



**Maratha Vidya Prasarak Samaj's  
Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering**

**An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune**

**Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013, Maharashtra, India**

## **Syllabus**

**First Year M. Tech. (2024 Pattern)**

**As per NEP 2020**

**Post-Graduate Program in Civil Engineering (Construction Management)**

**Academic Year 2024-25**

(Copy for Student Circulation Only)

**First Year M. Tech. Curriculum Structure (2024 Pattern)**  
**Civil Engineering (Construction Management)**  
**Semester - I**

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks						Credits			
			TH	PR	TU	CCE	ESE	TW	PR	OR	TOT	TH	PR	TU	TOT
205101	MLC	Research Methodologies and IPR <sup>@</sup>	4	-	-	50	50	-	-	-	100	4	-	-	4
205102	PCC	Management and Project Planning in Construction	3	2	-	50	50	25	-	25	150	3	1	-	4
205103	PCC	Construction Technology	3	-	-	50	50	-	-	-	100	3	-	-	3
205104	PCC	TQM in Construction	3	-	-	50	50	-	-	-	100	3	-	-	3
205105X	PEC-I	Elective-I*	4	2	-	50	50	25	-	-	125	4	1	-	5
205106	VSEC- I	Skill Development Laboratory – I	-	2	-	-	-	25	-	-	25	-	1	-	1
<b>Total</b>			<b>17</b>	<b>06</b>	<b>-</b>	<b>250</b>	<b>250</b>	<b>75</b>	<b>-</b>	<b>25</b>	<b>600</b>	<b>17</b>	<b>03</b>	<b>-</b>	<b>20</b>

**Abbreviations: TH:** Theory

**PR:** Practical

**TU:** Tutorial

**CCE:** Continuous Concrete Evaluation

**ESE:** End-Semester Examination

**TW:** Term Work

**OR:** Oral

**TOT:** Total

@ common to all branches

**First Year M. Tech. Curriculum Structure (2024 Pattern)**  
**Civil Engineering (Construction Management)**  
**Semester - II**

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks						Credits			
			TH	PR	TU	CCE	ESE	TW	PR	OR	TOT	TH	PR	TU	TOT
205201	PCC	Sustainability in Construction Projects	4	-	-	50	50	-	-	-	100	4	-	-	4
205202	PCC	Construction Contracts Administration and Management	3	2	-	50	50	25	-	25	150	3	1	-	4
205203	PCC	Project Economics and Financial Management	4	-	-	50	50	-	-	-	100	4	-	-	4
205204X	PEC-II	Elective-II**	4	2	-	50	50	25	-	-	125	4	1	-	5
205205	VSEC- II	Skill Development Laboratory – II	-	2	-	-	-	25	-	-	25	-	1	-	1
205206	ELC -I	Seminar	-	4	-	-	-	50	-	50	100	-	2	-	2
<b>Total</b>			<b>15</b>	<b>10</b>	<b>-</b>	<b>200</b>	<b>200</b>	<b>125</b>	<b>-</b>	<b>75</b>	<b>600</b>	<b>15</b>	<b>05</b>	<b>-</b>	<b>20</b>

**Abbreviations: TH:** Theory

**PR:** Practical

**TU:** Tutorial

**CCE:** Continuous Concrete Evaluation

**ESE:** End-Semester Examination **TW:** Term Work

**OR:** Oral

**TOT:** Total

**Second Year M. Tech. Curriculum Structure (2024 Pattern)**  
**Civil Engineering (Construction Management)**  
**Semester - III**

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks						Credits			
			TH	PR	TU	CCE	ESE	TW	PR	OR	TOT	TH	PR	TU	TOT
205301	SBC-I	Dissertation Phase -I	-	20	-	-	-	100	-	100	200	-	10	-	10
205302	ELC-II	Research Seminar	-	8	-	-	-	50	-	50	100	-	4	-	4
205303	SLC	MOOC Courses	-	4	-	-	-	50	-	-	50	-	2	-	2
205304	OJT	Internship / On-Job Training	-	8	-	-	-	100	-	50	150	-	4	-	4
<b>Total</b>			-	40	-	-	-	300	-	200	500	-	20	-	20

**Abbreviations: TH:** Theory

**PR:** Practical

**TU:** Tutorial

**CCE:** Continuous Concrete Evaluation

**ESE:** End-Semester Examination

**TW:** Term Work

**OR:** Oral

**TOT:** Total

**Second Year M. Tech. Curriculum Structure (2024 Pattern)**  
**Civil Engineering (Construction Management)**  
**Semester - IV**

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks						Credits			
			TH	PR	TU	CCE	ESE	TW	PR	OR	TOT	TH	PR	TU	TOT
205401	SBC-II	Dissertation Phase -II	-	40	-	-	-	200	-	100	300	-	20	-	20
<b>Total</b>			-	<b>40</b>	-	-	-	<b>200</b>	-	<b>100</b>	<b>300</b>	-	<b>20</b>	-	<b>20</b>

**Abbreviations: TH:** Theory

**PR:** Practical

**TU:** Tutorial

**CCE:** Continuous Concrete Evaluation

**ESE:** End-Semester Examination

**TW:** Term Work

**OR:** Oral

**TOT:** Total

## Program Elective Course - I and II

Course Code	* Elective -I	Course Code	** Elective -II
205105A	Sustainable Construction Materials	205204A	Green Building Design and Construction
205105B	Disaster Management	205204B	Infrastructure Development
205105C	Retrofitting of Structures	205204C	Material Management
205105D	Construction Safety	205204D	Value Engineering and Valuation
205105E	Building Services and Maintenance	205204E	Risk Analysis and Mitigation Practice
		205204F	Construction Equipment Management

Course Code	Skill Development Laboratory – I	Course Code	Skill Development Laboratory – II
205106	Software Skills	205205	Oral and Written Communication

## List of Abbreviations Used with Percentage of Credits

Abbreviations	Course Type	Number of Courses	Credits	% of Credits
PCC	Program Core Course	06	21	25.0
PEC	Program Elective Course	02	08	10.0
PLC	Program Laboratory Course	04	04	5.0
ELC	Experiential Learning Course	02	06	7.5
MLC	Mandatory Learning Course	01	04	5.0
VSEC	Vocational and Skill Enhancement Course	02	02	2.5
SBC	Skill Based Course	02	30	37.5
SLC	Self-Learning Course	02	06	7.5
<b>Total</b>		<b>21</b>	<b>80</b>	<b>100%</b>



- **Summary of Credits and Total Marks:**

Semester	Credits	Marks
I	20	600
II	20	600
III	20	500
IV	20	300
<b>Total</b>	<b>80</b>	<b>2000</b>

- **Definition of Credit :**

The Post Graduate (P.G.) programmes will have credit system. The details of credit will be as follow.

1 Credit = 1 hour/week for lecture  
= 2 hours/week for practical  
= 1 hour/week for tutorial



## Semester - I

<b>Course Code: 201104</b>	<b>Course Name: Research Methodology and IPR</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 4 Hours/Week</b>	<b>4</b>	<b>CCE : 50 Marks ESE : 50 Marks</b>

### Prerequisite Courses:

- Students should complete undergraduate courses in engineering/technology.

### Course Objectives:

- To provide an overview of the research problem and describe the functions of literature survey in research.
- To explain the statistical and probability analysis.
- To explain the art of writing research reports and papers.
- To understand the patenting process and its commercial aspects.
- To explain patent rights and new developments in IPR.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Understand research problem formulation, approaches of investigation of solutions for research problems and literature survey.

**CO2:** Apply the principles of statistics and probability analysis in research.

**CO3:** Acquire skills in research proposal/paper writing.

**CO4:** Discover the importance of IPR.

**CO5:** Understand patent rights and new developments in IPR.

### Course Content:

**UNIT-I: Research Problem and Literature Survey** **11 Hours**

**Research Problem:** Meaning of research problem, sources of research problem, characteristics of a good research problem, and errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, benchmarking, analysis, interpretation

**Literature survey:** Effective literature studies approaches, analysis, Plagiarism, its importance and software's, research ethics, research gap, writing objectives of research studies.

**UNIT-II: Statistics and Probability Analysis****10 Hours**

**Statistical Analysis:** Introduction, Sources of error and uncertainty, One-Dimensional Statistics: combining errors and uncertainties, t-test, ANOVA statistics.

**Probability Analysis:** Classical and empirical probability, axioms of probability, conditional probability, Bayes' rule, law of total probability and law of total expectation.

**UNIT-III: Technical Writing****11 Hours**

Characteristics of effective technical writing, developing a Research proposal, format of the research proposal, financial heads of the research project, research paper writing, abstracting and indexing of journals, impact factor, h index, research paper submission and review process, writing responses to reviewer's comments, Publications.

**UNIT-IV: Intellectual Property****10 Hours**

Patents, designs, trade and copyright, the process of filing patents, designs, trade and copyright, examination, examination report, writing responses to the examination report, patent grant, commercialization, patenting under PCT and its advantages, case studies.

**UNIT-V: Patent Rights and New Developments in IPR****10 Hours**

Scope of patent rights, Licensing and transfer of technology, patent information and databases, geographical Indications. Administration of patent system, new developments in IPR, IPR of biological systems, computer software etc.

**Learning Resources:**

1. Research Methodology: Methods and Trends, by Dr. C. R. Kothari.
2. Research Methodology: An Introduction by Wayne Goddard and Stuart Melville.
3. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar, 2<sup>nd</sup> Edition.
4. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd.
5. Mayall, Industrial Design, McGraw Hill.
6. Niebel, Product Design, McGraw Hill.
7. T. Ramappa, Intellectual Property Rights under WTO, S. Chand.
8. Paul L. Meyer, Introductory probability and statistical applications, Addison-Wesley Publishing Company, 1970.

**Web link for MOOC / NPTEL Links:**

1. [www.ipindia.gov.in](http://www.ipindia.gov.in)
2. [www.nptel.ac.in/courses/121106007](http://www.nptel.ac.in/courses/121106007)



<b>Course Code: 205102</b>	<b>Course Name: Management and Project Planning in Construction</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 3 Hours/Week</b> <b>Practical : 2 Hours/Week</b>	<b>3</b> <b>1</b>	<b>CCE : 50 Marks</b> <b>ESE : 50 Marks</b> <b>TW : 25 Marks</b> <b>OR : 25 Marks</b>

#### Prerequisite Courses:

- Basics of project management.

#### Course Objectives:

- To acquire knowledge of basic management practices adopted in civil engineering by using various techniques and software's.
- To acquaint knowledge of various aspects related work-study.
- To understand aspects of site safety and administration.

#### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Apply knowledge of Management in construction projects.

**CO2:** Analyze project scheduling using various techniques.

**CO3:** Evaluate various project monitoring techniques.

**CO4:** Apply knowledge of work-study on construction sites to improve productivity.

**CO5:** Evaluate safety norms in the construction site and decide incentive scheme.

#### Course Contents

##### UNIT-I: Basics of Management

**08 Hours**

Modern scientific management (Contribution by Fayol, F.W. Taylor, Mayo), Management functions, Management styles, SWOT analysis in construction, Basic forms of organization with emphasis on project and matrix structures; project life cycle, qualities, role and responsibilities of project manager, role of project management consultants.

##### UNIT-II: Project Scheduling

**08 Hours**

Work breakdown structure, activity cost and time estimation in CPM, PERT, RPM (Repetitive Project Modeling) techniques. LOB technique, Mass haul diagrams. Precedence Network Analysis.

