P.G. Section in
Construction Technology & Management

Curriculum & Syllabus
(First Revision)

M.TECH. CIVIL - CONSTRUCTION TECHNOLOGY & MANAGEMENT
(Revised at SVNIT Surat on 23-24 February 2018)

CIVIL ENGINEERING DEPARTMENT
SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY
ICHCHHANATH, SURAT-395 007
SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY

Our Vision

"To be one of the leading Technical Institutes disseminating globally acceptable education, effective industrial training and relevant research output"

Our Mission

"To be a globally accepted centre of excellence in technical education catalyzing absorption, innovation, diffusion and transfer of high technologies resulting in enhanced quality for all the stakeholders"

CIVIL ENGINEERING DEPARTMENT

Vision

To be a global centre of excellence for creating competent professionals in civil engineering

MISSION

M1: To provide excellent education producing technically competent, globally employable engineers who will be leaders in the chosen field

M2: To undertake research in conventional and advanced technologies fulfilling the needs and challenges of modern society

M3: To provide consultancy services and develop partnerships with society, industry and public organizations.

M4: To organize seminars, conferences, symposia, and continuing education programmes for academic and field community
COURSE DETAILS

1. Name of the department: Civil Engineering
2. Name of the course: Post Graduate Program (Construction Technology and Management)

<table>
<thead>
<tr>
<th>Title of Degree</th>
<th>Specialization</th>
<th>Intake (Full time)</th>
<th>Entry Level Qualification</th>
<th>Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Tech. CIVIL Engineering (Construction Technology &amp; Management)</td>
<td>Construction Technology &amp; Management</td>
<td>25</td>
<td>B.E./B.Tech. in Civil Engineering, Bachelor of Construction Technology, B. Arch., B. Planning</td>
<td>With valid GATE score of Civil Engineering - (CE) and Architecture and Planning - (AR) through CCMT and / or as per institute rules and regulations.</td>
</tr>
</tbody>
</table>

3. Course Structure and Scheme of Evaluation (Semester-wise, along with curriculum details as follows)
POST GRADUATE PROGRAMME IN
CONSTRUCTION TECHNOLOGY & MANAGEMENT

Program Educational Objectives

**PEO 1:** Excel in professional career and develop research skills in the field of Construction Technology & Management.

**PEO 2:** Exhibit professionalism through lifelong learning and able to work in teams for collaborative and various task.

**PEO 3:** Graduates will communicate effectively in their team, adapt to emerging trends for sustained growth in independent and reflective learning and exhibit social responsibility and professional ethics.
POST GRADUATE PROGRAMME IN
CONSTRUCTION TECHNOLOGY & MANAGEMENT

Program Outcomes (POs)

PO1 Acquiring sound knowledge on entire spectrum of activities associated with construction technology & management and develops ability to, evaluate, analyze and integrate existing knowledge with the innovative knowledge.

PO2 Analyze potential complexities critically, understand the project requirements and attempt to mitigate risks in a proactive manner.

PO3 Understand the importance of societal, health, safety, legal and cultural considerations in carrying out construction projects.

PO4 Design and conduct research experiments for acquisition/generation, analysis and interpretation of data based on literature survey for construction technology & management problems demonstrating higher order skill through appropriate research methodologies, techniques and tools independently or in a team.

PO5 Apply advanced tools, techniques and latest software, applicable to a range of construction applications.

PO6 Contribute positively to collaborative – multidisciplinary scientific research demonstrating capacity for self-management and teamwork, decision making based on open-mindedness, objectivity using knowledge of group dynamics to achieve common goals of advancement in learning for self and others.

PO7 Confidently apply modern management principles and engineering economics in agile environment and engage stakeholders and achieve results through proactive action.

PO8 Communicate effectively through technical reports and presentations with key stakeholders and give and receive clear instructions.

PO9 Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO10 Apply ethical principles in construction technology & management practices and professional responsibilities.

PO11 Learn from mistakes based on self observation of the outcomes of own actions and take corrective measures.
# MAPPING OF POs & PEOs

<table>
<thead>
<tr>
<th>Programme Outcomes</th>
<th>PEO 1</th>
<th>PEO 2</th>
<th>PEO 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO7</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO8</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>PO9</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO10</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>PO11</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

LEVEL OF RELATION- 1: Slightly  2: Moderately  3: Substantially
## M. TECH CONSTRUCTION TECHNOLOGY & MANAGEMENT

### SEMESTER I

<table>
<thead>
<tr>
<th>Code</th>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Pract/ Tuto.</td>
</tr>
<tr>
<td>CE 711</td>
<td>Construction Project Planning and Control</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>CE 713</td>
<td>Construction Methods &amp; Equipment</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>CE 715</td>
<td>Advanced Construction Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Elective I</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Elective II</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>CE 717</td>
<td>Construction Materials Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>CE 719</td>
<td>Graduate Report-I</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>15</td>
<td>2</td>
<td>6</td>
<td>500</td>
<td>125</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

### SEMESTER II

<table>
<thead>
<tr>
<th>Code.</th>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Pract/ Tuto.</td>
</tr>
<tr>
<td>CE 712</td>
<td>Project Appraisal and Finance</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>CE 714</td>
<td>Construction Contract and Law</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>CE 716</td>
<td>Construction Quality and Safety</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Elective-III</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Elective-IV</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>CE 718</td>
<td>Construction Management Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>CE 722</td>
<td>Graduate Report-II</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>15</td>
<td>2</td>
<td>6</td>
<td>500</td>
<td>125</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work
### SEMESTER III

<table>
<thead>
<tr>
<th>Code</th>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Pract</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>/ Tuto.</td>
</tr>
<tr>
<td>CE871</td>
<td>Professional Project</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>-</td>
<td>150</td>
</tr>
<tr>
<td>CE873</td>
<td>Dissertation Preliminaries</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>CE875</td>
<td>Seminar</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>CE877</td>
<td>Summer Training</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>-</td>
<td>400</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

