

SYLLABUS

OF

M. TECH

***(CONSTRUCTION TECHNOLOGY AND
MANAGEMENT)***

I YEAR

(CBCS)

**DEPARTMENT OF CIVIL
ENGINEERING**

**INTEGRAL UNIVERSITY
LUCKNOW**

**SYLLABI AND EVALUATION SCHEME (Full Time)
M.Tech. (Construction Technology & Management)**

(w.e.f. 2020-21)

Semester – I

| S. No. | Course Category | Code No | Name of Subject | Periods | | | Credits C | Evaluation Scheme | | | Subject Total | |
|--------------|-----------------|---------|---|---------|---|---|--------------|----------------------------|-------|----|---------------|----------|
| | | | | L | T | P | | Continuous Assessment (CA) | | | | Exam ESE |
| | | | | | | | UE | TA | Total | | | |
| 1 | DC | CE541 | Infrastructure Planning & Contract Management | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 2 | DC | CE542 | Project Management in Construction | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 3 | DC | CE543 | Construction Methods & Equipment Management | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 4 | DC | CE550 | Organization and Legislations in Construction | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 5 | DC | CE551 | Software and Procedures in Construction | - | - | 3 | 2 | 40 | 20 | 60 | 40 | 100 |
| Total | | | | | | | 18 | | | | 500 | |

Semester – II

| S. No. | Course Category | Code No | Name of Subject | Periods | | | Credits C | Evaluation Scheme | | | Subject Total | |
|--------------|-----------------|---------|---|---------|---|---|--------------|----------------------------|-------|----|---------------|----------|
| | | | | L | T | P | | Continuous Assessment (CA) | | | | EXAM ESE |
| | | | | | | | UE | TA | Total | | | |
| 1 | DC | CE546 | Infrastructural Economics & Finance | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 2 | DC | CE547 | Quality & Safety Management in Construction | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 3 | DC | CE548 | Modern Construction Techniques | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 4 | DC | CE552 | Research Methodology | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 5 | DC | CE553 | Statistics for Construction Managers | - | - | 3 | 2 | 40 | 20 | 60 | 40 | 100 |
| Total | | | | | | | 18 | | | | 500 | |

UE- Unit Exam, **TA-** Teacher Assessment; **ESE** – End Semester Examination.

Note: Duration of ESE shall be 03 (Three) hours per subject

M.Tech (Construction Technology & Management)

List of the Elective Paper:

Elective – I

- CE544 Urban Transportation System Planning
- CE641 Ready Mix Concrete Design and Quality Control
- CE642 Maintenance & Rehabilitation of Structures
- CE643 Prefabricated Structures
- CE644 Solid & Hazardous Waste Management

Elective – II

- CE647 Transportation Economics
- CE648 Principles of Affordable Housing
- CE649 Building Services & Maintenance Management
- CE650 Construction Information Systems



Integral University, Lucknow

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|--|--|----------------------------|---|----------|----------|----------|----------|
| Effective from Session: 2016-17 | | | | | | | |
| Course Code | CE541 | Title of the Course | Infrastructure Planning & Contract Management | L | T | P | C |
| Year | 1 st | Semester | 1 st | 3 | 1 | 0 | 4 |
| Pre-Requisite | | Co-requisite | | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop the knowledge of infrastructure planning ,Financial evaluation of project along with types of tendering process | | | | | | |