##### UNIT-III: Project Monitoring and Software

**08 Hours**

Monitoring and control, Crashing, Resource Levelling, Updating, software in Construction scheduling (MSP, primavera, Construction manager), Enterprise Resource Planning (ERP). Introduction to artificial intelligence technique ANN, Fuzzy Logic, Genetic Algorithms.

#### **UNIT-IV: Work Study**

**08 Hours**

Definition, objectives, basic procedure, method study and work measurement, work study applications in civil engineering. Method study – definition, objective, procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. Work measurement – time and motion studies, concept of standard time and various allowances, time study, equipment performance rating.

#### **UNIT-V: Construction Safety and Administration of Incentive Schemes**

**08 Hours**

Causes of accidents on various sites, safety measures and safety policies to be adopted, determination of safety parameters, and personal protective equipment. Workmen compensation Act, Minimum Wages Act, Hazard Identifications and Control Techniques - HAZOP, FMEA, and FMECA. Cost of construction injuries - legal implications. Necessity, merit rating, job evaluation, installation, modification and maintenance of incentive schemes based on implementation experience.

#### **Learning Resources:**

##### **Text Books:**

1. Total Quality Management P. N. Mukharjee
2. Total Quality Management by N.V.R Naidu, G. Rajendra New Age international ,First Edition, Jan 2006
3. Total Quality Management by R.S Naagarazan ,New Age international,3e, 2015.

##### **Reference Books:**

1. Construction Planning & management By P S Gahlot & B M Dhir , New Age International Limited Publishers.
2. Construction Management – Roy, Pilcher
3. Construction Management – O'Brien
4. Project Management-Planning and Control---Rory Burkey 4th Ed.—Wiley, India
5. Work study – Currie.
6. Project Management – K Nagrajan – New Age International Ltd.

##### **Web link for MOOC / NPTEL Links:**

1. <https://archive.nptel.ac.in/courses/105/104/105104161/>
2. <https://archive.nptel.ac.in/courses/105/103/105103093/>



## List of Assignments

1. Assignment on Work Breakdown structure.
2. Assignment on PERT.
3. Assignment on CPM and calculation of float.
4. Assignment on using MS Excel, MS Project software.
5. Assignment on ERP software.
6. Assignment on work study.
7. Assignment on safety practices in the construction industry- A case study.
8. Assignment on ANN, Fuzzy Logic, Genetic, Algorithms in the construction industry- A case study.

<b>Course Code: 205103</b>	<b>Course Name: Construction Technology</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 3 Hours/Week</b>	<b>3</b>	<b>CCE : 50 Marks ESE : 50 Marks</b>

### Prerequisite Courses:

- Building Construction and Materials, Concrete Technology, Geo-technical and foundation Engineering.

### Course Objectives:

- To explain different methods and techniques in the construction of deep foundations.
- To illustrate different construction processes with recommended specifications.
- To develop students in the area of construction technology.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Evaluate the appropriate techniques involved in pile construction.

**CO2:** Explain the type of coffer dam, caissons and diaphragm wall.

**CO3:** Describe methods of underwater construction and grouting.

**CO4:** Evaluate high rise construction & Pre-Engineered Building techniques.

**CO5:** Describe techniques in bridge construction and tunneling.

### Course Contents

#### UNIT-I: Pile Construction Techniques 08 Hours

Introduction, uses, selection of piles, Classification of piles, pile driving techniques and equipment, grouping of piles, efficiency of group of piles, pile cap and pile shoe, loads on piles and pile testing, causes of failures of piles and precautionary measures, Use of NDT in pile construction.

#### UNIT-II: Cofferdams, Caissons & Diaphragm Wall Construction 08 Hours

Types and selection of cofferdams, design features and construction of coffer dams, construction of single, double wall, Sheet pile cofferdams, concrete wall movable cofferdam. Types and uses of caissons, construction material, loads on caisson, Construction techniques used in pneumatic and precast caissons, floating, sinking and tilting of caissons, and caisson diseases. Diaphragm wall construction, soldier construction method, Leakage prevention and economic considerations.

#### UNIT-III: Underwater Excavation, Dewatering Techniques & Grouting 08 Hours

Underwater excavation problems, challenges and solutions, underwater drilling and blasting, grouting methods: jet grouting and chemical grouting, dewatering in shallow and deep

excavations, vacuum dewatering and well point system, electro-osmosis and injection techniques, freezing process and vibro-flotation.

#### **UNIT-IV: High Rise Construction and PEB Techniques**

**08 Hours**

Prefabrication in high-rise construction, shuttering/formwork systems for high-rise buildings, scaffold systems and safety measures, formwork for special structures, ready mix concrete plant erection and concrete pumping, slip forming and aluform techniques, high-rise construction maintenance practices, construction & erection process of pre-engineered buildings.

#### **UNIT-V: Techniques in Bridge Construction and Tunneling**

**08 Hours**

Different methods of bridge construction, launching of bridges by incremental launching, using false work and balanced cantilever construction method. Tunnel alignment, size and shape of a tunnel, tunneling in hard and soft strata, tunnel shaft-sinking and construction, techniques in tunnel lining, ventilation and lighting systems in the tunnel, advance techniques for tunnel maintenance, micro tunneling.

#### **Industrial Visit:**

1. Visit the site for piling work/ High-Rise Building / Pre-Engineered Building site / Bridge Construction sites.

#### **Learning Resources:**

##### **Text Books:**

1. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai & Sons, New Delhi.
2. S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press, New Delhi.
3. B.C. Punmia, Building Construction, Laxmi Publications, New Delhi.
4. S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand.
5. Construction Equipment Planning and Applications – Dr. Mahesh Varma
6. Bridge Engineering- S. Ponnuswamy.

##### **Reference Books:**

1. Construction Planning, Equipment and Methods – Peurifoy- Tata McGraw Hill Publication
2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
3. Journals such as CE & CR. Construction world, International Construction.
4. Dr. Kumar Niraj Jha, — Formwork for Concrete Structures, McGraw Hill Publication.

##### **Weblink for MOOC / NPTEL Links:**

1. <https://www.coursera.org/specializations/piling-construction-and-practices>.



<b>Course Code: 205104</b>	<b>Course Name: TQM in Construction</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 3 Hours/Week</b>	<b>3</b>	<b>CCE : 50 Marks</b> <b>ESE : 50 Marks</b>

### Prerequisite Courses:

- Project Management, Construction Management.

### Course Objectives:

- To implement TQM and describe role of its techniques for achieving TQM in the construction industry.
- To get acquainted knowledge of ISO 9001 and ISO 9004, training and development of human resources. To describe and discuss the role of techniques used in TQM and TPM in the construction industry.

### Course Outcomes:

After successful completion of the course, the learner will be able to:

**CO1:** To implement the basic concept and framework of Total Quality management in construction.

**CO2:** To describe and discuss the role of techniques used in TQM.

**CO3:** To prepare a checklist for RCC Work using training and development of human resources.

**CO4:** To get acquainted knowledge of ISO 9004 and related quality system standards and application of six sigma.

**CO5:** To analyze different types of construction defect.

### Course Content:

#### UNIT-I: Concept of Quality 08 Hours

Definition of quality as given by Deming, Juran, Crosby, and Quality Gurus, difference between Quality control and quality Assurance (QA/QC). Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in the construction industry, Quality Manual, Responsibility matrix, monitoring for quality- PDCA Cycle.

#### UNIT-II: Quality Control tools and statistical quality Control 08 Hours

Histogram, Pareto diagram, Fishbone diagram, Quality control chart-Testing required for quality control of construction material used in RCC Work- destructive and Non-Destructive Test (NDT) Statistical Quality Control- Necessity, Benchmarking, and Application of dispersion methods in quality control of construction activity.

**Quantitative Techniques:** Failure Mode Effect Analysis (FMEA), Kanban, Activity Based Costing (ABC). Taguchi Methods.

**UNIT-III: Training and development of Human Resources** **08 Hours**

Training needs assessment and preparation for training. Training, Project Rework Reduction Tool (PRRT) software, training for preparation of checklist necessary for RCC work for commonly used formats. Development of quality circles, quality inspection team, inspection reports, monitoring and control, 360° feedback for quality.

**UNIT-IV: ISO 9004- Quality System Standards, Six Sigma** **08 Hours**

Purpose of ISO standards. Difference between ISO 9001 and ISO 9004. Certification process for ISO 9001. Certification bodies involved. Eight principles of ISO. Management support and commitment are necessary for achieving the implementation of quality system standards.

**Six Sigma:** Definition of six sigma, evolution, historical aspects, six sigma training, application of six sigma tool.

**UNIT-V: Achieving TQM in Construction** **08 Hours**

Advantages, barriers, principles, steps in implementation, seven types of construction defects. Determining cost of poor quality including hidden cost. Quality functions deployment (QFD). Importance of third-party quality audits. CIDC CQRA quality rating systems, customers satisfaction surveys, non-conformity reports (NCR), remedial strategy for reducing NCR's. Kizen, 5 'S.

**Learning Resources:**

1. Total Quality Management P. N. Mukharjee.
2. Total Quality Management by N.V.R Naidu, G. Rajendra New Age international, First Edition, Jan 2006.
3. Total Quality Management by R.S Naagarazan, New Age international, 3e, 2015.

**Text Books:**

1. Construction Planning & management By P S Gahlot & B M Dhir , New Age International Limited Publishers.
2. Construction Management – Roy, Pilcher.

**Reference Books:**

1. International Standards Organization – ISO 9001 and ISO 9004
2. Mantri Handbook – A to Z of Construction – Mantri Publications
3. Juran's Quality Handbook – Joseph M. Juran, A. Blanton. Godfrey – McGraw Hill



International Edition (1998)

4. Probability and Statistics for Engineers – Miller, Freund-Hall, Prentice India Ltd.
5. Quality Control and Total Quality Management, P. L. Jain, Tata McGraw Hill Publ.

**Web link for MOOC / NPTEL Links:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_mg03/preview](https://onlinecourses.nptel.ac.in/noc21_mg03/preview)



<b>Course Code: 205105A</b>	<b>Course Name: Sustainable Construction Materials</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

#### Prerequisite Courses:

- Basic civil engineering, Concrete technology, Material testing, Building materials.

#### Course Objectives:

- To analyze the properties of common construction materials and their behavior under various environmental conditions.
- To explore the range of sustainable materials available in the market and assess their applications.
- To understand the properties, mechanical tests, and quality control measures for high-performance concrete.
- To comprehend the principles of sustainability in relation to sustainable building materials and conventional engineered building products.

#### Course Outcomes:

On completion of the course, learner will be able to:

**CO1:** Analyze the properties and environmental impact of sustainable construction materials.

**CO2:** Evaluate advanced concrete technologies and their application in sustainable construction.

**CO3:** Select appropriate recycled and emerging materials for enhancing sustainability in projects.

**CO4:** Design energy-efficient buildings integrating renewable energy solutions.

**CO5:** Apply green building standards and energy codes to achieve sustainable construction certifications.

#### Course Contents

##### UNIT-I: Fundamentals of Sustainable Construction Materials

**11 Hours**

Introduction to sustainable construction materials and their role in modern construction. Composition, properties, production methods, storage and distribution of sustainable materials. Economic considerations, testing methods, acceptance criteria and recent developments in sustainable construction materials. Overview of recent market trends in sustainable construction materials and their environmental impacts.