### SEMESTER IV

<table>
<thead>
<tr>
<th>Code</th>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Pract</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>/ Tuto.</td>
</tr>
<tr>
<td>CE882</td>
<td>Dissertation</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>-</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>-</td>
<td>400</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

### SUMMARY

<table>
<thead>
<tr>
<th>All Subjects &amp; Semesters</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Pract</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>/ Tuto.</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>30</td>
<td>04</td>
<td>52</td>
<td>1000</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE604</td>
<td>Environment Impact Assessment and Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE691</td>
<td>Research Analytical Technique</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>CE871</td>
<td>Soft Computing Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE634</td>
<td>Urban Infrastructure Planning &amp; Management</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>CE652</td>
<td>Real Estate Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>CE658</td>
<td>Applied Statistical Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>AM613</td>
<td>Rehabilitation of concrete structure</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE724</td>
<td>Formwork for Structure</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE721</td>
<td>Quantitative Methods</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE723</td>
<td>Organization Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE725</td>
<td>Lean Construction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE726</td>
<td>Low Cost Construction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE727</td>
<td>Precast and Prestress Construction</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE729</td>
<td>Infrastructure Valuation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE730</td>
<td>Disaster Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE720</td>
<td>Building Information Modeling</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE731</td>
<td>Resilience and Sustainable Infrastructure</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE734</td>
<td>Smart Infrastructure System</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>ME650</td>
<td>Optimization Technique</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE736</td>
<td>Maintenance and Rehabilitation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>CE735</td>
<td>Building Services and Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>3</td>
</tr>
</tbody>
</table>

**NOTE:**
- List of elective contains subjects of other departments, other post graduate programme of civil engineering and applied mechanics departments and related to area of construction technology and management in order to make the system more flexible and to offer options to P.G. students of their interest area.
- One external examiner & concerned internal examiners shall conduct end semester examination in case of Practical/Studio and Project. Final examination for dissertation will be conducted as per Institute norms.
• Continuous assessment evaluation of project/seminar will be carried by a panel of 3 examiners including guide / supervisor.

• Two progress evaluations each of dissertation preliminary and dissertation at 3rd and 4th semester will be conducted by the panel of 3 internal examiners, including guide / supervisor.

• There will be 6-8 weeks of mandatory summer training for all the candidates. Assessment of summer training report will be carried out in the 3rd semester by panels of 3 internal examiners.
Course Outcomes: At the end of the course, students will be able to-

CO1  Understand the principles of project management, resource management and inventory.
CO2  Prepare work break down plan and estimate resources requirements.
CO3  Learn in depth about project scheduling and time management.
CO4  Solve problems of resource allocation and levelling using network diagrams.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO \ PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Concept of Project Management
   Pre award to closing- A life cycle approach stakeholders in projects, Initiation, Planning, Execution, Monitoring & control and closing, Bidding stage assumptions and factors influencing project performance, Iron triangle Project Scope, Time & cost, Project Strategy, Project Feasibility

2. Work Breakdown Structure
   Scope Management, Project Charter, Scope of Work (SoW), Concept of WBS, WBS Quality principles, typical hierarchy in the WBS of a project, desirable characteristic of work packages, determinants having critical influences on the work packages, scope creep, change management, WBS, OBS & RBS, Control Accounts

3. Project Planning and Scheduling
   Importance of sound planning, Scheduling, principles and techniques, Scheduling methods (AOA & AON), critical path method, concept of float, project evaluation and review techniques, line of balance variances in project duration and cost, network scheduling with limited resources, resource allocation, smoothing and leveling, updating the network, master networks, the time -cost trade-off approach, progress review and reporting, risk of schedule delays, missing milestone deliverables and its impact (from client and contractors view point) change management, contemporaneous records, documenting delays and maintaining records.
4. **Project Control and Monitoring**

Parameters of project performance, time, cost and quality and their interrelationships, schedule and cost control tools and techniques, performance reporting, audit, corrective and preventive actions, fund flow control, management information system and application of management software.

**REFERENCES:**

Course Outcomes: At the end of the course, students will be able to-

CO1 To understand different formwork systems and temporary structures.
CO2 To learn in depth about steel and pre-stressed construction.
CO3 To perceive heavy and special construction techniques.
CO4 To judge appropriate selection of construction equipment.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Form Work and Temporary Structures
   Form work design and scaffolding, slip form and other moving forms, Shoring, Reshoring, and Back shoring in multi storied Building construction.

2. Steel Construction
   Shop and in-situ construction techniques, different connections. High strength bolts, Clearances and Tolerances, Erection of steel structures like Bridges, Trusses Chimneys, Power Houses.

3. Prestressing, Steel and composites construction methods
   Fabrication and erection of structures including heavy structures, Prefab construction, industrialized construction, Modular coordination.

4. Special construction methods
   High rise construction, Bridge construction including segmental construction, incremental construction and push launching techniques, Box pushing method, Top to bottom Construction.

5. Planning and Selection of Construction Equipment
   Factors affecting selection of equipment - technical and economic, Analysis of production outputs and costs, Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering, and Concreting, Ready mix concrete plants.
REFERENCES:

**Course Outcomes:** At the end of the course, students will be able to-

CO1 To study fundamentals of material science.
CO2 To analyses the properties of sustainable material.
CO3 To control quality of construction.

**Mapping of the Course Outcomes with Program Outcomes:**

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. **Material Science**
   Classification, Standardization, Codification and Variety. Details of Micro Structure of Different construction Materials, Different effects on materials of construction.

2. **Properties of Materials**

3. **Sustainable Materials**
   Introduction, sustainability and goals, current situation, earth's natural system, carbon cycle, role of construction materials, CO2 from fossil fuel vis-à-vis cement and other construction materials. Construction material and indoor air quality. Energy for production, transportation and erection, Estimation methodology, Computation of embodied energy for building. Primary energy and Energy Concepts

4. **Advance Concrete**
   High volume fly ash concrete, geo-polymer concrete and their embodied energy content against OPC concrete. Aggregate resource depletion, recycled aggregate from demolition etc. role of quality control and admixtures in sustainability. Durability of construction material and life cycle sustainability.