| Course Outcomes | |
|------------------------|---|
| CO1 | Able to do planning and appraisal of major infrastructure project and can prepare scheduling and management of planning activity. |
| CO2 | Able to Understand the methodologies of economic analysis of public works and accounting for risk and uncertainty. |
| CO3 | Able to Understand the time value of money, project cash flow, political and social perspective of infrastructure planning. |
| CO4 | Able to Understand different public law, private law. Contract property law and building by laws of local authority. |
| CO5 | Able to Prepare best contract document used for construction and procurement and will be well versed BOT, BOOT and EPC contract. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--|--|---------------------|------------------|
| 1 | Introduction-Infrastructure Planning | Definitions of infrastructure; Typical infrastructure planning steps; Planning and appraisal of major infrastructure projects; Screening of project ideas; Life cycle analysis; Multi-criteria analysis for comparison of infrastructure alternatives; Procurement strategies; Scheduling and management of planning activities | 08hrs | CO1 |
| 2 | Economic Analysis and Benefit Cost Ratio | Economic Analysis – Concepts and Applications, Principles of methodologies for economic analysis of public works, Social welfare function, indifference curves and tradeoffs, Demand curves and price elasticity’s; Benefit-cost ratio and internal rate of return; Shadow pricing; Accounting for risk and uncertainty; | 08hrs | CO2 |
| 3 | Economic Analysis and Benefit Cost Ratio | Financial Evaluation - Time value of money, Investment criteria, Project cash flows – elements and basic principles of estimation, Financial estimates and projections, Cost of capital, Rate of return; Project risk analysis; Political and social perspectives of infrastructure planning; Case studies. | 08hrs | CO3 |
| 4 | Construction Laws and Arbitration | Construction Law - public law; Government Departments and Local Authorities; Private Law, Contracts, property law and building law | 08hrs | CO4 |
| 5 | Contract Types and Specifications | Construction Contracts - Contract Specifications, types of contract documents used for construction, Contract Procurement - selecting a contractor, Introduction to BOT and BOOT projects, EPC contracts Price Adjustment: need for the formulae, comparison with previous system, Civil Engineering and building formulae, practical implications | 08hrs | CO5 |

Reference Books:

P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill, New Delhi, 2009.

J.D. Finnerty, Project financing-Asset-based financial engineering, John Wiley & Sons, New York, 1996.

A.S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, NewYork, 2006.

J. Parkinand D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.

Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M. Tripathi Private Ltd., Bombay, 1982.

e-Learning Source:
<https://nptel.ac.in/courses/105106115/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 2 | 1 | 3 | 2 | 2 | 2 | 0 |
| CO2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 0 | 2 | 1 | 3 | 2 | 2 | 2 | 0 |
| CO3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 0 | 2 | 1 | 2 | 2 | 2 | 2 | 0 |
| CO4 | 0 | 1 | 0 | 1 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 1 | 0 |
| CO5 | 2 | 0 | 0 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 0 |

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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| Effective from Session: 2018-19 | | | | | | | |
|---------------------------------|---|---------------------|------------------------------------|---|---|---|---|
| Course Code | CE542 | Title of the Course | Project Management In Construction | L | T | P | C |
| Year | 1 st | Semester | 1 st | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To make them understand the concepts of project management from Project initiation to project close out. To make them understand the need of scope management, activity sequencing to execute a project in due time. To enable them to response on situational based problems using quantitative methods to manage cost. To comprehend the fundamentals of recourse management, risk management, quality management in a project. To make them capable to analyze, apply & comment the project complexities based on procurement, contract management & risk control. | | | | | | |