**UNIT-II: Advanced and Innovative Concrete Technologies****11 Hours**

Role of construction chemicals and admixtures in sustainable construction. Utilization of supplementary cementitious materials like fly ash, silica fume, and self-compacting concrete. Innovative concrete technologies, including fiber-reinforced concrete, lightweight concrete and high-performance concrete. Nanotechnology applications in concrete, ferrocement technology. Aerated Concrete, Hempcrete, Papercrete, Fibre Reinforced Concrete, Permeable Concrete. CO<sub>2</sub> absorbing concrete.

**UNIT-III: Recycled and Emerging Materials in Construction****10 Hours**

Use of construction and demolition waste in concrete production. Applications of industrial waste materials for construction. Emerging materials in sustainable construction. Carbon Negative **Building Materials:** Traditional Building Materials, Alternate Building Materials, Introduction – environmentally friendly, reliable and durable Building Materials, Nano-cellulose composite brick, Agro bricks ( Date Palm Fibres, Rice Husk , Rice Husk Ash), Ecobind tiles. **Smart Building Materials:** Types, Facade systems, smart windows, liquid crystal panels, photochromics, electrochromics, suspended particle panels, thermotropic, thermochromics.

**UNIT-IV: Sustainable Building Practices****10 Hours**

Integration of Building Integrated Photovoltaics (BIPV) and other renewable energy technologies in buildings. Principles of energy efficiency, including concepts like Overall Thermal Transfer Value (OTTV). Use of renewable energy sources and energy optimization in sustainable construction. Lighting systems - Optimization of lighting systems, Adhesion-changing smart materials - Photo-adhesive smart materials, Titanium Di-oxide Products, Thermochromics, Magnetorheological and electrorheological, Thermotropic, Shape memory Phototropics, Mechanochromics, Chemochromics.

**UNIT-V: Green Building Standards and Energy Codes****10 Hours**

Operational energy in the building, role of materials and thermal conductivity, Operational energy reduction and net zero building, Optimization for the design of the building for energy efficiency, Overview of energy codes and their requirements including the Energy Conservation Building Code (ECBC). Green building certification systems such as LEED and GRIHA. Criteria for green performance ratings and their application in sustainable construction practices.

**Learning Resources:****Text Books:**

1. Carole Ryan, 2011, Traditional Construction For A Sustainable Future, Spon Press  
David Rockwood , 2015 Bamboo Gridshells, Routledge Press

2. Erik K. Lauritzen, 2019, Construction, Demolition and Disaster Waste Management- An Integrated and Sustainable Approach, CRC Press
3. Gajanan M. Sabnis, 2016, Green Building With Concrete Sustainable Design and Construction, CRC Press
4. Engineering Materials –Dr. S. V. Deodhar
5. Building Materials by M L Gambhir, Neha Jamwal, Tata McGraw Hill Publ.
6. Concrete Technology by M. S. Shetty, S. Chand Publ.
7. Concrete Technology by Neville.

**Reference Books:**

1. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Processes, 1st Edition, Elsevier, 2003
2. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Constituent Materials, 1st Edition, Elsevier, 2003
3. Kubba, S, LEED Practices, Certification, and Accreditation Handbook, 1st ed. Elsevier, 2010.
4. Ministry of Power, Energy Conservation Building Code 2018, Revised Version, Bureau of Energy Efficiency, 2018,
5. Architectural Energy Corporation, Building Envelope Stringency Analysis, International Institute for Energy Conservation, 2004
6. Indian Building Congress, Practical Handbook on Energy Conservation in Buildings, 1st ed. Nabhi Publication, 2008.
7. McQuiston, F.C., and Parker, J.D. Heating, Ventilating, and Air Conditioning, Analysis and Design, Fourth Ed. John Wiley & Sons, Inc, 1994.
8. Clarke, J.A., Energy Simulation in Building Design, Adam Hilger Ltd. 1985.
9. TERI-Griha's Green Design practices ([www.teriin.org/bcsd/griha/griha.htm](http://www.teriin.org/bcsd/griha/griha.htm))
10. Leadership in Energy and Environmental Design ([www.usgbc.org/LEED](http://www.usgbc.org/LEED))
11. Article on Residential Green Choice([www.austinenergy.com](http://www.austinenergy.com)).

**Weblink for MOOC / NPTEL Links:**

1. [https://onlinecourses.nptel.ac.in/noc19\\_ce40/preview](https://onlinecourses.nptel.ac.in/noc19_ce40/preview)
2. [https://onlinecourses.nptel.ac.in/noc24\\_ar20/preview](https://onlinecourses.nptel.ac.in/noc24_ar20/preview)

**List of Assignments:**

1. Analyze two sustainable construction materials. Include their properties, production processes, economic considerations, recent market trends, and a comparative analysis of their advantages and limitations.
2. Conduct an experiment comparing conventional and innovative concrete types (e.g., self-



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compacting or high-performance concrete). Discuss materials, methods, test results, and sustainability implications.

3. Write a case study on a construction project using recycled or emerging materials. Cover the project's sustainability goals, material selection, implementation, impacts, and lessons learned.
4. Create a conceptual design for an energy-efficient building with integrated renewable energy systems (e.g., BIPV). Include layout, technology used, energy savings, and design justification.
5. Evaluate a certified green building project (e.g., LEED, GRIHA). Discuss the certification criteria, energy codes, benefits, and areas for improvement.



<b>Course Code: 205105B</b>	<b>Course Name: Disaster Management</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

#### Prerequisite Courses:

- Construction Management.

#### Course Objectives:

- To explain various types of natural and manmade disasters and their effects.
- To resolve the challenges in disaster management using technological aids.
- To aware various IT aids, public awareness and their Management.

#### Course Outcomes:

On completion of the course, learner will be able to:

**CO1:** Apply concepts of disaster to management.

**CO2:** Explain various aspects of disaster management.

**CO3:** Organize emergency management programme.

**CO4:** Organize various public awareness programmes initiated by the government.

**CO5:** Describe risk identification, risk assessment and disaster mitigation.

#### Course Contents

##### **UNIT-I: Introduction to Hazard and Disaster** **11 Hours**

Introduction – hazard and disaster. Concepts of hazard, vulnerability, risks. Different types of disaster: **Natural disasters**- earthquakes, tsunami, floods, drought, landslides, cyclones and volcanic eruptions. Their case studies. Coastal disasters. Coastal regulation zone. **Man-made disaster:** Fire, industrial pollution, nuclear disaster, biological disasters, accidents (road, rail, sea & air) war & terrorism etc. Causes, effects, and practical examples for all disasters.

##### **UNIT-II: Disasters Management** **11 Hours**

Financing relief expenditure, legal aspects, and rescue operations. Casual management, risk management. Disaster prevention and mitigation. Refugee operations during disasters, human resettlement and rehabilitation issues during and after disasters, role of engineers on disaster management.

**UNIT-III: Emergency Management Program****10 Hours**

Administrative setup and organization. Hazard analysis, training of personnel, information management, emergency facilities and equipment necessary for public awareness creation, preparation, and execution of the emergency management program Epidemics.

**UNIT-IV: Organizations and International Adopted Practices****10 Hours**

**Organizations:** Various organizations registered with the Government and NGOs working for disaster relief-Challenges faced by organizations. International adopted practices, International adopted practices for disaster mitigation. Rules and regulations, monitoring aspects of disaster mitigation programs.

**UNIT-V: Methods of Assessment****10 Hours**

Methods of assessment of impact of disasters such as an economic impact assessment, social impact assessment, environmental impact assessment, health impact assessment, infrastructure impact assessment, psycho-social impact assessment.

**Learning Resources:****Text Books:**

1. R. Nishith, Singh AK, Disaster Management in India: Perspectives, issues and strategies New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.), Disaster Mitigation Experiences and Reflections, Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies, Deep & Deep Publication Pvt. Ltd., New Delhi.

**Reference Books:**

1. Construction Engineering and Management – Seetharaman.
2. Project Management, K Nagarajan (New Age International Ltd.)
3. NICMAR Publications.
4. CECR's Journals.

**Weblink for MOOC / NPTEL Links:**

1. [https://onlinecourses.swayam2.ac.in/cec24\\_hs83](https://onlinecourses.swayam2.ac.in/cec24_hs83)

**List of Practicals:**

1. Case study on natural Disaster including GI Tag Photo of disaster.
2. Assignment on Disaster Management including Financing relief expenditure, legal aspects, rescue operations.
3. Prepare flow chart on Emergency Management program considering any Real-time example.



4. Assignment on Organizations including in Disaster Management & internationally adopted practices in Disaster Management.

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<b>Course Code: 205105C</b>	<b>Course Name: Retrofitting of Structures</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

**Prerequisite Courses:**

- Building Construction, Concrete Technology, Advanced Concrete Technology.

**Course Objectives:**

- To impart knowledge about the maintenance and retrofitting of structures
- To acquire knowledge about repairs, rehabilitation and damage assessment
- To enable the students to understand the repair materials and techniques.

**Course Outcomes:**

On completion of the course, learner will be able to:

**CO1:** Evaluate the cause of deterioration of concrete structures.

**CO2:** Assess the damage and design the plan to repair.

**CO3:** Assessment of factor influencing on serviceability and durability of structures.

**CO4:** Decide the various techniques of retrofitting of structures.

**CO5:** Recognize good materials for repair and retrofitting technique.

**Course Contents****UNIT-I: Introduction to Retrofitting of Structures** **11 Hours**

Definition for Repair, Retrofitting, Strengthening and rehabilitation. Importance of retrofitting, Physical and Chemical Causes of deterioration of concrete structures. Rehabilitation studies of buildings, underground construction, bridges, highways, sewage treatment plants – masonry work, R.C.C works, and steel structures.

**UNIT-II: Damage Assessment** **11 Hours**

Purpose of assessment, rapid assessment, investigation of damage, evaluation of surface and structural cracks, damage assessment procedure, destructive, non-destructive, and semi-destructive testing systems.

**UNIT-III: Influence on Serviceability and Durability** **10 Hours**

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 cathodic protection. Factors influencing serviceability such as material properties, load conditions, design and construction quality, etc. Factors influencing durability such as material selection, environmental exposure, and protective measures etc. Relationship between serviceability and durability.

**UNIT-IV: Maintenance and Retrofitting Techniques****10 Hours**

Facts of maintenance and importance of maintenance, need for retrofitting, types of retrofitting such as structural retrofitting, energy efficiency retrofitting, seismic retrofitting, retrofitting of various RC structural members, study of different retrofitting techniques like externally bonding technique (ERB), near surface mounted (NSM) technique etc. Guidelines for seismic rehabilitation of the existing building.

**UNIT-V: Materials for Repair and Retrofitting of Earthquake Damages Building 10 Hours**

Types of FRP like CFRP, GFRP, AFRP, BFRP, and use of natural fibre like Sisal and Jute. Adhesives like Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Guniting and Shot-Crete, epoxy injection, mortar repair for cracks, shoring and underpinning. Construction chemicals based on nano-technology methods of seismic retrofitting, restoration of buildings, effects of earthquakes, response of buildings to earthquake motion, factors related to building damages due to earthquake, maintenance of rehabilitated structures.