5. **Other Material**
   Polymer materials, Thermo - Plastic, Polymer Concrete, Composite, materials, Ferro cement, Ferroconcrete, Building materials from Agricultural, & Industrial wastes, M Sand, Glass, Cladding, Light Weight Concrete
REFERENCES:
Course Outcomes: At the end of the course, students will be able to-

CO1  To test the properties of materials.
CO2  To design the concrete.
CO3  To analyze the results of experiments.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

Tests related to quality control at site, in-situ tests, tests related to damage and deterioration assessment, performance monitoring of structures will be performed.

1. Testing of cements and supplementary cementations materials
2. Testing of chemical admixtures
3. Mixture design of special concretes
4. Moisture profile and acoustic measurements
5. Non destructive tests, half-cell potential, pH measurement, carbonation depth, water and air permeability
6. Effect of high temperature on concrete
7. Calorimetric and shrinkage
8. Alkali Silica Reaction
9. Advanced characterization of construction materials
10. Behavior of construction joints, water-proofing and precast joints

REFERENCES:

Course Outcomes: At the end of the course, students will be able to-
CO1  To develop technical writing and communication skills.
CO2  To find the research gap from the literature.
CO3  To aware about current innovative practices and technology.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO \ PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

• Students are expected to prepare graduate reports on various topics of the subjects as assigned by the faculty advisor and submit duly computer typed reports, present & participate in subject wise group discussion.
Course Outcomes: At the end of the course, students will be able to-

CO1  To learn the fundamentals of project formulation and appraisal.
CO2  To monitor and control project.
CO3  To implement concepts of finance management in practice.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO \ PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Project Formulation
   Generation and screening of project ideas, project identification, preliminary analysis, market, technical, financial, economic and ecological pre-feasibility report and its clearance, project estimates and techno-economic feasibility report, detailed project report, different project clearances required.

2. Project Appraisal
   NPV, BCR, IRR, ARR, urgency-payback period, assessment of various methods, Indian practice of investment appraisal, international practice of appraisal, analysis of risk, different methods for selection of a project and risk analysis in practice, ownership structures; BOT, BOLT, BOOT models.

3. Project Accounting
   Profit and loss, balance sheet, income statement, ratio analysis, depreciation and amortization, preparation of financial statements, inflation accounting and corporate practices in India.

4. Working Capital Management
   Policy for working capital, estimating working capital need, inventory management, account receivable, credit and cash management, managing payments to supplies and outstanding, capital investment decisions, techniques of capital budgeting, cost of capital. Cash flow analysis.
5. **Long term financing and Budgeting**

   Working of financial institutes in India and abroad, self financing, stock exchanges, types of securities, borrowings, debentures, types of budgeting, procedure for master budget, key factor, budget manual, and new approach to budgeting, cash flow forecast.

**REFERENCES:**

Course Outcomes: At the end of the course, students will be able to-

CO1  To prepare contract schedules, notice inviting tender and contract documents.
CO2  To understand laws of construction contract.
CO3  To implement dispute resolution techniques in practice.
CO4  To prepare contract management plan as per standards.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Construction Contracts
   Concept of contract, types of contracts, joint venture, merging, acquisition, features and suitability, design of contract documents, international contract document, standard contract document, law of torts, Indian contract act 1872, Introduction to various standard forms of contract such as FIDIC, JCT and NEC.

2. Tenders
   Prequalification and Bidding process, potential contractual problems, Rules of interpretation of contract clauses, Concession agreements

3. Construction Claims and Disputes
   Sources of claims and disputes, construction claims procedure, methods of dispute resolution, alternative dispute resolution method, comparison of actions and laws, agreements, subject matter, violations, Arbitration and Conciliation act 1996 and recent amendments in 2015, Delay analysis, case studies, professional ethics, duties and responsibilities of parties.

4. International Construction Contracts
   Type of contracts, surety bonds, time provisions, safety clause, insurance, Employer’s Liability Policy, Builder’s risk, Foreign corrupt practice Act, rate of inflation, use of local labor, Differences in Ethic, languages and culture
REFERENCES:
Course Outcomes: At the end of the course, students will be able to-
CO1 Understand different aspects of quality and related tools.
CO2 Apply techniques of total quality assurance and quality control programme and cost implication.
CO3 Understand importance of various aspects of safety during execution of construction activities.
CO4 Apply to principles and theories of safety to construction projects.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Construction Organization
   Types of organization, inspection, control and enforcement, quality management systems and method, responsibilities and authorities in quality assurance and quality control; architects, engineers, contractors, and consultants, quality circle

2. Quality Assurance and Control
   Objectives, regularity agent; owner, design, contract and construction oriented objectives, methods/techniques and needs of QA/QC different aspects of quality, appraisals, factors influencing construction quality-critical, major failure aspects and failure mode analysis stability methods and tools, optimum design, reliability testing, reliability coefficient and reliability prediction selection of new materials.

3. Total Quality Management
   Road Map for TQM Implementation, Role of management in TQM, Quality improvement planning measurement, construction site implementation, six sigma in quality management.

4. Safety and Health in Construction
   Safety and accidents in construction projects, theories of accident causation, health and illness related with construction works, cost of construction injuries, safety risk analysis and control, personal protective equipment, occupational and safety hazard assessment, legal implications, OSH Management System
5. Safety Programme and Contractual obligations
   Problem areas in construction safety, elements of an effective safety programme, job site safety assessment, safety meetings, and safety incentives. Safety in construction contracts, substance abuse, safety record keeping.

6. Decision for Safety
   Safety culture, safe workers, safety and first line supervisors, safety and middle managers, top management practices, company activities and safety, safety personnel, sub contractual obligation, project coordination and safety procedures and workers compensation.