| Course Outcomes | |
|-----------------|---|
| CO1 | Learner will be able to understand the concept of project based management techniques to deal with different project parameter involved in various stages of a project. |
| CO2 | Based on the feasibility studies the learner will be able to create a scope statement that includes activity oriented network diagram to perform critical analysis. |
| CO3 | Understand the concept of cost management principle based on situational based problems and to analyses the response for future in modifications. |
| CO4 | Apply the Recourse management, Quality management & Risk management methods to develop risk management plan with utmost utilization of project resource & quality objectives. |
| CO5 | Understand the concept of contract management, project procurement & value management for better analysis of a project and its growth. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|---------------------------------------|--|--------------|-----------|
| 1 | Basics of Project Management | Introduction to project management processes - Initiating, Planning, Executing, Controlling, and Closing processes; Project Integration Management - Project plan development, Project plan execution, and Overall change control; | 08 Hrs | CO1 |
| 2 | Project Scope and Schedule Management | Project Scope Management - Initiation, Scope planning, Scope definition, Scope verification, and Scope change control; Project Time Management - Activity definition - work breakdown structure, Activity sequencing-scheduling logic, precedence diagramming method, arrow diagramming method, Activity duration estimation, Schedule development and analysis - critical path method, program evaluation and review technique, production curves, line-of-balance method, Duration compression, Resource constrained scheduling, Schedule control; | 08 Hrs | CO2 |
| 3 | Project Cost and Qualitative Methods | Project Cost Management - Resource planning, Cost estimating, Cost budgeting, and Cost control – earned value method; Quantitative Methods in Construction management: Introduction and concepts of probability and statistics, Linear programming, Transportation and assignment problems. Dynamic programming, Queuing theory, Decision theory, Games theory simulations applied to construction, Modifications and improvement on CPM/PERT techniques | 08 Hrs | CO3 |
| 4 | Resource and Quality Management | Project Resource Management - Resource aggregation, Resource leveling – method of moments, double moments, Resource allocation; Time-cost Tradeoff; Project Quality Management - Quality planning, Quality assurance, and Quality control; Project Risk Management - Risk identification, Risk quantification, Risk response development and control; | 08 Hrs | CO4 |
| 5 | Procurement Management | Project Procurement Management - Procurement planning, Solicitation planning, Solicitation, Source selection, Contract administration, and Contract close-out; Material Management; Life-cycle Costing; Value Management; Knowledge Management. | 08 Hrs | CO5 |

Reference Books:

- T. Hegazy, Computer-based construction project management, Prentice Hall, New Jersey, 2002.
- S.M. Levy, Project management in construction, 5th Edition, McGraw Hill, New York, 2007.
- PMI, A guide to the project management body of knowledge, 3rd Edition, Project Management Institute, Pennsylvania, 1996.
- M. Mawdesley, W. Askew and M. O'Reilly, Planning and controlling construction projects, Addison Wesley Longman Limited, Essex, 1997.
- J. Kelly, S. Male and D. Graham, Value management of construction projects, Blackwell Publishing, Oxford, 2003.
- Joy P.K, "Handbook of Construction Management", MacMillan Publications, 1991

e-Learning Source:

<http://nptel.ac.in/courses/105103093/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO- PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 1 |
| CO2 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 |
| CO4 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 2 |
| CO5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 3 | 3 | 2 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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Integral University, Lucknow

| Effective from Session: 2018-19 | | | | | | | |
|---------------------------------|---|----------------------------|---|----------|----------|----------|----------|
| Course Code | CE543 | Title of the Course | Construction Methods & Equipment Management | L | T | P | C |
| Year | 1 st | Semester | 1 st | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop knowledge of economics related matters of construction equipment. To develop the understanding of different types of construction equipment. To develop the understanding of working characteristics of different types of construction equipment. To develop the modeling and optimization techniques of construction equipment productivity | | | | | | |