**Learning Resources:****Text Books:**

1. Sidney, M. Johnson, Deterioration, Maintenance and Repair of Structures, McGraw Hill
2. Denison Campbell, Allen & Harold Roper, Concrete Structures Materials, Maintenance and Repair Longman Scientific and Technical.
3. Technology of Building Repairs, Raikar R N, Bombay Technology of Building Repairs 1973.
4. Construction, Maintenance and Restoration and Rehabilitation of Highway Bridges, K. S. Rakshit
5. Modi, P.I., Patel, C.N. (2016). Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi.

**Reference Books:**

1. IABSE, (2010). Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures, Volume 12, Structural Engineering Documents (SED), Switzerland.
2. Varghese, P.C. (2014), Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI India, New Delhi.

3. Bhattacharjee, J. (2017), Concrete Structures Repair Rehabilitation and Retrofitting, CBS Publishers & Distributors, New Delhi
4. Maintenance & Repairs of Buildings, P. K. Guha, New Central Book Agency (P) Limited, 2011.
5. R.T. Allen and S.C. Edwards, Repair of Concrete Structures-Blakie and Sons.
6. Raiker R.N., Learning for failure from Deficiencies in Design, Construction and Service- R&D Center (SDCPL).
7. Concrete Structures Protection Repair and Rehabilitation, R. Dodge Woodson, Elsevier Publication.
8. Retrofitting of Concrete Structures by Externally Bonded FRP's-CEB-FIP, Technical report.
9. Handbook on repair and rehabilitation of RC structure by –CPWD.

**Weblink for MOOC / NPTEL Links:**

1. <https://archive.nptel.ac.in/courses/105/105/105105213/>
2. <https://www.youtube.com/watch?v=WZixd9UhW3w>

**List of Practicals:**

1. Assignment on damage assessment.
2. Assignment on maintenance and retrofitting Techniques.
3. Collection and comparative study of retrofitting materials.
4. Case study presentation by an individual on any topic from the above syllabus.
5. Site visit of the structure under retrofitting details report on causes of distress of structure and type of retrofitting, material used in retrofitting.

<b>Course Code: 205105D</b>	<b>Course Name: Construction Safety</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

### Prerequisite Courses:

- Basic civil engineering techniques, materials, plants and equipment.

### Course Objectives:

- To acquaint students with industry-specific safety laws, standards and regulations governing construction sites.
- To identify potential hazards in construction projects and develop preventive measures.
- To gain proficiency and to comply with all the statutory requirements of construction safety

### Course Outcomes:

On completion of the course, learner will be able to:

**CO1:** Apply the principles of safety in construction.

**CO2:** Implement safety management systems that ensure continuous monitoring, evaluation and improvement of safety practices.

**CO3:** Suggest safety measures for handling of construction material.

**CO4:** Develop and deliver effective safety programs on construction sites.

**CO5:** Analyze accident data and trends to identify areas for improvement in safety practices.

### Course Contents

#### UNIT-I: Introduction to Health and Safety in Construction 11 Hours

Basic definitions of health, safety, welfare and environment; need for maintaining good standards of health, safety welfare and environment, human factors contributing to accidents, government's policy in industrial safety; safety & health legislation in India, construction sites (safety) regulations.

#### UNIT-II: Codes of Practice 11 Hours

Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures. Safety in use of construction equipment e.g. vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms.

**UNIT-III: Construction Materials Handling****10 Hours**

**Manual handling of materials:** Basic principle of correct lifting and handling of materials maximum loads that may be carried; lifting and carrying of objects of different shapes, size and weights, safe use of accessories for manual handling; ergonomics consideration, mechanical.

**Handling of materials:** Lifting machinery, lifts and hoists, conveyors; stacking, storage and handling of construction materials: general considerations for stacking and storage-planning for storage layout.

**UNIT-IV: Construction Safety Management****10 Hours**

Safety organization, site management, role of the safety department, safety officer, safety committee. Introduction to safety checklist, site safety inspection, safety tag system, safety audit report objective of safety audit and training, safety incentives and safety manuals.

**UNIT-V: Accident Prevention****10 Hours**

Principles of accident prevention, job safety analysis, fault tree analysis, accident management, accident count, hazards of construction and their prevention, fire safety, electrical hazards.

**Learning Resources:****Text Books:**

1. Construction Project Management: Theory and Practice"\* by K. K. Chitkara
2. Construction Safety, by R.K. Mishra, AITBS Publisher
3. Construction Safety Management, 1st Edition, by Kumar Neeraj Jha/ Dilip A Patel/ Amarjit Singh, Pearson Publication.

**Reference Books:**

1. Construction safety manual published by National Safety Commission of India.
2. Safety Management in Construction Industry – A manual for project managers. NICMAR
3. Construction Safety Handbook – Davies V. S. Thomasin K, Thomas Telford, London.
4. IS Codes for safety in Construction – Bureau of Indian Standards.
5. Construction Safety Management and Engineering, by Darryl C. Hill and David V. McCollum, ASSE
6. Safety and Health for Engineers, by Roger L. Brauer, Wiley.

**Weblink for MOOC / NPTEL Links:**

1. [https://www.edx.org/executive-education/university-of-cape-town-occupational-health-and-safety?index=product&queryID=58b13eff038748a447cfd04f75f4d31&position=1&results\\_level=first-level-results&term=safety&objectID=course-cbb17299-3740-4bfe-aa67-3ac8e36ebb9c&campaign=Occupational+Health+and+Safety&source=2u&product\\_category=executive-education&placement\\_url=https%3A%2F%2Fwww.edx.org%2Fsearch](https://www.edx.org/executive-education/university-of-cape-town-occupational-health-and-safety?index=product&queryID=58b13eff038748a447cfd04f75f4d31&position=1&results_level=first-level-results&term=safety&objectID=course-cbb17299-3740-4bfe-aa67-3ac8e36ebb9c&campaign=Occupational+Health+and+Safety&source=2u&product_category=executive-education&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch)
2. [https://onlinecourses.nptel.ac.in/noc21\\_ce16/preview](https://onlinecourses.nptel.ac.in/noc21_ce16/preview)



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3. [https://www.edx.org/executive-education/university-of-cape-town-construction-management?index=product&queryID=58b13eff038748a447cfd04f75f4d31&position=3&results\\_level=first-level-results&term=safety&objectID=course-1bdbf677-b0c2-44b8-9b75-b8b682616626&campaign=Construction+Management&source=2u&product\\_category=executive-education&placement\\_url=https%3A%2F%2Fwww.edx.org%2Fsearch](https://www.edx.org/executive-education/university-of-cape-town-construction-management?index=product&queryID=58b13eff038748a447cfd04f75f4d31&position=3&results_level=first-level-results&term=safety&objectID=course-1bdbf677-b0c2-44b8-9b75-b8b682616626&campaign=Construction+Management&source=2u&product_category=executive-education&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch)

**List of Practicals:**

1. Report on safety codes available.
2. Accident prevention measures.
3. Laws related to construction safety and compensation act.
4. Report on safety audits.
5. Site visit to understand the implementation of safety measures on site.



<b>Course Code: 205105E</b>	<b>Course Name: Building Services and Maintenance</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

#### Prerequisite Courses:

- Building Construction, Architectural Planning and drawing, Construction Materials.

#### Course Objectives:

- To acquaint knowledge in the design, operation, and maintenance of building services systems, including HVAC, plumbing, electrical, fire protection and vertical transportation.
- To enable students to integrate these systems effectively into building designs, ensuring they operate efficiently, safely and sustainably throughout the building's lifecycle.
- To develop and implement maintenance strategies that optimize system performance, reduce operational costs and extend the lifespan of building services.

#### Course Outcomes:

On completion of the course, learner will be able to:

- CO1:** Demonstrate comprehensive knowledge of various building services systems, including HVAC, plumbing, electrical, fire protection, and vertical transportation.
- CO2:** Identify common issues in building services systems, utilizing technical knowledge and problem-solving techniques.
- CO3:** Design efficient plumbing and firefighting systems in buildings, ensuring the safety, reliability, and sustainability of these critical infrastructure components.
- CO4:** Explore the role of technology for smart building systems and building management Systems (BMS).
- CO5:** Implement effective maintenance strategies, including preventive, predictive, and corrective maintenance, to ensure the longevity and efficient operation of building services.

#### Course Contents

##### UNIT-I: Introduction to Building Services

**11 Hours**

Importance of material management and its role in the construction industry: scope, objectives and functions, integrated approach to materials management, role of materials manager, materials procurement, codification and standardization, vendor development, suppliers evaluation, purchase procedure.

**UNIT-II: Mechanical and Electrical Services****11 Hours**

HVAC systems, Refrigeration systems, fire protection systems, elevator and escalator systems. Power distribution and electrical systems, lighting systems (natural and artificial lighting, emergency power systems (generators, UPS systems), energy management and conservation techniques.

**UNIT-III: Plumbing and Fire Safety Services****10 Hours**

Cold and hot water supply systems, drainage and sewage systems, water conservation methods, rainwater harvesting systems, fire detection and alarm systems, firefighting systems (sprinklers, hydrants, security systems (CCTV, access control), building evacuation and safety protocols.

**UNIT-IV: Building Management Systems****10 Hours**

Introduction to building management systems (BMS), automation in HVAC, lighting and security systems, smart buildings and IoT integration, energy monitoring and control. Role of facility managers in building services. Space management and utilization, health and safety management in buildings, legal and regulatory considerations in building maintenance.

**UNIT-V: Maintenance Strategies****10 Hours**

Types of maintenance (preventive, predictive, reactive), maintenance planning and scheduling, asset management and lifecycle costing, condition monitoring and diagnostics, sustainable building practices and green technologies, energy-efficient systems and renewable energy integration, waste management and recycling in buildings.

**Learning Resources:****Text Books:**

1. A textbook on Building Services R. Uday kumar Eswar Press, Chennai.
2. Building Services S. M. Patil, Seema Publication, Mumbai Revised edition.
3. National Building Code of India - 2005 Bureau of Indian Standards BIS, New Delhi.
4. Maintenance of Buildings, by A.C. Panchdhari, New Age International, 2006.

**Reference Books:**

1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi.
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers and Distribution(P) Ltd
4. Maintenance of Buildings—A. C. Panchodhari—New Age International Publishers.
5. Building Services Engineering, by David Chadderton, by Routledge, 2012.

**Weblink for MOOC / NPTEL Links:**

1. [https://onlinecourses.swayam2.ac.in/nou21\\_ce04/preview#:~:text=By%20Dr.%20Munish%20Kumar%20Bhardwaj%20%7C%20Indira%20Gandhi%20National%20Open](https://onlinecourses.swayam2.ac.in/nou21_ce04/preview#:~:text=By%20Dr.%20Munish%20Kumar%20Bhardwaj%20%7C%20Indira%20Gandhi%20National%20Open)
2. [https://onlinecourses.nptel.ac.in/noc20\\_ce09/preview#:~:text=Fire%20Protection%20Services%20and%20Maintenance%20Management%20of%20Building.%20By%20Prof.](https://onlinecourses.nptel.ac.in/noc20_ce09/preview#:~:text=Fire%20Protection%20Services%20and%20Maintenance%20Management%20of%20Building.%20By%20Prof.)

**List of Practicals:**

1. Develop a detailed plan that includes HVAC, plumbing, electrical, fire protection, and vertical transportation systems.
2. Perform a cost-benefit analysis to evaluate the financial viability of the potential energy savings, payback period, and impact on building performance.
3. Perform a lifecycle cost analysis (LCCA), including initial installation costs, operational costs, maintenance costs, and eventual replacement or disposal costs.
4. Suggest smart technologies for any selected existing building.
5. Case study on applications of advanced technologies (BIM, IoT, AI) in building projects.



