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<td>7.</td>
<td>CE767</td>
<td>Project Risk Analysis and Mitigation Techniques</td>
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<td>8.</td>
<td>CE768</td>
<td>Planning of Prefabricated Structures</td>
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<td>CE769</td>
<td>Safety in Material Handling at Construction</td>
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<td>CE770</td>
<td>Non Destructive Evaluation</td>
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<tr>
<td>11</td>
<td>CE771</td>
<td>Value Engineering</td>
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<td>CE772</td>
<td>Strategic Management in Construction</td>
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<td>CE773</td>
<td>Lean Construction Concepts, Tools and Practices</td>
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<td>14</td>
<td>CE774</td>
<td>Quantitative Methods in Construction Management</td>
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<tr>
<td>15</td>
<td>CE775</td>
<td>Formwork Design</td>
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** Electives chosen from other PG specializations of Department of Civil Engineering and Electrical and Electronics Engineering shall follow the respective course codes.
**Course Code:** CE751  
**Course Title:** Construction Planning & Control  
**Credit:** 3  
**Type:** Core

**Course Content**  
Project Management: Basic forms of organization with emphasis on Project and matrix structures; project life cycle, planning for achieving time, cost, quality, project feasibility reports based on socio-techno-economic-environmental impact analysis, project clearance procedures and necessary documentation for major works like dams, multistoried structures, ports, tunnels, Qualities, role and responsibilities of project Manager, Role of Project Management Consultants, Web based project management.

Project Scheduling – Non-Networking Techniques: Gantt-Chart, Networking Techniques: Formulation and Applications of Critical Path Method (CPM) and Program Evaluation & Review Technique (PERT), Precedence Diagram Method (PDM), RPM (Repetitive Project Modeling) techniques. Linear Scheduling, LOB technique, Mass haul diagrams.


Performance Measurement, Earned Value, Multiple Construction Projects, Real time Applications

**References**

**Course Code:** CE752  
**Course Title:** Construction Methods & Equipment  
**Credit:** 3  
**Type:** Core

**Course Content**  
Underground Construction – Tunnel boring machineries, Tunnel-Shaft sinking, Micro Tunneling, Tunnel driving in hard and soft strata, bedding of conduits.

Under water construction - Problems encountered. Underwater drilling, blasting, Grouting methods in soft and hard soil including Jet grouting and Chemical grouting, Dewatering in shallow and deep excavations using different methods, Vacuum Dewatering and Well point system.

Pile Construction- Piling – Single pile and a group piles (Bored and Driven); driven and cast-in-situ piles, Piles in land and marine structures. Precast piles, pre stressed piles, steel piles and friction piles. Methods of pile driving by Vibration and Construction of micro piles, Diaphragm Walls.


Construction engineering fundamentals- Concrete construction batching, mixing, transport, placement, finishing, formwork, scaffolding.


Construction equipment and machinery- Earthwork, Hoisting and lifting, Material handling, Concreting, Pile driving, dewatering equipment. Characteristics and performances analysis of production outputs and costs

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Course Content
Construction economics - Overview of construction economics - time value of money - cash flow diagram - single payment now compared to a single payment in future (F/P) - Future payment compared to a uniform series of payments (F/A) - one present payment compared to a uniform series of payments (A/P) - arithmetic Gradient G, Geometric gradient.

Financial Returns analysis - Comparing Alternatives - Present Worth Method-Annual payments method- Future worth methods, Rate of Return (ROR), Incremental Rate of Return (IROR), Break even analysis, Marginal costing, Cost Benefit analysis.

Accounting methods - Depreciation accounting, income tax accounting, inflation, replacement analysis.

Construction costing - Methods of construction costing- percentage completion method – Fixed contract Pricing- cost plus pricing- Escalation clause- Sources of Finance, Infrastructure financing; Life-cycle costing, Construction cost control, Personnel costs；Equipment costs, Job in directs and markup.