| Course Outcomes | |
|-----------------|--|
| CO1 | Given the utilization conditions, learner will be able to understand various cost components of construction equipment and analyze available alternatives. |
| CO2 | Knowing the project specification, learner will be able to identify types of construction equipment required and find out most suitable or combination of construction equipment. |
| CO3 | Knowing the process associated with concrete mix production, learner will be able to understand the requirements and can supervise the setting up a concrete or asphalt mix production plant as well laying of concrete mix. |
| CO4 | Given the conditions of construction activity, learner will be able to understand different methods of productivity optimization and prepare required activity optimization plan. |
| CO5 | Depending upon construction site characteristics, learner will be able to analyze construction equipment safety requirements & accident data and prepare construction equipment safety plan. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|--|--|--------------|-----------|
| 1 | Construction Equipment Economics | Introduction, Cost of Owning and Operating Construction Equipment - Ownership cost, Depreciation, Operating cost, and Ownership and operating costs calculation methods; Equipment Life and Replacement Procedures - Physical, profit and economic life, Replacement analysis. | 08hrs | CO1 |
| 2 | Engineering Fundamentals of Moving Earth | Rolling resistance, Effect of grade on tractive effort, Effect of altitude on performance of IC engines; Earthmoving, Excavating, and Lifting Equipment Selection-Bulldozers, Front-end Loaders, Scrapers, Trucks, Excavators, Backhoes, Front shovels, Cranes, and Forklifts; Piles and Pile-Driving Equipment. | 08hrs | CO2 |
| 3 | Concrete & Asphalt Mix Production | Production of Crushed-stone Aggregate, Stone crushers- Primary & Secondary Crushers; Concreting Equipment; Asphalt Mix Production and Placement - Asphalt Plants, and Paving Equipment. | 08hrs | CO3 |
| 4 | Estimating and Optimizing Construction Equipment System Productivity | Peurifoy's method of optimizing productivity, Phelps' Method, Scheduling Equipment-Intensive Horizontal Construction Projects - Linear scheduling method, Precedence diagramming method. | 08hrs | CO4 |
| 5 | Construction Equipment Site Safety | Introduction, Job Safety Plan, Heavy Construction Equipment Site Safety Considerations, Job Safety Analysis for Earthmoving, Lifting Safety, OSHA Accident Reporting and Record Keeping, Safety Requirements for Construction Equipment. | 08hrs | CO5 |

Reference Books:

- D.G. Gransberg, C.M. Popescu and R.C. Ryan, Construction Equipment Management for Engineers, Estimators, and Owners, Taylor & Francis, New York, 2006.
- R. L. Peurifoy, C. J. Schexnayder, A. Shapira and R. Schmitt, Construction Planning, Equipment, and Methods, 8th ed., McGraw Hill, New York, 2008.

e-Learning Source:

- <https://nptel.ac.in/courses/105104161/12>
- <https://youtu.be/PIIUTTufpvA>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 |
| CO2 | 3 | 0 | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| CO3 | 2 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| CO4 | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 |
| CO5 | 0 | 3 | 3 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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|--|---|----------------------------|---|----------|----------|----------|----------|
| Effective from Session: 2016-17 | | | | | | | |
| Course Code | CE550 | Title of the Course | Organization and Legislations in Construction | L | T | P | C |
| Year | 1 st | Semester | 1 st | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To understand the rules, practices and regulations that govern the formation as well as operation of corporations | | | | | | |

| Course Outcomes | |
|------------------------|---|
| CO1 | Develop the student's understanding of construction legislations |
| CO2 | Develop student's understanding of managing human resources in construction |
| CO3 | Develop student's understanding of organizational hierarchies |
| CO4 | Students will gain understanding of the importance of leadership and its applications |
| CO5 | Students will gain understanding of entrepreneurial skills |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|-------------------------------|---|---------------------|------------------|
| 1 | Construction Legislations | The Indian Contract Act, 1872: Definition of a Contract and its essentials, Formation of a valid Contract - Offer and Acceptance, Consideration, Capacity to Contract, Free consent, Legality of object, Discharge of a Contract by performance, Impossibility and Frustration, Breach, Damages for breach of a contract, Quasi contracts. Special Contracts Contract of Indemnity and Guarantee, Contract of Bailment and Pledge, Contract of Agency. The Companies Act, 1956: Nature and Definition of a Company, Registration and Incorporation, Memorandum of Association, Articles of Association, Prospectus, Kinds of Companies, Directors: Their powers and duties, Meetings, Winding up. | 08hrs | CO1 |
| 2 | HR Management in Construction | Challenges of managing people in construction; organization and management theory; HRM theory; strategic HRM approaches; operational HRM approaches; employee relations; employee empowerment; diversity and work/life balance; employee welfare; strategic human resource development; employment legislation. Labor Legislations: Industrial Dispute Act, Factories Act, Payment of Wages Act, Workmen's Compensation Act. Important Provisions of Employees' State Insurance Act, Payment of Gratuity Act, Employees Provident Fund Act | 08hrs | CO2 |
| 3 | Organization and its Groups | Groups versus teams; Nature and types of groups and teams; Five stages of group/team development; Determinants of group behavior; Typical teams in organizations | 08hrs | CO3 |
| 4 | Leadership Management | Leadership as a concept and its essence; Leaders versus managers- Hersey and Blanchard's situational leadership; Transactional versus Transformational leadership; Equity in Workforce - Women as leaders; Leadership in entrepreneurial and family business organizations. | 08hrs | CO4 |
| 5 | Entrepreneurship | Definition growth of small-scale industries; characteristics and types of small-scale industries; Contribution of small-scale industries to national economy; Government policy for small scale industry | 08hrs | CO5 |