REFERENCES:
Course Outcomes: At the end of the course, students will be able to-
CO1 To prepare detailed schedule of different construction projects.
CO2 To develop on their own simple algorithms for any construction software
CO3 To integrate software applications for complex problems

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

Introduction to construction project models - analytical and numerical. Application of software for project planning, scheduling & control. Programming exercises for estimation, network planning and control, LP in construction. MATLAB Programming in linear and non-linear programming

REFERENCES:
Course Outcomes: At the end of the course, students will be able to-

CO1 To develop technical writing and communication skills.
CO2 To find the research gap from the literature.
CO3 To aware about current innovative practices and technology.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

- Students are expected to prepare graduate reports on various topics of the subjects as assigned by the faculty advisor and submit duly computer typed reports, present & participate in subject wise group discussion.
SEMESTER - III

M. TECH. II (CTM) SEMESTER- III
CE871 PROFESSIONAL PROJECT

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

Course Outcomes: At the end of the course, students will be able to understand

- CO1 To familiarize the field practices
- CO2 To identify the gap of standard practice in the field.
- CO3 To prepare the technical report

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

- Twelve weeks including summer vacation training on major construction projects is to be carried at National/State/Local Government Project level after the Second Semester Examination and prior to the first test of third Semester and project report on the same is to be prepared & submitted duly certified by the Project Organization.
Course Outcomes: At the end of the course, students will be able to:

CO1  To understand current issues and research areas.
CO2  To understand the process and importance of literature review in identifying research area.
CO3  To finalize research methodology.
CO4  To define scope, sample size and models.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

Dissertation preliminaries should clearly identify the goals & objectives and scope of the dissertation work taken up by the candidate. The focus is on data identification and proposed field surveys, questionnaire design, sample size decision. The study methodology and literature review on the dissertation topic is to be completed and a typed report is to be finalized in consultation with dissertation supervisor and submitted for the assessment at the end of the semester.
Course Outcomes: At the end of the course, students will be able to-

CO1 To understand the process of literature survey.
CO2 To make exposure towards research areas in the field.
CO3 To collect database of inventory available in various topic.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO \ PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

- Each student is required to prepare and submit a seminar paper from any area of material/technology/management with emphasis on development of a project/process/techniques/materials/organization techno economic feasibility studies etc. in consultation with Dissertation Supervisor.

- At least two seminars in area of construction technology and management will be organized by invited professionals, experts, researchers, and policy makers.

- Seminar is to be presented on scheduled date decided by the P.G. Centre. Focus will be on development of attitudes, training of mind, independent and innovative thinking etc.
CE877 SUMMER TRAINING

CO1 To aware about the construction practices and management.
CO2 To make interaction with personnel of projects.
CO3 To develop technical writing and communication skill.

Six/Eight week summer training on construction projects, is to be carried at National/State/Local Government Project level after the Second Semester Examination and prior to opening of Third Semester and project report on the same is to be prepared & submitted duly certified by the Project Organization as well as presented in institute.
**Course Outcomes:** At the end of the course, students will be able to understand

**CO1** To enhance ability for conception of the idea through conduct of research.

**CO2** To enhance ability and confidence to undertake field studies, data collection, analysis and presentation.

**CO3** To develop ability of preparing research proposal.

**Mapping of the Course Outcomes with Program Outcomes:**

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

- The preliminary dissertation work initiated in Third semester is further extended over fourth semester to cover up the field studies, data analysis, modeling, if any and research finding followed by conclusion etc.

- The main objective of the dissertation work is to provide scope for original & independent research to express the ability of using analytical approach or technical investigation.

- Thesis is to be prepared by each student under the guidance of faculty supervisor and finally submitted in six typed bound sets as per the specified time.

- The assessment of the dissertation work will be carried out in two stages, first during the semester for 160 marks, and final viva-voce exam for 240 marks at the end of the semester.
ELECTIVE SUBJECTS

M. TECH. (CTM)

CE604 ENVIRONMENT IMPACT ASSESSMENTS AND MANAGEMENT

Course Outcomes: At the end of the course, students will be able to

CO1 Identify the environmental attributes for EIA study.
CO2 Identify methodology and prepare EIA reports.
CO3 Identify methods for prediction of impacts.
CO4 Formulate environmental management plans.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. EIA: Introduction and Planning

2. EIA: Methodologies and Strategies

3. Environmental Management

REFERENCES:
Course Outcomes: At the end of the course, students will be able to
CO-1 Understand and analyse probability distributions.
CO-2 Understand the data types, sampling and choice of method to evaluate
CO-3 Carry out multivariate data analysis and identify correlations.
CO-4 Test hypothesis using goodness of fit measures.
CO-5 Appreciate optimization concepts for solving transportation problems.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Social Research Formulation
   Design of research - Scaling techniques - Sampling design - Design of questionnaire - Data collection and statistical processing, variables, types of variables, scaling of variables, coding of variables in software tools

2. Statistics & Probability Base
   Various probability distributions & their applications - Parameter estimation - Hypothesis testing - Random variables - Method of maximum likelihood - Hypothesis testing to compare multiple population - Statistical quality control

3. Regression Analysis
   Simple linear regression, residuals and variances, Assumptions, multiple linear regression, two stage regression, forward, backward and step-wise regression, residual analysis, correlation analysis, type of correlations, coefficient of correlation, Karl-Pearson’s coefficient, multivariate data analysis, factor analysis, applications in transportation engineering, goodness-of-fit tests and curve fitting.