<b>Course Code: 205106</b>	<b>Course Name: Skill Development Laboratory – I (Software Skills)</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Practical : 2 Hours/Week</b>	<b>1</b>	<b>TW : 25 Marks</b>

### Prerequisite Courses:

- Project management, Basic operating systems, MS Office, Estimation and costing, Construction methods.

### Course Objectives:

- To acquire basic software skills and competency skills.
- To learn planning, and scheduling using software.
- To learn resource management using the software.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Prepare a detailed cost estimate for the project.

**CO2:** Apply project planning, scheduling and monitoring techniques.

**CO3:** Organize resources for a project using software.

### Course Contents

#### ASSIGNMENT-I: 08 Hours

Prepare detailed cost estimates for any selected construction project by using MS Excel.

#### ASSIGNMENT-II 08 Hours

Defining and creating the WBS hierarchy for any project.

#### ASSIGNMENT-III 06 Hours

Application of MS Project/ Primavera software for project planning, scheduling and control.

#### ASSIGNMENT-III 06 Hours

Manage resources such as labour, materials, equipment, finance, suppliers, and contractors by using (Enterprise Resource Planning) ERP Software.



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**Learning Resources:****Text Books:**

1. Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication.
2. Construction Project Management Planning, Scheduling and Controlling-Chitakara- Tata McGraw Hill, New Delhi.
3. Estimating, Costing, Specification & Valuation In Civil Engineering by M Chakrabort

**Reference Books:**

1. Learning Microsoft Project 2019 by Srikanth Shirodkar
2. Planning and Managing Projects with PRIMAVERA (P6) Project Planner by P. Vinayagam ,A. Vimala



## Semester - II

<b>Course Code:205201</b>	<b>Course Name: Sustainability in Construction Projects</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 4 Hours/Week</b>	<b>4</b>	<b>CCE : 50 Marks ESE : 50 Marks</b>

### Prerequisite Courses:

- Basic knowledge about sustainability and environmental impact.

### Course Objectives:

- To acquire knowledge of recent innovative approaches and technologies to reduce environmental footprint and improve the sustainability of construction projects.
- To get acquainted with environmental laws.
- To acquire details about the design and delivery of sustainable construction projects.
- To explain efficient energy building services.
- To understand the framework required to assess sustainability in construction projects,

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Understand climate change and the need for environmental management systems.

**CO2:** Understand the environment and pollution control laws.

**CO3:** Apply the knowledge of design and delivery of sustainable construction projects.

**CO4:** Design energy-efficient services in buildings.

**CO5:** Evaluate the extent of sustainability of built-assets through sustainability rating systems.

### Course Content:

#### **UNIT-I: Introduction to Sustainability** **11 Hours**

Introduction-Implication of development projects on the climate change, eco- system- land, water and air; environment and ecology. Protocol and Policies in Climate Change Mitigation. Role of Construction industry and built environment in sustainable development.

#### **UNIT-II: Environment and Pollution Control Laws** **11 Hours**

Rules and regulations and laws governing energy, conservation in India and developed Nations- Energy Conservation Act 2001, Revisions and present state of implementation standardization and labeling, Electricity Act 2003, Revisions and present status of implementation.

**UNIT-III: Designing and Delivering Sustainable Construction Projects 10 Hours**

Green Construction: Introduction, Definition, Need, Principles, and Key terminologies, Green buildings and infrastructure, Circular economy principles to design and construct green buildings: materials, energy, water and construction and demolition (C&D) waste perspective, Green building commissioning, High performance, Net Zero and Net positive buildings.

**UNIT-IV: Energy Efficient Services 10 Hours**

Energy building design-Energy efficient and environmentally friendly building, Thermal phenomena, thermal comfort, indoor air quality, climate, sun and solar radiation, Psychometrics, passive heating and air cooling systems, Energy analysis, active HVAC Systems, preliminary investigation, goals and policies, energy audit, types of wastage, priority of conservative measures, maintenance of energy program.

**UNIT-V: Framework for Assessing Sustainability in Construction Projects 10 Hours**

Preparation of EIA report for projects; Involuntary dislocation, guidelines of the World Bank and other funding agencies, ISO 14001. Codes, Standards, Rating and Certification Systems for Green Construction: Indian and International Perspective, Green Rating frameworks, for Buildings (IGBC, GRIHA, LEED etc.), Green Rating frameworks for Infrastructure (CEEQUAL, Green roads.

**Learning Resources:****Text Books:**

1. Environmental Impact Assessment and Audit by Larry W. Canter Environmental, Tata McGraw Hill.
2. Environmental Monitoring and Characterization by Artiola CBS Publishers 2006.
3. Environmental and Pollution Laws in India by Justice T. S. Doabia, I. P. S. Doabia and M. S, S. Doabia, Second Edition 2010.

**Reference Books:**

1. Environmental Engineering, 4 E by Weiner CBS Publishers 2010
2. Socioeconomic and Environmental Impacts of Biofuels, by Alexandros Gasparatos and per Stromberg, October 2012.
3. Environmental Pollution and Control, 4th Edition, J. Jeffrey Peirce, P Aarne Vesilind and Ruth Weiner, Nov 1997.
4. Financing Energy Efficiency: Forging the Link between Financing and Project Implementation, By Silvia Rezessy and Paolo Bertoldi.
5. Institute Of Energy European Commission, May 2010.



6. Public Procurement Of Energy Efficiency Services Lessons From International Experience by Jas Singh, Dilip R. Limaye, Brian Henderson, And Xiaoyu Shi.
7. Energy Management Handbook By Steve Doty And Wayne C. Turner, 8th Edition
8. Energy Conservation Act 2001, Electricity Act 2003.

**Web link for MOOC / NPTEL Links:**

1. <https://archive.nptel.ac.in/courses/129/106/129106002/>
2. <https://leap.unep.org/en/countries/in/case-studies/video-lecture-environmental-law-india>
3. <https://archive.nptel.ac.in/courses/105/102/105102195/>

<b>Course Code: 205202</b>	<b>Course Name: Construction Contracts Administration and Management</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 3 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>3</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

**Prerequisite Courses:**

- Project Management and Finance, Tenders and Contracts.

**Course Objectives:**

- To develop valuable expertise in civil engineers in the construction sector, engineering and analysis are employed.
- To nurture civil engineers with an understanding of Construction Contracts Administration and Management
- To develop civil engineers who are well-versed in the assessment of Construction Contracts Administration and Management.

**Course Outcomes:**

After successful completion of the course, learner will be able to:

**CO1:** Infer the construction contracts in projects.

**CO2:** Explain the contract formation in projects.

**CO3:** Analyze the contract conditions in projects.

**CO4:** Analyze the construction claims and understand dispute resolution in projects.

**CO5:** Explain Conciliation and Arbitration in Projects.

**Course Contents****UNIT-I: Construction Contracts****08 Hours**

**Indian Contract Act (1872):** Definition of the contract as per the ACT. Valid, Voidable, Void contracts, Objectives of the act. **Clauses 1 to 75:** Contract formation, contract performance, valid excuses for nonperformance, Breach of contract, effects of breach- understanding the clauses and applying them to situations/scenarios on construction projects. Importance of the Workmen's Compensation Act on construction projects.

**UNIT-II: Contract Formation****08 Hours**

**Standard Forms of Contracts:** methods of inviting tenders, pre-bid meetings, pre-qualification system, scrutiny of tenders, and comparative statements.

**Contract Formation:** Conditions of contracts, contracts with various stakeholders on major construction projects, contract pricing by the client, project management consultants, and the contractor, contract performance, contract correspondence, and contract closure.

### UNIT-III: Contract Conditions and FIDIC

**08 Hours**

General conditions and Particular conditions, Conditions of Ministry of Statistics and Program Implementation- Government of India. Model forms of contract. **ICE Conditions:** Introduction, FIDIC conditions - the evolution of FIDIC document, types based on whether the design is of employer or contractor, design and build contract, EPC contract, short forms of contract- colour code. Various conditions of red book.

### UNIT-IV: Construction Claims and Dispute Resolution

**08 Hours**

**Construction Claims:** Extra items and causes of claims. Types of construction claims, documentation, settlement of claims.

**Dispute Resolution:** Causes of disputes and importance of the role of various stakeholders in the prevention of disputes, Alternate dispute resolution methods: mediation, conciliation, arbitration and dispute resolution boards.

### UNIT-V: Conciliation & Arbitration

**08 Hours**

**Indian Arbitration and Conciliation Act 1996:** Difference between the 1940 Act and the 1996 Act. Extent of application of 1996 Act. Objectives, general provisions. Composition of the arbitral tribunal, jurisdiction of the arbitral tribunal, duties, power of arbitrators.

**Conciliation:** Conciliation and its provisions in the Act, Conduct of conciliation and arbitral proceedings, grounds for challenge. Arbitral award and its enforcement. Procedure of appeal against the awards.

### Learning Resources:

#### Text Books:

1. Civil Engineering Contracts and Estimates by B. S. Patil, Universities Press, 2006 Edition reprinted in 2009.
2. Law of contract Part I and Part II, Dr. R.K. Bangia, 2005 Edition, Allahabad Law Agency.
3. Arbitration, Conciliation and Alternative Dispute Resolution Systems, Dr. S. R. Myneni 2004 Edition, reprinted in 2005, Asia Law House Publishers.

#### Reference Books:

1. The Indian Contract Act (9 of 1872), 1872, Bare Act, 2006 edition, Professional Book Publishers.
2. The Arbitration and Conciliation Act (1996), 1996 (26 of 1996), 2006 Edition, Professional Book Publisher.



3. The Workmen's Compensation Act, 1923 (8 of 1923) Bare Act, 2005, Professional Book Publishers.
4. Standard General Conditions for Domestic Contracts - 2001 Edition, Published by Ministry of Statistics and Program Implementation, Government of India.
5. FIDIC Document (1999).
6. Dispute Resolution Board foundation manual, [www.drbf.org](http://www.drbf.org).

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<b>Course Code: 205203</b>	<b>Course Name: Project Economics and Financial Management</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory : 4 Hours/Week</b>	<b>4</b>	<b>CCE : 50 Marks ESE : 50 Marks</b>

#### Prerequisite Courses:

- Project Management and Finance.

#### Course Objectives:

- Acquire knowledge of economics to facilitate the process of economic decision-making
- Acquire knowledge of basic financial management aspects
- Develop the skills to analyze financial statements.

#### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Acquire knowledge of principles of economics and capital.

**CO2:** Acquainted with economic analysis and taxation of the corporate sectors.

**CO3:** Adapt the concept of financial planning and budget.

**CO4:** Analyze financial statements using ratio analysis, Balance sheet, and profit and loss account statement.

**CO5:** Apply the concepts of financial management for project appraisal.

#### Course Content:

#### UNIT-I: Principles of Economics and Capital 11 Hours

**Principles of Economics:** Importance of the economic background to measurement, objectives of business firm. Factors bearing on size of firms. Motives to growth. Obstacles to growth of firms, Study of the present economy.

**Capital:** Analysis of need for working capital, Estimation of requirements of working capital, Credit Management, Cash Management, Corpus Fund.

#### UNIT-II: Economic Analysis and Corporate Sector 11 Hours

**Economic Analysis:** Capital investment in project, Cost planning techniques, Cost control during design and construction, depreciation, various appraisal criteria methods. Break-even analysis, Cash flow analysis, Role of Lender's Engineer.