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| Reference Books: |
| Kuchhal M.C.-Business Law (Vikas Publication, 4th Edition) |
| Gulshan S.S. -Business Law Including Company Law (Exce lBooks) |
| e-Learning Source: |
| https://www.legalbites.in/library-company-law/ |
| https://www.scribd.com/document/144562410/ctm-unit-4 |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 0 | 1 | 0 |
| CO2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 0 | 1 | 0 |
| CO3 | 1 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 1 | 3 | 2 | 3 | 0 | 1 | 0 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 2 | 3 | 0 | 1 | 0 |
| CO5 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 0 | 1 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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| Effective from Session: 2016-17 | | | | | | | |
| Course Code | CE551 | Title of the Course | Software and Procedures in Construction | L | T | P | C |
| Year | 1 st | Semester | 1 st | 0 | 0 | 3 | 2 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | To impart knowledge of MS Project software in Project Management | | | | | | |

| Course Outcomes | |
|------------------------|--|
| CO1 | To make the students familiar with the MS project software application in Project scheduling and management. |
| CO2 | Learner will be able to understand the basics of tender invitation & formation as per the guidelines. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--------------------------|--|---------------------|------------------|
| 1 | MS Project | Introduction of MS Project and Project Interface. | 03hrs | CO1 |
| 2 | Project Template | Creating Project & Project calendar using a Project Template. | 03hrs | CO1 |
| 03hrs | Work Breakdown structure | WBS creation & Activity addition using a Project Template. | 03hrs | CO1 |
| 4 | Project Scheduling | Scheduling of a project using a Project Template. | 03hrs | CO1 |
| 5 | Resource assigning | Resource assigning and leveling using a Project Template. | 03hrs | CO1 |
| 6 | Earned Value Analysis | Understanding of Project Tracking and Monitoring using CPM & EVA using a Project Template. | 03hrs | CO1 |
| 7 | Tenders | Tender Drafting and NIT. | 03hrs | CO2 |
| 8 | Contracts | Identification of GCC & SCC in a Contract. | 03hrs | CO2 |

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| Reference Books: |
| Johnson, T., Chatfield, C., Lewis, C. (2019). Microsoft Project 2019 Step by Step. Pearson Education |
| Tendering for Civil Engineering Contracts. (2001). United Kingdom: Thomas Telford |
| e-Learning Source: |
| https://www.youtube.com/channel/UCqyBfm_H9ugGirk1ufYA2YA |
| Scheduling Techniques in Projects - Course (nptel.ac.in) |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 2 | 0 | 3 | 3 | 0 | 0 | 0 | 2 | 0 | 3 | 0 | 1 | 3 | 1 |
| CO2 | 1 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 2 | 0 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| <p align="center">Name & Sign of Program Coordinator</p> | <p align="center">Sign & Seal of HoD</p> |
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|--|--|----------------------------|---------------------------------------|----------|----------|----------|----------|
| Effective from Session: 2018-19 | | | | | | | |
| Course Code | CE546 | Title of the Course | Infrastructural Economics and Finance | L | T | P | C |
| Year | 1 st | Semester | 2 nd | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop concept of construction accounting and Capital Management. To make learner understand the need of Strategic management and Decision-making techniques in construction sector. | | | | | | |