References

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<tr>
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<tr>
<td>Course Title:</td>
<td>Construction Quality &amp; Safety Management</td>
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Course Content
Construction Safety Management – Concept of safety. Factors affecting safety: Physiological, Psychological and Technological. Roles, duties and responsibilities of workers, Supervisors, Managers and Owners, safety program components - safety committee, safety training, incentives and monitoring. ISO 45001 standard for health and safety at work - Safety Procedures for various construction operations, preparation of safety manuals, safety checklists and inspection reports, safety audits; Safety laws, Labor laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices, Case studies on various construction projects

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<tr>
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<td>Course Title:</td>
<td>Construction Contracts &amp; Specifications</td>
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Course Content

Comprehensive study of different types of Tenders, Applications to various works

Type of contracts, International Contracts, FIDIC, Indian Contract Act 1872, Problems in the operation of contracts Claims, compensation and disputes, Dispute resolution Techniques, Delay analysis

Arbitration and Conciliation Act 1996, Arbitration case studies

Professional practices, ethics, duties and responsibilities, Management Information systems, Case studies

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<td>Organizational Behaviour</td>
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**Course Content**

Leadership in Organizations. Characteristics of Organizations: Organization Structure and Design, Organizational Behavior, Organizational Culture and climate

Individuals in Organizations - individual decision-making; Group Dynamics: Group behavior, Inter-group relation and conflict; Communication;

Motivation and behavior, Motivation at work, designing motivating jobs

Functional and Dysfunctional conflict–conflict management strategies - Principles and Tactics of Negotiation- Factors affecting Intergroup Relations and Managing Intergroup Relations

Organizational change and Development - Managing Innovation and Technology in changing environments - case studies of OD interventions in mega-construction projects.

**References**


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<td>Course Title:</td>
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**Course Content**

Elements of Personnel Management – Organization - Requirement of Organization, Organization structure, Organization Hierarchical charts, Staffing Plan, Development and
Operation of human resources, Managerial Staffing, Recruitment, Selection strategies, Placement and Training.

Manpower Planning process - Organising, Staffing, directing, and controlling, Estimation of manpower requirement, Factors influencing supply and demand of human resources, Role of HR manager, Personnel Principles, Welfare measurements

Leadership – Functions, types of Leadership and its importance, Productivity - Assessment tools, Productivity Improvement, Competency Development. Motivation – Types and Theories, Performance planning and Assessment, Rewards. Team Behavior – Stages and Characteristics of Team work. Communications – Methods and Channels of communication and its function, Crisis Management – Features and Case studies

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<tr>
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<tr>
<td>Course Title:</td>
<td>Construction Software Management Laboratory</td>
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Course content
Computer aided Cost Estimation, Spreadsheet, Database applications, Project management software - Network preparation and computations, Scheduling and allocation, Simulation and Optimization Software etc., application of L.P. in construction problem - Construction applications

References
Course Code: CE760  
Course Title: Construction Engineering and Information Laboratory  
Credit: 2  
Type: Core

Course Content
Deterministic and Probabilistic Inventory Models - Software applications.
Building Information Modelling (BIM) - Introduction to BIM, Model-based Cost Estimating, Construction Scheduling and 4D Simulation, Design Coordination, BIM to the Field

References

PROGRAMME ELECTIVES

Course Code: CE761  
Course Title: Modern Construction Materials  
Credit: 3  
Type: Elective

Course Content


Special Concretes: High strength concrete, Effect of RHA on the properties of HSC, High performance concrete –applications, Self-Compacting Concrete, Concrete made with waste rubber, Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics, Nano Concrete, Changes in concrete with respect to time.
Steel construction, Types of steel used for construction, Methods of utilizing steel in construction, Advantages and Applications of steel in construction


Reference

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<tr>
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<tr>
<td>Course Title:</td>
<td>Functional Efficiency of Building</td>
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<tr>
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Course Content
Environmental factors: Solar Control and shading devices, Louvre design; ventilation; introduction to lighting; units of light, color, lamps, luminaries, Day light design of general lighting schemes; Energy management and lighting - codal requirements. GRIHA rating to evaluate the environmental performance of a building.