4. Hypothesis Testing
   Hypothesis testing, types of error in hypothesis, confidence interval, significance tests for comparing variances and means, tests with small and large samples, two-tail and one-tail student’s t-test, analysis of variance (ANOVA), non-parametric tests (Chi-square test and Kolmogorov–Smirnov test), central limit theorem, practice with transportation data.
5. **Optimization Techniques**

   Linear programming - Simplex method - Transportation model - Concepts of non-linear programming - Decision theories – Rules - Decision under uncertainty, Applications in Transportation Engineering

**PRACTICALS**
1. Exercise for measuring central tendency, dispersion and shape of data, graphical representation, plots and pattern, interpretation of results, and histograms using MS office tools and other statistical packages
2. Sampling exercises, data storing, handling, cleaning, and descriptive analysis exercises by using statistical tools.
3. Exercise for fitting probabilistic distributions and hypothesis testing using statistical tools.
4. Exercise for correlation analysis, simple linear and multiple linear regressions, nonlinear regression, using statistical tools.
5. Exercise for parametric and non-parametric tests, test of significance, paired and unpaired sample tests and evaluation, using statistical tools.
7. Exercise for solving optimization problems using solver and using statistical tools.
8. C++ /Java/python/R/MATLAB programming for statistical analysis and probability studies

**REFERENCES:**
Course Outcomes: At the end of the course, students will be able to-

CO1 Understand the concepts of Genetic Algorithms, Fuzzy Set Theory, Artificial Neural Network

CO2 Develop a programme to apply Genetic Algorithms, Fuzzy Set Theory, Artificial Neural Network

CO3 Develop a model using Genetic Algorithms, Fuzzy Set Theory, Artificial Neural Network

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Genetic Algorithms

2. Fuzzy Logic

3. Artificial Neural Networks

4. Hybrid Systems
REFERENCES
Course Outcomes: At the end of the course, students will be able to-

CO1 Apply urban infrastructure fundamentals
CO2 Review norms and guidelines of urban infrastructure such as sewage, water supply, and solid waste management.
CO3 Apply modern management techniques the better maintenance of infrastructure.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly, 2: Moderately, 3: Substantially

1. Urban Infrastructure
   Types, significance, impact on urban form, norms and financial aspects.

2. Networks And Services Systems
   Urban services overview, classification and significance. Concepts and theories for design and operation, components, interrelationship, requirements of appropriate technology, cost recovery, Gap analysis.

3. Water Supply
   Water Supply: Source, treatment and plant location, pipe network and distribution, location of distribution station, Norms.

4. Sewerage System
   House hold collection, pipe network, location of sewerage pumping station, treatment plant and location, disposal site, Norms. Sewerage drainage, refuse collection, storage, recycling and disposal, minimum basic needs, formulation of objectives, norms and standards both for space allocation and quality control, Storm water Network.

5. Solid Waste Management
   Types, Generation, collection system, transfer station location, Segregation, transportation, disposal, site selection, Effect of population density, Impact of Urban land use, Bio-medical waste and disposal

6. Electricity & Communication Network
   Location, transformer, station, street lighting requirements, telecommunication network requirement
7. Social Infrastructure

Health and Education hierarchy, norms and location. Energy distribution, fire protection requirements, milk distribution system.

REFERENCES:
1. TCPO and Ministry Of Works and Housing, Norms and Standards for Urban Water Supply and Sewerage Services, New Delhi.
Pre Requisite Courses:

Course Outcomes: At the end of the course, students will be able to-

CO1 To apply the concept and principles of real estate sector
CO2 To identify the role of urban building industry.
CO3 To prepare and review the urban land policy and its direct government action, legal and physical controls.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Economics of location
Factors affecting different land uses such as residential, commercial, industrial, public and semi public; Land value – Concept and factors affecting; Rent and modern theory of rent; Macro and Micro approaches of Location such as trade-off model and environment preference model.

2. Real Estate
Concepts and characteristics; Urban real estate market problems, factors affecting real estate property, rights and interests; Contract law and real estate; Speculation in urban land; betterment and worsenment.

3. Urban land policy
Contents, importance, objectives, measures, instruments for its implementation, direct Govt. action, legal and physical controls; Relationship between economic trends, land market and urban development.

REFERENCES:
M. TECH. (CTM)  
CE658 APPLIED STATISTICAL ANALYSIS  

Course Outcomes: At the end of the course, students will be able to
CO1 Explain the multivariate analysis and its application.
CO2 Analyze the multivariate data using different multivariate model.
CO3 Interpret the outcomes of multivariate models.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  
2: Moderately  
3: Substantially

1. Introduction
   Concept, Scope, Introduction to multivariate statistical modelling, univariate descriptive statistics, sampling distribution, estimation, hypothesis testing

2. Basic Multivariate statistics
   Multivariate descriptive statistics, multivariate normal distribution, multivariate inferential statistics

3. Regression and Factor Analysis
   Analysis of variance, multivariate analysis of variance, multiple regression analysis, multivariate linear regression, principle component analysis, factor analysis

4. Structural Equation Modelling,
   Confirmatory factor analysis, path model, testing of path model, analysis of output, application of softwares, cluster analysis, correspondence analysis

REFERENCES:
Course Outcomes: At the end of the course, students will be able to-

CO1 Identify and define all the terms and concepts associated with deterioration of concrete structures.

CO2 Describe and apply the importance of quality control in concrete construction and significance of protection and maintenance of structures.

CO3 Assess the condition of structures

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Causes for Distress in Structure
   Philosophy & definition, causes of failure, failure in ancient time & recent times. Deficiency in design drag, material production, maintenance etc. Failure related problems; Manmade and natural failure or damage. Diagnosis of failure; change in appearance on an exposure, chemical deterioration, Mechanical deterioration. Cracking in buildings. Failure of flat roofs, balconies, trenches, dams, piles abutments piers, silos, chimney, cooling towers, R.C.C. frames, Failure information & Analysis. Format of investigation. Shear, Torsion compression failure, Erection difficulty, failure in tanks silos, space frame, precast assemblies prestressed concrete structure, formwork failure, case studies.

2. Maintenance & repair of structures
   Need for maintenance and repairs Inspection of Structures for repairs and maintenance methods for repairs, Material and methodology for repairs, Cost of repair & maintenance, Repair to foundation columns, piles, floor, roof and walls.