| Course Outcomes | |
|------------------------|---|
| CO1 | Gather background information about construction accounting and determine its effect on a project evaluation. |
| CO2 | Describe and explain the features of inflation, taxation & contract bidding to enhance the performance of a construction project. |
| CO3 | Understand the concept of international finance to accomplish performance appraisal through capital management tools. |
| CO4 | Identify the need of strategy formulation & their implementation to understand external and internal factors in organization. |
| CO5 | Describe and explain the basic features of corporate strategy & social responsibility. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|---|--|---------------------|------------------|
| 1 | Introduction: Construction Accounting | Construction accounting - Income statement - Depreciation and amortization - Engineering economics - Benefit-cost analysis - Replacement analysis. | 08hrs | CO1 |
| 2 | Capital Budgeting and Contract Bidding | Break even analysis - Risks and uncertainties and management decision in capital budgeting - Taxation and inflation - Work pricing - contract - bidding and award – revision - escalation - Turnkey activities – Project appraisal and yield | 08hrs | CO2 |
| 3 | Working Capital Management | Working capital management – International finance - Budgeting and budgetary control – Performance appraisal. | 08hrs | CO3 |
| 4 | Strategic Management and Final Strategies | Introduction to Strategic Management Concepts, Strategy Formation and Implementation, External and Internal Environment Analysis, Financial Strategies | 08hrs | CO4 |
| 5 | Corporate Decision-Making Techniques | Decision and Analytical Tools, Corporate Strategic Events, Leadership and Decision-making, Corporate Social Responsibility | 08hrs | CO5 |

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|---|--|
| Reference Books: | |
| Danny Myers, Construction Economics: A New Approach, Taylor and Francis Publisher, 2004 | |
| Ofori, G, The Construction Industry Aspects of its economics and Management, Singapore University Press | |
| David Langford, Steven Male, Strategic Management in Construction, 2nd Edition, John Wiley and Sons, 2008 | |
| e-Learning Source: | |
| https://nptel.ac.in/courses/105106115/ | |
| Infrastructure Economics - Course (nptel.ac.in) | |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| | CO1 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| CO2 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| CO3 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| CO4 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 |
| CO5 | 2 | 0 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| <p align="center">Name & Sign of Program Coordinator</p> | <p align="center">Sign & Seal of HoD</p> |
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| Effective from Session: 2020-21 | | | | | | | |
|---------------------------------|--|----------------------------|---|----------|----------|----------|----------|
| Course Code | CE547 | Title of the Course | Quality & Safety Management in Construction | L | T | P | C |
| Year | 1 st | Semester | 2 nd | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop concept of quality general and in construction in particular. To develop the understanding of different levels of quality and its significance. To develop concept of safety and its need in construction field. To develop the understanding of different guidelines regarding safety at construction site. | | | | | | |

| Course Outcomes | |
|-----------------|--|
| CO1 | Knowing the fundamentals of quality regimes, learners will understand the sequential development of quality approach and are able to compare the different quality levels |
| CO2 | Given the requirements of structure, material and machinery used, learner will understand about different tools and techniques of quality management and able to develop a quality plan |
| CO3 | Knowing the international requirements of quality protocols, learner will understand quality assurance in construction and be able to develop quality assurance plan |
| CO4 | Knowing the principles of Total Quality Management, learner will understand the necessity of health & safety of occupants at workplace and be able to analyze the hazard potential for prevailing conditions |
| CO5 | Given the site conditions, learner will understand the legal requirements for safety and be able to develop safety plan for construction site |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|----------|--|--|--------------|-----------|
| 1 | Quality Transitions | Introduction to quality; Importance of quality; Quality transition - quality control and inspection, quality assurance, total quality management; Evolution of quality management; | 08hrs | CO1 |
| 2 | Tools of Quality Management | Planning and control of quality during design of structures; Tools and techniques for quality management; Inspection of materials and machinery; | 08hrs | CO2 |
| 3 | Quality Assurance System | Quality assurance in construction; Systems quality management; Quality standards/codes in design and construction; (ISO:9000); | 08hrs | CO3 |
| 4 | Total Quality Management & Safety Management | Total quality management (TQM) - principles, tools and techniques. Introduction to safety; Safety and health programs in construction industry; Planning for safety provisions; Analysis of construction hazards and accidents; | 08hrs | CO4 |
| 5 | Safety at Construction Site | Construction hazards and safety guidelines; Prevention techniques for construction accidents; Site management with regard to safety recommendations; Training for safety awareness and implementation; Construction safety and health manual | 08hrs | CO5 |