**Corporate Sector:** Corporate tax planning, public policies on ICRA grading of exchange, World financial market, Role of financing institutes in Construction sector, SEBI regulation., GST, CGST, SGST, Direct Tax Court System.

### UNIT-III: Financial Planning and Budget

10 Hours

**Financial Planning:** Need and sources of Finance, long term finance planning, stock, borrowings, debentures, loan capital, public deposit, dividend policies, bonus shares, market value of shares, and reserves.

**Budget:** Types of budgets, procedure for master budgets. Budget manual.

### UNIT-IV: Construction Accounts

10 Hours

Accounting process, preparation of profit and loss account and balance sheet as per the Companies Act 2013, Ratio Analysis. Escrow Account for PPP Project.

### UNIT-V: Case Studies

10 Hours

Case studies (any two) for 1) PPP projects, 2) Dams and Canals, 3) Mass Transit System, 5) Government Funded Projects with respect to a) Project Appraisal b) Raising of funds c) Cost to complete analysis.

### Learning Resources:

#### Text Books:

1. Prasanna Chandra, Financial Management (Theory & Practices)
2. Weston & Brigham, Essentials of Managerial Finance.

#### Reference Books:

1. Construction project scheduling and control, Mubarak, Wiley India.
2. Construction Management & PWD Accounts, D Lal, S. K. Kataria & Sons, 2012
3. Construction Management and Accounts -- Singh H. Tata McGraw Hill, New Delhi, 1988
4. Construction Management: Planning and finance, Cormican D. Construction press, London, Feb 2002.
5. Principles of Corporate Finance, Brealey R.A. Tata McGraw Hill, New Delhi, 2003.
6. Engineering Economics, by Kumar, Wiley, India.
7. Engineering Economy, Leland T. Blank. Anthony Tarquin. McGraw Hill, 2008.
8. Engineering Economics, David Bedworth, Sabah Randhawa. McGraw Hill, 1996.
9. Real Estate, Finance and Investment, Bruggeman. Fishr, McGraw Hill, 2010.
10. Foundations of Financial Management, Block Hirt. McGraw Hill, 2009.
11. Case studies in finance, Burner, McGraw Hill, 2009.



12. Cases in Finance, DeMello McGraw, 2003.
13. The cost management toolbox; A Managers guide to controlling costs and boosting profits.  
Oliver, Lianabel. Tata McGraw Hill, 1999.
14. Financial Management, Indian Institute of Banking and Finance – Macmillan Publications.
15. Projects planning, Analysis Selection, Implementation and Review, Prasanna Chandra,  
Tata McGraw Hill, New Delhi, 2005
16. Fundamentals of Engineering Economics, by Pravin Kumar, Wiley, India.

**Web link for MOOC / NPTEL Links:**

1. [https://onlinecourses.nptel.ac.in/noc24\\_mg85/preview](https://onlinecourses.nptel.ac.in/noc24_mg85/preview)



<b>Course Code: 205204A</b>	<b>Course Name: Green Building Design and Construction</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

#### Prerequisite Courses:

- Building Construction, Sustainable Design Principles, Environmental engineering.

#### Course Objectives:

- To introduce the fundamental concepts and benefits of green buildings, including key requisites and the role of the Indian Green Building Council.
- To equip students with the skills to design energy-efficient buildings by applying strategies to reduce energy demand and integrate renewable energy sources effectively.
- To introduce various environment-friendly and cost-effective building technologies and materials, enabling students to select and implement innovative construction methods.
- To develop proficiency in material conservation practices, waste management, and indoor air quality improvement, ensuring sustainable and healthy building environments.

#### Course Outcomes:

After successful completion of the course, learner will be able to:

- CO1:** Recognize the key requisites for constructing a green building and the essential sustainable features required for effective implementation.
- CO2:** Apply strategies to reduce energy demand and utilize renewable energy sources in building design.
- CO3:** Evaluate various eco-friendly building technologies and materials, including alternative construction methods and pre-engineered components.
- CO4:** Implement waste reduction techniques and select sustainable materials to enhance indoor air quality and overall building performance.
- CO5:** Assess the application of solar energy and green composites in buildings, focusing on energy efficiency, water management, and waste handling.

#### Course Contents

##### UNIT-I: Green Building Concepts and Practices

**11 Hours**

Green building, necessity of green building, benefits of green buildings, green building materials

and equipment in India, key requisites for constructing a green building, important sustainable features for green building, Indian green building council, green building moment in India, benefits experienced in green buildings, launch of green building rating systems, residential sector, market transformation; green building opportunities and benefits: opportunities of green building, green building features, material and resources, water efficiency, optimum energy efficiency, typical energy saving approach in buildings, LEED India rating system and energy efficiency.

**UNIT-II: Green Building Design****11 Hours**

Introduction, reduction in energy demand, onsite sources and sinks, maximize system efficiency, steps to reduce energy demand and use onsite sources and sinks, use of renewable energy sources. Ecofriendly captive power generation for factory and building requirements.

**UNIT-III: Environment-Friendly and Cost-effective Building Technologies 10 Hours**

Different substitutes for wall construction Flemish Bond , Rat Trap Bond – Arches – Panels , Cavity Wall, Ferro Cement and Ferro Concrete constructions – different pre-cast members using these materials , Wall and Roof Panels – Beams – columns, Door and Window frames, Water tanks, Septic Tanks, Alternate roofing systems, Filler Slab, Composite Beam and Panel Roof, Pre-engineered and ready to use building elements, wood products, steel and plastic, Contributions of agencies – Costford , Nirmithi Kendra , Habitat.

**UNIT-IV: Material Conservation****10 Hours**

Handling of non-process waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, rapidly renewable building materials and furniture; indoor environment quality and occupational health: air conditioning, indoor air quality, sick building syndrome, tobacco smoke control, minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, measure of IAQ, reasons for poor IAQ, measures to achieve acceptable IAQ levels.

**UNIT-V: Utility of Solar Energy and Green Composites in Buildings****10 Hours**

**Utility of Solar Energy:** Utility of solar energy in buildings concepts of solar passive cooling and heating of buildings. Low energy cooling. Case studies of solar passive cooled and heated buildings.

**Green Composites for Buildings:** Concepts of green composites. Water utilization in buildings, low energy approaches to water management. Management of solid wastes. Management of sullage water and sewage. Urban environment and green buildings. Green cover and built environment.



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## Learning Resources:

### Text Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air Conditioning Engineers, 2009.
2. Green Building Handbook by Tomwoolley and Samkimings, 2009. Industrial Organization & Engg. Economics, T.R.Banga, S.C.Sharma, Khanna Publ.
3. Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition, Ross Spiegel, Dru Meadows
4. Green Building: Principles & Practices, Dr. Adv. Harshul Savla,
5. Green Building Fundamentals, Notion Press, HarharaIyer G.

### Reference Books:

1. Complete Guide to Green Buildings by Trish Riley
2. The standard for the Design for High-Performance Green Buildings by Kent Peterson, 2009
3. C.J. Kibert (2008) —Sustainable Construction: Green Building Design and Delivery, 3rd Ed., John Wiley, Hoboken, New Jersey
4. G.T. Miller Jr. (2004) —Living in the Environment: Principles, Connections, and Solutions, 14th Ed., Brooks Cole, Pacific Grove, California.

### IS Codes:

1. Handbook on functional requirements of buildings (SP41), Bureau of Indian Standards, New Delhi, New Delhi, 1987.
2. Energy Conservation Building Code (ECBC), Bureau of Energy Efficiency, 2017
3. Sustainable Building Design Manual- Volume I & II, TERI, 2009.
4. Green Rating for Integrated Habitat Assessment (GRIHA) guidelines.

### Web link for MOOC / NPTEL / YouTube Links:

1. [https://onlinecourses.nptel.ac.in/noc20\\_ce09/preview#:~:text=Fire%20Protection%20Services%20and%20Maintenance%20Management%20of%20Building.%20By%20Prof.](https://onlinecourses.nptel.ac.in/noc20_ce09/preview#:~:text=Fire%20Protection%20Services%20and%20Maintenance%20Management%20of%20Building.%20By%20Prof.)

### List of Assignments:

1. Write a report on the benefits and features of green buildings, comparing them with conventional buildings and analyzing the impact of Indian green building rating systems.
2. Create a proposal for a small green building, focusing on reducing energy demand and integrating renewable energy sources.
3. Compare different eco-friendly wall construction techniques, highlighting their environmental and cost impacts.
4. Develop a plan for managing construction waste, emphasizing recycling and use of materials with recycled content.
5. Solar Energy Case Study: Analyze a building with solar passive cooling and heating, detailing its design and energy savings.
6. Site visit to a green building or construction project consists of sustainable design.



<b>Course Code: 2025204B</b>	<b>Course Name: Infrastructure Development</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory :</b> 4 Hours/Week <b>Practical:</b> 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

### Prerequisite Courses:

- Transportation Engineering, Building Planning & Construction.

### Course Objectives:

- To know the role of Infrastructure in the Nation's Economy.
- To co-relate Budget provisions and construction sector for infrastructure development.
- To describe the role of Public Private Partnership in Economic development.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Explain the role of Infrastructure in the National Economy.

**CO2:** Co-relate the Indian budget and its relation with respect to any of the Construction sector.

**CO3:** Explain Government Schemes and Public Private Partnership (PPP) in Infrastructure.

**CO4:** Identify issues related to infrastructure development and solutions.

**CO5:** Explain provisions made for infrastructure development.

### Course Content:

#### UNIT-I: Construction Industry 11 Hours

Nature, characteristics, size and structure. Role of infrastructure development in employment generation and improvement of the national economy. Various agencies associated with infrastructure development in India as regards various sectors.

#### UNIT-II: Status of Infrastructure in India 11 Hours

Road sector port, Railway, communication, water supply and drainage, power sector, oil and industry, health and educational services. Infrastructure development, Indian budget and its relation with infrastructure development projects in India.

#### UNIT-III: Government Schemes and Public-Private Partnership (PPP) 10 Hours

Various programs related with infrastructure development in rural and urban sector, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), PMGSY – Pradhan Mantri Gram Sadak Yojana, Sagarmala – Sagartat Samridhi Yojana, Deen Dayal Upadhyaya Gram Jyoti Yojana

(DDUGJY), Ports Connectivity Projects, International airport project, status and infra in nuclear power projects in India: concept, definition, benefits; Processes, modules of PPP, draft concession agreement for PPP projects, Escrow Agreement.

#### **UNIT-IV: Issues related to Infrastructure Development**

**10 Hours**

Pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing, funding and managing infrastructure projects, roles and responsibilities of project management consultants. FDI in Infrastructure development, problem areas and solutions.

#### **UNIT-V: Provisions made for Infrastructure Development**

**10 Hours**

Five-year plans of the Planning Commission Government of India: Overview, NITI Aayog provisions and objectives, Formation of the Indian Infrastructure Development Corporation. SPV's for Infra projects. Detailed study of 20 years plans by Govt. and provisions made for the development of Infrastructure.

#### **Learning Resources:**

##### **Text Books:**

1. Construction Engineering & management of Projects (For Infrastructure and Civil Works) by S. C. Sharma, Khanna Publishers, 2 Edition, 2011.
2. India Infrastructure Report – Rakesh Mohan.
3. Infrastructure Development in India by Rajarshi Majumder Rawat Publications – 2010.