3. Rehabilitation of Distress Structures
   Inspection and testing distressed structures, Techniques for rehabilitation of concrete structures, retrofitting of structures.

4. Structure Assessment & Legal aspects
   Art of structure assessment, Method of testing, IS code for testing, Safety assessment, Legal aspects in connection to failure and repair.

5. Preventive measures for durability of structures
   Proper selection and specification for material, the use of modern techniques for construction, Proper design, Better workmanship.
REFERENCES:
Course Outcomes: At the end of the course, students will be able to-
CO-1 Design decking, form work and false work.
CO-2 Understand the sequence of construction of civil engineering structures.
CO-3 Understand the safety steps involved in the design of form work and false work.
CO-4 Select a right material for manufacturing false work and form work suiting specific requirements.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. 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.

2. Formwork - Design
Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork.

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

4. Special Forms
The use and applications of special forms.

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

REFERENCES:
M.TECH. (CTM)  L T P C
CE721 QUANTITATIVE METHODS  3 0 0 3

Course Outcomes: At the end of the course, students will be able to understand
CO1 To learn basics of statistical methods.
CO2 To understand operation research models.
CO3 To be able to make decisions based on decision theories.
CO4 To be aware about economics of management.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Statistics
Probability, Sampling, Uni-square and analysis of variance, simple regression and correlation, multiple regression and modeling techniques

2. Operation Research
Introduction to operations research, linear programming, graphical and simplex methods, duality and post-optimality analysis, transportation and assignment problems, queuing theory, queuing model

3. Production Management
Inventory control, EOQ, quantity discounts, safety stock-replacement theory-modification and improvement on PERT and CPM, simulation models.

4. Decision Theory
Decision theory, decision rules, decision making under conditions of certainty, risk and uncertainty, decision trees utility theory, decision making techniques. Deterministic and probabilistic situation, single and multiple person decision making.

5. Managerial Economics
Cost concepts, break-even analysis, pricing techniques, game theory and its applications.

REFERENCES:
Course Outcomes: At the end of the course, students will be able to understand
CO1  To study organizational management theories.
CO2  To understand human behavior in terms of organization management.
CO3  To learn employment management and development.
CO4  To understand labour legislations.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Manpower Planning
   History of development of management thoughts, concepts and scope of management, manpower planning, organizing, staffing, directing and controlling and personnel principles.

2. Organization
   Concept of organization, span of control, organization charts, staffing plan, development and operation of human resources, managerial staffing, recruitment, selection, placement, training and development.

3. Human Behavior
   Introduction to the field of management, basic individual psychology, motivation, job design and performance management, managing groups at work, self managing work teams, inter group behavior and conflict in organizations, leadership, behavioral aspects of decision, making; and communication for people management.

4. Management and Development Methods
   Compensation, wages and salary, employee benefits, appraisal and assessment, employee services, safety and health, discipline and discharge, special human resource problems, performance appraisal, employee hand book and personnel manual, job descriptions and organization structure and human relations, productivity of human resources.
5. Labour Legislation


REFERENCES:

Course Outcomes: At the end of the course, students will be able to-
CO1 Know unnecessary cost associated with every design & project.
CO2 Target unnecessary cost associated with every design & project.
CO3 Remove unnecessary cost associated with every design & project.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. **Lean Concept and Principles**
   History, basic approach, definitions, lean philosophy, role of value engineering and management, effect of cost on design parameters, purpose and application to construction industry, application to design, market value.

2. **Value Management Job Plan**
   Role and purpose of VM job plan, steps of VM job plan, general phase, project selection phase, information phase, functional phase, judicial phase, evaluation phase, recommendation phase and implementation phase.

3. **Functional Analysis**
   Functions, relationship, function analysis systems technique (FAST), application in value management, improvement in systems;

4. **Life Cycle Costing**
   Life cycle cost elements; LCC logic, application to facilities, analysis of the total cost of ownership, escalation & its impact, cost analysis concepts, cost matrix in LCC analysis

5. **Costing & Costing Modeling**
   Cost estimation system; use of cost models; establishing cost targets; objectives of costing; cost target team and organization; classification of costs based on complexity; datum creation; matrix and functional cost model; quality cost model, equipment cost model, billing cost model.

6. **Methods of Valuation**
   Rental method: essential ingredients, forms of rent, year purchase, capitalized value, shares and debentures, bonds of gilt-edged securities, life of structures, case studies in rental method of evaluation. land & building method: cost of construction, estimate on area basis, estimate on cubic basis, estimate by cost index, residual or demolition value of old building and case studies, profit method of valuation with case studies.
REFERENCES:
Course Outcomes: At the end of the course, students will be able to
CO-1 Identify the cost effective material use in construction.
CO-2 Use technique and equipment for low cost construction
CO-3 Generate substantial cost savings construction.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Concepts of low cost materials
   Soil, Fly ash, Ferro cement, Lime, Fibers, Stone Dust, Boulders and oversize metal, Bitumen etc.

2. Low cost building material products
   Walls; Stabilized and sun dried, soil blocks & bricks, Hollow concrete blocks, stone masonry blocks, Ferro cement partitions. Roofs; Precast R.C. Plank & Joists roof, Precast channel roof, Precast L-panel roof, Precast Funicular shells, Ferro cement shells, Filler Slab, Seasal Fiber roof, Improved country tiles, Thatch roof.

3. Low cost construction Techniques and Equipment
   Techniques; Rat trap bond construction, Precast R.C. and Ferro cement technique, Mud Technology. Equipments; Brick molding machine, Stabilized soil block making machine and plants for the manufacturing of concrete blocks, Low Cost Roads.