Reference Books:

- B.G. Dale, Managing quality, 4th ed., Blackwell Publishing, Oxford, 2003.
- D.Reese and J. V. Eidson, Handbook of OSHA construction safety and health, 2nd ed., CRC Press, Bocaaton, 2006.
- F. Harris, R. Mc Caffer and F. Edum-Fotwe, Modern construction management, 6th ed., Blackwell Publishing, Oxford, 2006
- K. Knutson, C. J. Schexnayder, C. M. Fiori and R. Mayo, Construction management fundamentals, 2nd ed., McGrawHill, New York, 2008.
- S.J. Holt, Principles of construction safety, Blackwell Publishing, Oxford, 2008.

e-Learning Source:

- <https://www.slideshare.net/zishanrkiul/unit-1-ce-547-quality-transition>
- <https://www.slideshare.net/zishanrkiul/unit-2-ce547>
- <https://www.slideshare.net/zishanrkiul/unit-3-ce547>
- <https://www.slideshare.net/zishanrkiul/unit-4-ce547>
- <https://nptel.ac.in/courses/105103093/21>
- <https://www.osha.gov/>

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| PO-PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO | | | | | | | | | | | | | | | |
| CO1 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| CO2 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| CO3 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| CO4 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| CO5 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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Integral University, Lucknow

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|--|---|----------------------------|--------------------------------|----------|----------|----------|----------|
| Effective from Session: 2019-20 | | | | | | | |
| Course Code | CE548 | Title of the Course | Modern Construction Techniques | L | T | P | C |
| Year | 1 st | Semester | 2 nd | 3 | 1 | 0 | 4 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop the understanding between construction and technology. To develop the understanding of different needs of a building and its modern solutions. To make learner abreast with latest construction techniques. To make learner abreast with latest materials used in construction. | | | | | | |

| Course Outcomes | |
|------------------------|---|
| CO1 | Knowing the modern requirements, learner will understand the developments in the area of concrete use and be able to design concrete mix as per requirements |
| CO2 | Knowing the modern construction techniques, learner will be aware of developments in structural framing, building components etc and be able to plan for construction incorporating modern developments |
| CO3 | Knowing about different kinds of form works and fire resistance needs, learner will be able to understand the requirement of National building code and able to apply provisions of it |
| CO4 | Given the utilization conditions, learner will develop the understanding of sustainable building construction practices and be able to prepare plan giving due importance |
| CO5 | Knowing past experiences, learner will develop the understanding about situational requirements and be able to suggest technologically driven solutions |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--|--|---------------------|------------------|
| 1 | Advancements in Concrete | Introduction to Concrete mix design, Fiber Reinforced Concrete, Concrete Mix with polymer additives, Reinforced and pre stressed concrete construction – IS Code provisions for Earthquake resistance, Pre-stressing system. | 08 Hrs | CO1 |
| 2 | Construction with Steel & Building Facilities | Construction techniques associated with steel framing; floor systems, current advancements; roof systems; masonry construction; curtain walls; building insulation; and interior and exterior finishes. | 08 Hrs | CO2 |
| 3 | Concrete Formwork & Fire Resistance Provision | Concrete formwork: Table form/flying form, System column formwork, Horizontal panel systems, Vertical panel systems, Jump form, Slip form etc., fire resistant construction techniques- Provisions & Requirements of National Building Code. | 08 Hrs | CO3 |
| 4 | Building Sustainability & Modern Construction | Cost Effective Construction Technique (CECT), repair techniques, prefabrication and pre-casting, modular construction, in-situ pre-fabrication, lift slab and tilt up construction. | 08 Hrs | CO4 |
| 5 | Case Studies on Modern Construction Techniques | Case Studies on modern construction practices, Implementation of modern construction techniques in housing sectors, Non Destructive Testing, Modern Construction Materials, Smart Materials, 3D-Printing. | 08 Hrs | CO5 |