##### **Reference Books:**

1. Document of five year plans, published by Govt. of India.
2. Public Private Partnership in Infrastructure by R. N. Joshi Vision Publications – 2010
3. Journal of the Indian Roads Congress.
4. Infrastructure Today – Magazine.
5. Indian Highways – Journals.

##### **Web link for MOOC / NPTEL Links:**

1. [https://www.edx.org/learn/construction/the-university-of-maryland-college-park-the-industry-and-profession-in-construction-management?index=product&queryID=65ac5659ae329f08505215c8a8ab6aaa&position=3&results\\_level=second-level-results&term=Civil+Engineering&objectID=course-6e6e0f90-67b7-4179-b07b-5f0a69c9060f&campaign=The+Industry+and+Profession+in+Construction+Management&source=edX&product\\_category=course&placement\\_url=https%3A%2F%2Fwww.edx.org%2Fsearch](https://www.edx.org/learn/construction/the-university-of-maryland-college-park-the-industry-and-profession-in-construction-management?index=product&queryID=65ac5659ae329f08505215c8a8ab6aaa&position=3&results_level=second-level-results&term=Civil+Engineering&objectID=course-6e6e0f90-67b7-4179-b07b-5f0a69c9060f&campaign=The+Industry+and+Profession+in+Construction+Management&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch)
2. [https://onlinecourses.nptel.ac.in/noc24\\_ce81/preview](https://onlinecourses.nptel.ac.in/noc24_ce81/preview)

**List of Assignments (Any Five):**

1. Presentation on any one of: Atma Nirbhar Bharat, MGNREGA, AMRUT, PMGSY, DDU-GKY, PMAY(G), Shyama Prasad Mukherji Rurban Mission (SPMRM), Saansad Adarsh Gram Yojana SAGY, Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban Transport, Swachh Bharat Mission, Sagarmala Programme- Port connectivity projects and its New forms.
2. Case study of any Public Private Partnership scheme.
3. Presentation on Infrastructural activities and its effect on GDP in India.
4. Detailed study with respect to objectives of Five-year plan and its provisions for the development of Infrastructure and role of NITI Aayog.
5. Study on features of PM-Surya Ghar Muft Bijli Yojana
6. Study on features of Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM-KUSUM)
7. Study on features of Mukhyamantri Saur Krushi pump Yojana.



<b>Course Code: 2025204C</b>	<b>Course Name: Material Management</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory :</b> 4 Hours/Week <b>Practical:</b> 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

### Prerequisite Courses:

- Basic construction materials and its classification, principles of management.

### Course Objectives:

- To acquire the knowledge of principles and practices involved in managing construction materials.
- To mastering techniques for efficient procurement, inventory control, and cost management while ensuring materials meet quality and sustainability standards.
- To understand the concept, principles and strategies of supply chain management.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Discuss the role of material management in construction.

**CO2:** Apply techniques for efficient inventory management.

**CO3:** Develop strategies for organizing and managing construction material stores, inventory tracking, optimal storage conditions, and the efficient flow of materials.

**CO4:** Implement quality control procedures for materials, ensuring that all materials meet project specifications and industry standards.

**CO5:** Implement strategies to optimize the supply chain in construction projects, ensuring the coordination and integration of suppliers, manufacturers and logistics.

### Course Content:

#### UNIT-I: Introduction to Material Management

**11 Hours**

Importance of material management and its role in the construction industry: scope, objectives and functions, integrated approach to materials management, role of materials manager, materials procurement, codification and standardization, vendor development, suppliers evaluation, purchase procedure.

#### UNIT-II: Inventory Management

**11 Hours**

Inventory classification, selective inventory control techniques: ABC, XYZ, VED, etc, inventory models: EOQ Analysis, Q and P models, two bin technique, safety stock, reorder level, lead time,

concept of JIT: Just in time management.

### UNIT-III: Store Management

10 Hours

Storing of materials, management of stores, receipt and inspection, location: site layout and site organization, different types of stores, methods of storing, store accounts, stock verification, care, safety and security of materials, losses on storage, wastage, stores equipment, materials handling equipment, factors affecting materials handling.

### UNIT-IV: Quality Control

10 Hours

Quality control: conventional methods of quality control of Construction materials. Statistical method of quality control, sampling techniques quality control in process. Quality management and its economics or techniques in material management.

### UNIT-V: Supply Chain Management

10 Hours

Introduction to supply chain management; Process view of supply chain; Supply chain performance measures; Supply chain performance measures; Make or buy decisions; Supply Chain Strategy: competitive and supply chain strategies, achieving a strategic fit, expanding strategic scope; SCM: drivers; Design supply chain network; Supply chain planning and analysis: Supply chain operations.

### Learning Resources:

#### Text Books:

1. Materials Management: An Integrated Approach, P. Gopal Krishnan and M. Sundaresan, Prentice Hall India
2. Jhamb, L. C. (2014). Materials-and-Logistics-Management, Everest Publishing House
3. Materials Management a Supply Chain Perspective: Text and Cases, 3rd Edition, Kindle Edition, by A. K. Chitale, R. C. Gupta.

#### Reference Books:

1. Purchasing and Inventory Control- by K. S. Menon, Wheeler Publication.
2. Datta, A. K. (1998). Materials Management: Procedures, Text and Cases, New Delhi, Prentice Hall of India.
3. Dam Jespersen, B., and Skjøtt-Larsen, T. (2005). Supply Chain Management: In Theory and Practice. Copenhagen Business School Press.
4. Pagh, J. D. and Cooper, M. C. (1998). Supply chain postponement and speculation strategies: how to choose the right strategy. Journal of Business Logistics, 19(2), 13

#### Web link for MOOC / NPTEL Links:

1. <https://archive.nptel.ac.in/courses/110/105/110105095/>



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2. <https://www.edx.org/learn/supply-chain-design/massachusetts-institute-of-technology-supply-chain-fundamentals>
3. <https://www.edx.org/learn/supply-chain-management>

**List of Practicals:**

1. Prepare vendor selection criteria for construction material.
2. Selection of inventory control techniques on construction sites.
3. Case study analysis for material management in Mega Projects.
4. Use of advanced technologies of AI, IoT, and Blockchain to optimize the supply chain for construction materials.
5. Site visit to understand material procurement, storage, handling, inventory management, and waste reduction practices.



<b>Course Code: 2025204D</b>	<b>Course Name: Value Engineering and Valuation</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory :</b> 4 Hours/Week <b>Practical:</b> 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

### Prerequisite Courses:

- Project Management and Finance.

### Course Objectives:

- To create valuable expertise in civil engineers in the construction sector, engineering and analysis are employed.
- To acquaint with value engineering and life cycle costing analysis.
- To build civil engineers who are well-versed in the assessment of different types of assets.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Assess the engineering value of the product.

**CO2:** Execute a number of steps for the development of the product.

**CO3:** Identify the methodology for assessing value.

**CO4:** Examine the lifecycle cost.

**CO5:** Write a report that applies value engineering to a construction project.

### Course Content:

#### UNIT-I: Value Engineering 11 Hours

Definition, importance to contractors, potential. VE applications value: basic and secondary functions, factors contributing to value such as aesthetic, ergonomic, technical, economic: identifying reasons or unnecessary costs.

#### UNIT-II: Value Analysis 11 Hours

Ten Commandments of value analysis; value analysis team; principles of value analysis, elements of a job plan viz. orientation, information, presentation. Implementation, follow-up action, benefits of value analysis, various applications, assessing the effectiveness of value analysis.

#### UNIT-III: Value Engineering Techniques 10 Hours

Orientation phase, information phase, function analysis phase, creative phase, evaluation phase, development phase, presentation phase, implementation phase.

**UNIT-IV: Life Cycle Costing****10 Hours**

Forecasting of capital as well as operating and maintenance costs, time value, present worth analysis, DCF methods, ROR analysis and sensitivity analysis.

**UNIT-V: Valuation of Construction Project****10 Hours**

VE during the planning phase of a construction project, VE during the design phase of a construction project, VE during the construction phase of a construction project, valuation report, contents, standard formats, case study of any one report.

**Learning Resources:****Text Books:**

1. Value Engineering: Analysis And Methodology By Del Younke, CRC Press Inc
2. Industrial Organization & Engineering. Economics, T. R. Banga, S. C. Sharma, Khanna Publication
3. Estimating and Costing in Civil Engineering: Theory and Practice B.N Dutta Published S. Dutta & Company, Lucknow.

**Reference Books:**

1. Industrial Engineering & Mgt., O. P. Khanna, Dhanpat Rai Publication,
2. Estimating and Costing By: G. S. Birdie, Dhanpat Rai Publication.
3. Estimating and Costing By: Rangwala Published By: Charotar Publishing House
4. Practical Information for Quantity Surveyors, Property Valuers, Architects Engineers and Builders. P. T. Joglekar, Pune Vidyarthi Griha Prakashan, 2008 reprint.

**e-Books:**

1. [https://www.routledge.com/Value-Engineering-Analysis-And-Methodology/Younker/p/book/9780824706968?srsId=AfmBOooHa5sxuo3fMNy5RFzo\\_g\\_fkRJILT4sdoUo3yGCAKuP92y22KegT](https://www.routledge.com/Value-Engineering-Analysis-And-Methodology/Younker/p/book/9780824706968?srsId=AfmBOooHa5sxuo3fMNy5RFzo_g_fkRJILT4sdoUo3yGCAKuP92y22KegT).

**Web link for MOOC / NPTEL Links:**

1. Product design and value engineering,  
<https://archive.nptel.ac.in/courses/112/107/112107282/>

**List of Practicals:**

1. A case study on the application of Value Engineering in large scale construction projects.
2. Evaluate the cost-benefit analysis of implementing sustainable practices of VE.
3. Detail step-by-step application of the value engineering process in real-world construction projects.



4. A case study to compare the LCCA of a green-certified building versus a traditional building.
5. Detailed value analysis report for any one infrastructure and real estate project analysis.

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<b>Course Code: 2025204E</b>	<b>Course Name: Risk Analysis &amp; Mitigation Practice</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory :</b> 4 Hours/Week <b>Practical:</b> 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

### Prerequisite Courses:

- Project management and finance, tenders and contracts

### Course Objectives:

- To identify the various types of risks associated with construction projects.
- To analyze the identified risk in the construction industry.
- To apply the risk mitigation techniques.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Understand the risk in projects.

**CO2:** Analyze the risk management in projects.

**CO3:** Evaluate the risk assessment using different techniques.

**CO4:** Apply the risk evaluation using different techniques.

**CO5:** Apply the risk mitigation in projects.

### Course Content:

#### UNIT-I: Introduction to Risk 11 Hours

Definitions, life cycle of project, stakeholders in project, classification of risks, components of risk, quantifiable and un-quantified (qualitative) risks.

#### UNIT-II: Risk Management 11 Hours

Risk management, ISO 31000, principle of risk management, key areas in risk management, framework of risk management, processes of risk management.

#### UNIT-III: Risk Assessment 10 Hours

Risk identification and techniques, risk assessment tools and techniques - systems approach, taxonomy based, risk breakdown structure, HHM, SWOT, root cause analysis, influence diagram, PHA, HAZOP, JSA, risk matrix, risk index and risk ranking, FMEA, FTA, CCA, ALARP.