4. Low cost sanitation
   Waste water disposal system, Low cost sanitation for rural and urban areas, Ferro cement Drains

5. Cost analysis and comparison
   Low cost materials, Low cost techniques

REFERENCES:
2. NBO, Handbook of Housing Statistics, Government of India.
Course Outcomes: At the end of the course, students will be able to-
- CO-1 Appreciate modular construction and industrialized construction.
- CO-2 Design the precast and pre-stress elements.
- CO-3 Apply the construction method using prefabricated elements.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Prefabricated Construction

2. Modular Construction
   Modular coordination, basic module, planning and design modules, Modular grid systems, National Building Code Specification, Standardization, Dimensioning of products, Preferred dimensions and sizes, tolerances and deviations layout and processes.

3. Prefabricates
   Classification, foundation, columns, beams, roof and floor panels, wall panels, clay units, box prefabricates erection and assembly.

4. Design of prefabricated Elements
   Lift points, beams, slabs, columns, wall panels, footings, design of joints to transfer axial forces, moments and shear forces.

5. Construction Techniques
   Large panel construction, Lift slab system, Glover system, Jack block system, Constrain V-Plate system, Bis on system, Silber-Kuhi System, Control of construction processes. Equipments, horizontal and vertical transportation.

REFERENCES:
Course Outcomes: At the end of the course, students will be able to-

CO-1 Understand the importance of Infrastructure valuation in a business organization.
CO-2 Apply special techniques in Infrastructure valuation.
CO-3 Apply analytical and decision-making skills in the valuation job.
CO-4 Understand structured phases of value engineering and build teams.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Concepts
   Introduction, History of value engineering, Value, Function, Cost, Worth, Case Study Discussions.

2. General Techniques in Infrastructure Valuation

3. Special Techniques in Infrastructure Valuation

4. Applications of Infrastructure Valuation
   Team Dynamics - Team Structure and Team Building, Definition of the creative and structured phases of value engineering, The workshop approach to achieving value, Target setting, Time management, Case Study Discussions.
REFERENCES:
Course Outcomes: At the end of the course, students will be able to-
CO1 Decide emergency, vulnerability and the importance of disaster management to handle the situation.
CO2 Prepare damage assessment of natural and manmade disasters.
CO3 Work out financing relief expenditures and distribution program.
CO4 Prepare emergency management program.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Introduction
   Concepts of disaster; Types of disaster, natural and manmade: Cyclone, flood, land slide, land subsidence, fire and earthquake. Atmospheric disaster, Issues and concern for various causes of disasters.

2. Disaster Mitigation and Preparedness
   Techniques of monitoring and design against the disasters, Mitigation through capacity building, legislative responsibilities of disaster management; disaster mapping, assessment, pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation; disaster related infrastructure development

3. Emergency Management Programme
   Administrative setup and organization, information management, emergency facilities, equipment necessary, public awareness creation, preparation and execution of emergency management programme, Role of Media in Disasters

4. Technology in Disaster Management
   Electronic Warning Systems, Recent Trends in Disaster Information Provider, Geo Informatics in Disaster Studies, Cyber Terrorism, Remote Sensing & GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology

REFERENCES:
Course Outcomes: At the end of the course, students will be able to-
CO1  Understand Building Information Modelling concepts and theories.
CO2  Use BIM Authoring tools.
CO3  Do the integration of BIM with construction project management.
CO4  Apply BIM in civil engineering.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Introduction of BIM
   Introduction to BIM process and integrated project delivery, nD modelling, BIM software systems and guidelines to choosing different BIM software systems

2. Basic Modelling
   Introduction of modelling environment and tools, modelling approaches to producing plans, 3D models, views and sections of buildings, creating an initial sample of 3D BIM model using a BIM authoring software, Modelling of building including basic and vital elements, production of plans, views and 3D models, annotations and preparations of sheets for printing and publishing

3. Advance Concepts
   Model customizations, elements and materials, creation of internal components, external elements, massing and site modelling, Elements visibility, visualization and walkthroughs, model/information exchange and merging of models

4. nD Modelling
   Introduction to aspects of nD modelling, scheduling and quantity take-offs using BIM-enabled systems and export to spreadsheets, Production of a 4D program in 4D BIM software, cost estimation, producing cost estimates in a 5D BIM software

5. Interoperability in BIM
   Basics about interoperability, Export formats and applications, exchange of information through IFC, COBie, BIM 360 Glue, Mobile BIM
6. **Advances in BIM**

   Clash detection, Overview of clash detection tools, use of software to detect/resolve clashes in a BIM model, project collaboration using cloud/mobile BIM systems and common data environments

**REFERENCES**


Course Outcomes: At the end of the course, students will be able to

CO1 Understand Infrastructure Management basics
CO2 Evaluate Infrastructure Performance Management Strategies.
CO3 Formulate Infrastructure Resiliency Management Strategies.
CO4 Design Infrastructure Sustainability Management Strategies.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. **Introduction of Infrastructure Asset Management**
   Infrastructure Asset Management Definitions, Framework and Primers, Infrastructure Asset Management Steps Process and Techniques, Infrastructure Asset Management Hierarch, Inventory, and Register

2. **Advanced Infrastructure Asset Management**
   Advanced Infrastructure Management: Likelihood of Failure, Advanced Infrastructure Management: Likelihood of Failure, Advanced Infrastructure Management: Risk Analysis and Management

3. **Performance of Infrastructure Asset Management**

4. **Infrastructure Asset Management - Sustainability**
   Infrastructure Sustainability Management Definition, Framework and Primers, Infrastructure Sustainability Metrics, Indices, Tools and Techniques, Infrastructure Sustainability Management and Real World Application

5. **Infrastructure Asset Management - Resiliency**
REFERENCES
Course Outcomes: At the end of the course, students will be able to understand

CO1  To learn fundamentals of modern cities.
CO2  To know about smart infrastructures.
CO3  To learn fundamentals of telecommunication systems.
CO4  To understand the smart transport and ecology.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Modern Cities-Characteristics
   Three layers concept of modern cities (Urban infrastructure, facility & service layers), Understanding the need to reduce carbon emissions and developing sustainable smart solutions. Four facets of smart solutions - Physical, Institutional, Social & Economic Infrastructure; Framework of public information system in smart cities.