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|--|--|--|--|--|
| Reference Books: | | | | |
| <ul style="list-style-type: none"> Allen E, Iano, J, Fundamentals of Building Construction Material and Method, John Wiley & Sons, 2011. Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8th Edition, Prentice Hall, 2009. | | | | |
| e-Learning Source: | | | | |
| <ul style="list-style-type: none"> https://www.brmca.org.uk https://www.slideshare.net/zishanrkiul/unit-2-ce548 https://www.slideshare.net/zishanrkiul/unit-3-ce548 https://www.slideshare.net/zishanrkiul/unit-4-ce548 | | | | |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| PO-PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO | | | | | | | | | | | | | | | |
| CO1 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 3 | 0 |
| CO2 | 0 | 0 | 3 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 0 |
| CO3 | 3 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 |
| CO4 | 0 | 0 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 0 |
| CO5 | 0 | 0 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 0 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| Name & Sign of Program Coordinator | Sign & Seal of HoD |
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Integral University, Lucknow

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|--|---|----------------------------|--------------------------------------|----------|----------|----------|----------|
| Effective from Session: 2016-17 | | | | | | | |
| Course Code | CE553 | Title of the Course | Statistics for Construction Managers | L | T | P | C |
| Year | 1 st | Semester | 2 nd | 0 | 0 | 3 | 2 |
| Pre-Requisite | NIL | Co-requisite | NIL | | | | |
| Course Objectives | <ul style="list-style-type: none"> To develop the skill to perform descriptive statistic on a dataset. | | | | | | |

| Course Outcomes | |
|------------------------|--|
| CO1 | Ability to visualize dataset from large and small samples |
| CO2 | Skill to extract and interpret descriptive statistics on a dataset. |
| CO3 | Capability to test hypothesis and compare means of populations using inferential statistics. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|-----------------|--------------------------|--|---------------------|------------------|
| 1 | Data Visualization | Visualization of dataset using charts and histogram | 03hrs | CO1 |
| 2 | Descriptive statistics | Determination of frequency and plotting distribution curve | 03hrs | CO2 |
| 3 | Descriptive statistics | Extracting descriptive statistics from the dataset | 03hrs | CO2 |
| 4 | Descriptive statistics | Measuring the reliability of a dataset | 03hrs | CO2 |
| 5 | Statistical Analysis | Comparing two population mean when variance is known on large sample using z-test | 03hrs | CO3 |
| 6 | Statistical Analysis | Comparing two population mean on small sample using t-test with equal and unequal variance | 03hrs | CO3 |
| 7 | Statistical Analysis | Determination of correlation and covariance in a dataset | 03hrs | CO3 |
| 8 | Statistical Analysis | One way ANOVA test on three or more population for comparing mean | 03hrs | CO3 |

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| Reference Books: | |
| Cramer, D., Bryman, A. (2012). Quantitative Data Analysis with IBM SPSS 17, 18 & 19: A Guide for Social Scientists. Taylor & Francis | |
| Gaur, S. S., Gaur, A. S. (2009). Statistical Methods for Practice and Research: A Guide to Data Analysis Using SPSS. India: SAGE Publications | |
| Hair, J., Sarstedt, M., Ringle, C. M., Hult, G. T. M. (2016). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). United States: SAGE Publications. | |
| e-Learning Source: | |
| https://www.youtube.com/watch?v=B69S9b2cl-k | |
| https://www.youtube.com/channel/UCg4oxYuBpcEF3RTa43U9kfg | |

| Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PO-PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 |
| CO2 | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 |
| CO3 | 3 | 3 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

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| <p align="center">Name & Sign of Program Coordinator</p> | <p align="center">Sign & Seal of HoD</p> |
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