Climatic design - Climatic factors, classification of tropical climates, site climate, microclimate of human settlements, ventilation requirements for health, mechanisms and estimation of natural ventilation, airflow patterns in building.


Propagation of sound, sound insulation absorption and transmission, reverberation, Design of floor, roofing and walling system for sound absorption and insulation. Design of auditoria Noise control in buildings.

References

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<tr>
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<tr>
<td>Course Title:</td>
<td>Advanced Concrete Technology</td>
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**Course Content**


**Reference**

Course Code: CE764  
Course Title: Disaster Mitigation And Management  
Credit: 3  
Type: Elective

Course Content
Meaning and types of hazards, disasters and catastrophes – Disaster Management;
Earthquakes: causes and effects – measurements - earthquake zones India – vulnerability and
microzonation; - volcanic hazards;

Landslides: Causes and effects – landslide prone zones in India –Cyclone: Origin and types -
effects on land and sea – damage assessment; Flooding: Tsunami –Soil Erosion-Drought:
Characteristics- Occurrence – Preventive measures

Emerging approaches in Disaster Management- Pre- disaster stage (preparedness) - Preparing
hazard zonation maps, Predictability/forcasting & warning- Preparing disaster preparedness
plan- Land use zoning- Disaster resistant house construction- Population reduction in
vulnerable areas- Awareness

Emergency Stage - Rescue training for search & operation at national & regional level-
Immediate relief- Assessment surveys - Post Disaster stage-Rehabilitation- Political
Administrative Aspect- Social Aspect-

Economic Aspect- Environmental Aspect
Mitigation - Role of Media - Monitoring Management- Preventive Measures- A regional
survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with
particular reference to India -Ecological planning for sustainability & sustainable
development in India-Sustainable rural development

Soft Solutions for Disaster Management - Case studies - Earthquake, volcano and landslide -
Flood prone area analysis and management – risk assessment – cyclones and floods - Drought
and desertification

References
1. National Disaster Management Division (2004) Disaster Management in India - A
Disasters Relief Organization, Vienna.
Publications, New Delhi.
4. Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of
Containment, New India Publishing Agency, New Delhi.

Course Code: CE765  
Course Title: Construction Supply Chain Management  
Credit: 3  
Type: Elective
Course Content

Introduction to Construction supply chain management - Supply Chain Performance: Achieving Strategic Fit and Scope - Supply Chain Drivers and Metrics - Managing cross-functional drivers in supply chain - Sourcing Decisions in a Supply Chain - Pricing and Revenue Management in Supply Chain – Supply Chain Risks – Framework agreements-Information Technology in Supply Chain - Coordination in Supply Chain


Contemporary opportunities and challenges for construction logistics and supply chain management in the context of sustainable development - Construction Supply chain case studies

References

5. V.V. Sople, “Supply Chain Management, text and cases”, Pearson Education South Asia, 2012

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<tr>
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<td>Course Title:</td>
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<td>Course Title:</td>
<td>Project Risk Analysis and Mitigation Techniques</td>
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Course Content

Use of risk prompts, use of Risk Assessment tables, details of RAMP process, utility of Grading of construction entities for reliable risk assessment. Risk Mitigation – by elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, mitigation
of un-quantified 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.

Reference
2. Dr. Surendra Kumar Satya Prakashan, Industrial Engineering and Management of Manufacturing Systems.

<table>
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<tr>
<th>Course Code:</th>
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<tr>
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<td>Planning of Prefabricated Structures</td>
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Course Content
Types of prefabrication, fabrication systems and structural schemes- Disuniting of structures- Structural behaviour of precast structures.