**UNIT-IV: Risk Evaluation****10 Hours**

Qualitative and quantitative risk analysis, risk prioritization, objectivity in risk rating, likelihood, impact, risk appetite and tolerance, basic accounting, application of risk assessment tools and techniques, risk treatment process, fundamental risk treatment strategies, performance monitoring and review, decision making under uncertainty, decision trees, Monte Carlo simulation, application of risk treatment strategies, performance monitoring and review.

**UNIT-V: Risk Mitigation****10 Hours**

Necessity risk mitigation, importance of risk mitigation, process of risk mitigation, risk mitigation strategies, risk mitigation practices, risk mitigation tools.

**Learning Resources:****Reference Books:**

1. Engineering Risk Management By Thierry Meyer, De Gruyter Publishing.
2. Risk Management and Assessment, By John Fraser, Intech Open Publishing.
3. Risk Management and Governance Concepts, Guidelines and Applications By Terje Aven, Ortwin Renn, Springer Berlin Heidelberg.
4. Corporate Financial Risk Management A Computer-based Guide for Non-specialists By Roy Nersesian, Bloomsbury Publishing.
5. Enterprise Risk Management Today's Leading Research and Best Practices for Tomorrow's Executives By John Fraser, John R. S. Fraser, Betty J. Simkins, Wiley Publishing.
6. Financial Risk Management, By Bradstreet, Tata McGraw-Hill Publishing Comp Ltd.
7. Mastering Risk Modeling By Day A.L., Pearson Publishing.
8. Principles of Risk Management By Keller K.L., Pearson Publishing.
9. Risk Management and Insurance By Harrington S.E., Niehaus G.R., Tata McGraw-Hill Publishing Comp Ltd.

**Web link for MOOC / NPTEL Links:**

1. <https://www.youtube.com/watch?v=wW1kjrntDU&pp=ygUnUmlzayBtYW5hZ2VtZW50IGJ5IERyLiBBLiBUaGlzGFpIFJhamFu>
2. <https://www.youtube.com/watch?v=ZGjXFkdGeNU>
3. <https://www.youtube.com/watch?v=6FLA8WpqJDc>
4. <https://www.youtube.com/watch?v=ZIHXB0bF7jI>
5. <https://www.youtube.com/watch?v=gOi0SL2sqtA>
6. <https://www.youtube.com/watch?v=YsqU2gk4SxI>
7. [https://www.youtube.com/watch?v=\\_ByfzB\\_6x8g](https://www.youtube.com/watch?v=_ByfzB_6x8g)



8. <https://www.youtube.com/watch?v=82OUSjOM2bg>

### List of Practicals:

1. Assignment on finding out different risks and stakeholders in any construction project.
2. Assignment on study of ISO 31000.
3. Assignment on application of risk assessment technique for the identified risks in assignment 1.
4. Assignment on application of risk evaluation technique for the identified risks in assignment 1.
5. Assignment on application of risk mitigation for the identified risks in assignment for the identified risks in assignment 1.

<b>Course Code: 205204F</b>	<b>Course Name: Construction Equipment Management</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Theory</b> : 4 Hours/Week <b>Practical</b> : 2 Hours/Week	<b>4</b> <b>1</b>	<b>CCE</b> : 50 Marks <b>ESE</b> : 50 Marks <b>TW</b> : 25 Marks

**Prerequisite Courses:**

- Construction techniques, plants and machineries

**Course Objectives:**

- To acquaint with selection criteria of construction equipment.
- To apply principles of equipment management, including optimization of equipment utilization, maintenance strategies, cost analysis, and the integration of technology to enhance productivity and safety on construction sites.

**Course Outcomes:**

After successful completion of the course, learner will be able to:

**CO1:** Discuss the selection criteria of construction equipment.

**CO2:** Identify and categorize various types of construction equipment and machinery based on their functions and applications in different phases of construction projects.

**CO3:** Calculate and analyze the total costs associated with construction equipment, including initial investment, operating costs, maintenance, and depreciation.

**CO4:** Implement strategies to optimize the use of equipment, reducing idle time, enhancing operational efficiency and record keeping of equipment.

**CO5:** Develop maintenance plans for various types of equipment ensuring their reliability, longevity, and safety.

**Course Contents****UNIT-I: Introduction to Construction Equipment****11 Hours**

Overview of construction equipment types and their roles in construction projects, the importance of equipment management in construction productivity and cost control, Factors influencing equipment selection.

**UNIT-II: Construction Equipment and Machinery****11 Hours**

Operation and applications of earthmoving equipment, concrete production and placement

equipment, material handling equipment, pile driving equipment, concrete/bitumen road construction equipment, tunneling equipment, aggregate production equipment, compressors.

### **UNIT-III: Equipment Economics**

**10 Hours**

Cost components of construction equipment: initial cost, operating cost, maintenance cost, and depreciation, economic life and replacement analysis, equipment cost estimation and budgeting, financing options for equipment procurement.

### **UNIT-IV: Equipment Management**

**10 Hours**

Costing, optimum utilization and equipment selection, depreciation, interest on capital, manpower, spare parts etc., documentation, logbooks, history books, periodical MIS report.

### **UNIT-V: Equipment Maintenance**

**10 Hours**

Types of maintenance: preventive, predictive, corrective, and condition-based, Maintenance scheduling and planning, common issues and troubleshooting in construction equipment, Equipment repair processes and decision-making for repair or replacement.

### **Learning Resources:**

#### **Text Books:**

1. Construction Planning, Equipment and Methods – Peurifoy-Tata McGraw Hill Publication.
2. Construction Technology: Analysis, and Choice, Bryan, Wiley India.
3. Construction Planning, Equipment and Methods – Peurifoy-Tata McGraw Hill Publication.
4. Construction Equipment Planning and Applications – Dr. Mahesh Varma.

#### **Reference Books:**

1. Journals such as CE and CR. Construction World, International Construction.
2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
3. Dr. Kumar Niraj Jha, Formwork for Concrete Structures, McGraw Hill Publication

#### **MOOC / NPTEL / YouTube Links:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_ce21/preview](https://onlinecourses.nptel.ac.in/noc21_ce21/preview)

### **List of Practicals:**

1. Site visit for fleet management on any construction project and submission of a report.
2. Cost comparison of various construction equipment's for any construction activity cost-effective analysis of equipment used for a construction activity.
3. Determination of work cycle time for any Equipment for its use.
4. Prepare the checklist of maintenance for any equipment and its analysis of maintenance cost.
5. Case study/Literature review on implementation of advanced technologies such as IoT, AI, etc. in monitoring performance of construction equipment.



<b>Course Code: 205205</b>	<b>Course Name: Skill Development Laboratory – II (Oral and Written Communication)</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Practical : 2 Hours/Week</b>	<b>1</b>	<b>TW : 25 Marks</b>

### Prerequisite Courses:

- Basic communication skills and English language.

### Course Objectives:

- To facilitate holistic growth among students.
- To aware the significance of soft skills and English aptitude.
- To develop the ability to effectively communicate through individual and group activities.
- To expose to right attitude and behavioral aspects and build the same through various activities.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Express effectively through verbal/oral communication skills.

**CO2:** Prepare for group discussions/meetings/interviews and presentations.

**CO3:** Operate effectively in diverse, multidisciplinary teams through interpersonal relationships, conflict management, and leadership.

### Guidelines:

1. Total activities to be conducted are four out of five.
2. Total: five activities in 15-20 hours.

### Course Contents

#### UNIT I: Group Discussion and Debate

**06 Hours**

**Group Discussion:** Make students aware of proper and globally accepted ethical ways to handle work, colleagues and clients. Develop group communication skills. Learn to speak-up one's opinion in a forum. Cultivate the habit of presenting solution-driven analytical arguments making them contributors in any team. **Debate on current affairs/ Social relevance topics:** Cultivate the habit of presenting forceful arguments while respecting the opponent's perspective and enhancing verbal skills.

**UNIT-II: Public Speaking****06 Hours**

Any one of the following activities may be conducted: **Prepared speech:** Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver. **Extempore speech:** Students deliver speeches spontaneously for 5 minutes each on a given topic.

**UNIT-III: Writing an Article and Email Etiquettes****06 Hours**

Build writing skills, improve language and gain knowledge about how to write an article/ report. Provide students with an in-depth understanding of writing formal emails.

**UNIT-IV: Reading and Listening Skills****06 Hours**

The batch can be divided into pairs. Each pair will be given an article by the facilitator. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students would be asked questions and needful corrections in the article. The facilitator can evaluate the students for reading and listening skills.

**UNIT-V: Telephonic Etiquettes and Mock Interviews****06 Hours**

**Telephonic etiquettes:** To teach students the skills to communicate effectively over the phone. Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call. **Mock interviews:** Guide students and conduct mock interviews.

**Learning Resources:****Text Books:**

1. Barrun Mitra, Personality Development and Soft Skills, Oxford Higher Education
2. Stephen Lucas, the Art of Public Speaking, McGraw-Hill Education.

**Reference Books:**

1. Marica weaver, empowering employees through basic skills, Quality Resources, 1996.
2. Gerald Ratiga, Aced: Superior interview skills to gain an unfair advantages to land Your DREAM JOB!, Gerald Ratigan, CMA, CPA Publisher.

**Web Link for MOOC / NPTEL / YouTube Links:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_hs77/preview](https://onlinecourses.nptel.ac.in/noc22_hs77/preview)

**List of Practicals:**

1. Term work is based on above activity report with all necessary documents and photographs.

<b>Course Code: 205206</b>	<b>Course Name: Seminar</b>	
<b>Teaching Scheme</b>	<b>Credit</b>	<b>Evaluation Scheme</b>
<b>Practical : 4 Hours/Week</b>	<b>2</b>	<b>TW : 50 Marks</b> <b>OR : 50 Marks</b>

### Course Objectives:

- To understand, develop research ability and present the knowledge gained from curriculum.
- To study the recent trends, technological innovations in civil engineering construction management field.
- To learn how to prepare, seminar research project topic report and enhance presentation skills.

### Course Outcomes:

After successful completion of the course, learner will be able to:

**CO1:** Apply theoretical knowledge gained in the Research Internship/ Field Visit Case Study/ Experiential Learning activities to practical research projects and real-world engineering challenges.

**CO2:** Develop advanced problem-solving skills, critical thinking abilities, and a deep understanding of engineering principles.

### Guidelines:

Seminar shall be on any related topic of specialization approved by a guide/authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the department/institute.

1. Individual student need to study recent topics in the field of construction management under the guidance of allocated guide.
2. Students can choose topic related to construction management, considering recent trends and its societal importance.
3. The extensive literature survey, mathematical modeling of particular method, experimentation and valuable conclusion is expected from seminar study.
4. Seminar report should be submitted as a compliance of term work.
5. Technical paper publication is expected as outcome of seminar.
6. Total duration: 24 contact hours and additional 24 hours should be spend by students on completion of related activities and requirements.

**Course Contents**

<b>Week</b>	<b>Activities</b>
<b>1 and 2</b>	Guide allotment and finalization of topic (Review 1)
<b>2 and 3</b>	Literature review, objectives and planning of the work.
<b>4 and 5</b>	Literature review, methodology finalization.
<b>5 and 6</b>	Detail topic data collection, mathematical model, case study analysis, experimentation methodology and findings. (Review 2)
<b>6 to 8</b>	Result and discussion, solutions to the identified problem or research gaps.
<b>9 to 12</b>	Seminar report writing, preparation of presentation and publication or copyright planning, final Review conduction.