2. Smart Security Infrastructure

3. Smart Telecommunications Infrastructure
   Wired & wireless network systems, Role of satellite communication, Wi-Fi and RF systems in smart communication, Optical Fiber Cable and DWDM (Dense Wave Division Multiplexing), IPMPCS (Multi Protocol Cable Switching) solutions

4. Smart Transport Infrastructure
   Smart transportation, Logistics, Real time Information systems, traffic information management, smart solutions for water supply and waste water engineering; remote sensing & GIS technology

5. Energy Solutions
   Renewable energy, Smart grid systems, Reducing carbon emissions without compromising on convenience of users, Community Energy Management systems, Energy on wheels, H2H & V2H (Home to Home & Vehicle to Home) Energy solutions,
smart meters, case studies-Japan and Europe countries

REFERENCES:
2. Concept oriented research and development in Information Technology Edited by Kinji Mori WILEY Publ.
Course Outcomes: At the end of the course, students will be able to-
- CO1 Know various optimization techniques
- CO2 Apply optimization techniques in construction management
- CO3 Validate output obtained by using optimization techniques in research

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 1: Slightly  2: Moderately  3: Substantially

1. Introduction of Optimization Methods
   Single and Multivariable optimization methods, constrained optimization methods, Kuhn–Tucker conditions, Necessary & sufficiency theorems.

2. Linear programming
   Linear programming - Traveling salesman problem and Transshipment problems – Post optimization analysis.

3. Integer programming
   Integer programming - All integer, mixed integer and zero - one programming.

4. Geometric and Dynamic programming
   Geometric programming - concept - degree of difficulty - solution of unconstrained & Constrained non-linear problems by geometric programming, Dynamic programming

REFERENCES:
Course Outcomes: At the end of the course, students will be able to understand
CO1 To assess the health condition of structures.
CO2 To inspect and evaluate damaged structures.
CO3 To learn fundamentals of serviceability and durability of structure.
CO4 To understand the techniques for repairing of structures.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. General
   Performance of construction materials and components in services Causes of deterioration, Preventive measurements and maintenance.

2. Influence on Serviceability and Durability
   Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and catholic protection, Principles of assessment of weathering and durability, Characteristics of materials. Diagnosis of construction failures, dealing with cracks.

3. Maintenance and Repair Strategies
   Facets of Maintenance importance of Maintenance, Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

4. 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.

5. Techniques for Repair and Demolition
   Rust eliminators and polymers coating for rebars during repair foamed concrete, painting, water proofing, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning and special techniques and demolition techniques.
REFERENCES:
Course Outcomes: At the end of the course, students will be able to understand
CO1 To assess the health condition of structures.
CO2 To inspect and evaluate damaged structures.
CO3 To learn fundamentals of serviceability and durability of structure.
CO4 To understand the techniques for repairing of structures.

Mapping of the Course Outcomes with Program Outcomes:

<table>
<thead>
<tr>
<th>CO\PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: 1: Slightly 2: Moderately 3: Substantially

1. Fire protection System
Fire Protection: Process of combustion in fire, Effect of fire load & ventilation condition on enclosure fire, growth and decay of fire in enclosure, Concepts of fire resistant and severity, Effect of fire on materials. Design of elements for given fire resistance, structural fire protection, Site Planning, Internal planning for Escape and refuges, Fire detection & suppression systems, Smoke venting

2. Vertical Transportation and HVAC

3. Electrical System
Element of Electrical Services in building, Illumination & intelligent building

4. Maintenance and Repair Strategies
Element of Electrical Services in building, Illumination & intelligent building, Definition, Role of building maintenance in construction process Maintenance generators, Expression of Standards, selection of level of maintenance and fixing standards, Maintenance cycle, maintenance profile, repair & replacement models, statistical methods, decision models, optimal renewal cycle, budgeting etc.

REFERENCES:
### Seat Matrix to be submitted to CCMT 2020

<table>
<thead>
<tr>
<th>Institute Code</th>
<th>Institute Name</th>
<th>Department</th>
<th>Program</th>
<th>Group (G1, G2, G3)</th>
<th>Eligible UG degree</th>
<th>Eligible GATE subject against each of the Eligible UG degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sardar Vallabhbhai National Institute of Technology, Surat</td>
<td>Department of Civil Engineering-(CE)</td>
<td>Construction Technology and Management-(CTM)</td>
<td>G1</td>
<td>B.E./B.Tech./AMIE in Civil Engineering (T118)</td>
<td>Civil Engineering – (CE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bachelor of Architecture-(A401)</td>
<td>Architecture and Planning -(AR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bachelor of Planning-(A402)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Architectural Engineering-(T106)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Architecture-(T107)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Building and Construction Technology-(T114)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Civil Environmental Engineering-(T119)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Construction Engineering-(T125)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Construction Technology-(T126)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Environmental Engineering-(T142)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Structural Engineering-(T180)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Town planning-(T183)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Transportation Engineering-(T184)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Architecture and Regional Planning-(T193)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Civil Engineering and Planning-(T208)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Civil Technology-(T209)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Computer Aided Design of Structures -(T212)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Construction and Project Management -(T220)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.E./B.Tech. in Construction</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T221</td>
<td>Engineering and Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T222</td>
<td>B.E./B.Tech. in Construction Technology and Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T322</td>
<td>B.E./B.Tech. in Town and Country Planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T324</td>
<td>B.E./B.Tech. in Civil and Transportation Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T332</td>
<td>B.E./B.Tech. in Architecture and Interior Decoration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T336</td>
<td>B.E./B.Tech. in Civil and Transportation Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T337</td>
<td>B.E./B.Tech. in Civil Engineering (Public Health Engineering)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T345</td>
<td>B.E./B.Tech. in Facilities and Services Planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T380</td>
<td>B.E./B.Tech. in Project Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>