Reference

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<tr>
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<td>Course Title:</td>
<td>Safety in Material Handling at Construction</td>
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**Course Content**

**Manual Material Handling**
Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.

**Lifting Tackles and Mechanical Material Handling**
Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection , safe slinging practices – Testing procedures for wire rope slings, chain slings and lifting tackles like Shackles, eye bolts – Inspection and maintenance of lifting tackles, chain pulley block and slings.

**Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.** Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, Inspection and examination of lift and hoist

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<td>Non Destructive Evaluation</td>
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Course Content
Surface Methods - Visual Inspection - Liquid Penetrant Testing - Magnetic Particle Inspection, Cover meter testing.


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<td>Course Title:</td>
<td>Value Engineering</td>
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Course Content
Value Analysis - Value - Meaning of value, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, and economic.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.

Factors governing project selection – Types of Projects-Life Cycle Costing (LCC) for Managing the Total Value

Life cycle costing - Forecasting of Capital as well as operating & maintenance costs, time value, present worth analysis, DCF methods, ROR analysis, sensitivity analysis. Different methods of performing value engineering.

Phases of Value Engineering:
Creative thinking and creative judgment- positive or constructive discontent. Tangible and Intangible costs of implementation - False material-labour and overhead saving, Relationship between savings and probability of success-Reliability estimation, System reliability-Reliability elements in series and parallel. General Phase, Information Phase, Function Phase – Type of costs, Evaluation of Functional Relationships. Checks for consistency-Function – cost-weight-matrix-VIP Index – High cost and Poor value areas. Creativity/Speculation Phase

References
1. Value Engineering: Analysis And Methodology By Del Younke, 2003

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<tr>
<th>Course Code:</th>
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Course Content
Introduction to Strategic Management Concepts: Introduction to strategy, Purpose, Objectives, goals, Policies and programs,7-S frame work, Board of Directors-Roles, Responsibilities, Structure and composition Role of top management.

External and Internal Environment Analysis: Strategic Management process, SWOT Analysis Macro and Micro environmental factors. Importance of value chain.

Decision and Analytical Tools: Competitive Environment-five forces model, Factors driving industry change. Key factors for success in organization, overall cost Leadership, focus and differentiation strategies.


Corporate Strategic Events: Corporate parenting strategy, Ansoffs product market Grid- Product Development, Market Development and Market penetration and diversification strategies.

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**Course Content**
Introduction – Lean concepts - Lean Principles – Types of Wastes - overview and review of project management and productivity, productivity measurement and forecasting


Lean in Design, Supply Chain Management, Organizational Culture - Managing People, Integrated project delivery strategy, Information Technology applications, and Case studies.

References

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<th>Course Code:</th>
<th>CE774</th>
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<tbody>
<tr>
<td>Course Title:</td>
<td>Quantitative Methods in Construction Management</td>
</tr>
<tr>
<td>Credit:</td>
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**Course Content**
Introduction - Use of Operations Research in Civil Engineering and Managerial Decision making process. Introduction to Optimization Techniques and their application in Engineering Planning, Design and Construction. Various models; Objective function and constraints, convex and concave functions, regions and sets and concepts of probability and statistics.
Linear programming – Formulation of Linear optimization models, Civil engineering applications. Simplex method, special cases in simplex method, Method of Big M, Two phase method, duality, sensitivity analysis.

Transportation problems – Approximation method, Assignment problems – Hungarian Methods of Solution.

Dynamic programming – Bellman’s principle of optimality. Other Techniques - Decision theory, Queuing theory and Games theory – Monte Carlo Simulation.

References
5. Hira and Gupta, S.Chand, Operation Research, S. Chand Publisher, 2007.

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<td>Course Title:</td>
<td>Formwork Designs</td>
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<tr>
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Course Content
Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms, Slip form techniques.

Formwork – Design: Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork.

Design of Decks and False works: Types of beam, decking and column formwork, Design of decking, false work design, Effect of wind load, Foundation and soil on false work design.

Special Forms: The use and applications of special forms.

Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and false work.

Reference
4. Tudor Dinescu and Constantin Radulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004