SYLLABUS

OF

M. TECH

(Construction Technology and Management)

I YEAR

(CBCS)

DEPARTMENT OF CIVIL ENGINEERING

INTEGRAL UNIVERSITY LUCKNOW

STUDY 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				Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			Exam ESE	
								CT	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				**12**	**4**	**3**	**18**					**500**

Semester – II

S. No.	Course Category	Code No	Name of Subject	Periods				Evaluation Scheme				Subject Total
				L	T	P	C	Continuous Assessment (CA)			Exam ESE	
								CT	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				**12**	**4**	**3**	**18**					**500**

L – Lecture; **T –** Tutorial; **P –** Practical; **C** – Credits; **CT** – Class Tests; **TA** – Teacher Assessment
Continuous Assessment (CA) = Class Tests + Teacher Assessment

Subject Total = Continuous Assessment (CA) + End Semester Examination (ESE)

DC – Departmental Core **DE** – Departmental Elective

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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	I	**Semester**	I	3	1	0	4
Pre-Requisite		**Co-requisite**					
Course Objectives	• 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	08	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;	08	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.	08	CO3
4	Construction Laws and Arbitration	Construction Law - public law; Government Departments and Local Authorities; Private Law, Contracts, property law and building law	08	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	08	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, New York, 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 CO	**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	2
CO2	1	2	1	2	1	1	2	0	2	1	3	2	2	2	2
CO3	1	2	1	1	2	1	1	0	2	1	2	2	2	2	2
CO4	0	1	0	1	0	3	1	1	1	1	0	2	2	1	2
CO5	2	0	0	1	2	0	1	1	1	1	1	1	3	2	2

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

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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	I	**Semester**	I	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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 excite 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	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	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	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	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	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	0
CO2	1	3	2	0	0	0	0	0	0	0	3	0	3	3	0
CO3	3	3	0	0	0	0	0	0	0	0	3	0	3	3	0
CO4	3	0	0	3	0	0	0	0	0	0	3	0	3	3	0
CO5	3	0	0	0	0	0	0	0	0	3	3	0	3	3	0

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

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Effective from Session: 2018-19							
Course Code	CE543	**Title of the Course**	Construction Methods & Equipment Management	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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.	08	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.	08	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.	08	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.	08	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.	08	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., Mc-Graw Hill, New York, 2008.

e-Learning Source:

https://nptel.ac.in/courses/105104161/12

https://youtu.be/PI1UTTufpvA

	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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Effective from Session: 2021-22							
Course Code	CE550	**Title of the Course**	Organization and Legislations in Construction	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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.	08	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	08	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	08	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.	08	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	08	CO5

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

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	CE551	**Title of the Course**	Software and Procedures in Construction	**L**	**T**	**P**	**C**
Year	I	**Semester**	I	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.	03	CO1
2	Project Template	Creating Project & Project calendar using a Project Template.	03	CO1
3	Work Breakdown structure	WBS creation & Activity addition using a Project Template.	03	CO1
4	Project Scheduling	Scheduling of a project using a Project Template.	03	CO1
5	Resource assigning	Resource assigning and leveling using a Project Template.	03	CO1
6	Earned Value Analysis	Understanding of Project Tracking and Monitoring using CPM & EVA using a Project Template.	03	CO1
7	Tenders	Tender Drafting and NIT.	03	CO2
8	Contracts	Identification of GCC & SCC in a Contract.	03	CO2

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CE546	**Title of the Course**	Infrastructural Economics and Finance	L	T	P	C
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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.	08	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	08	CO2
3	Working Capital Management	Working capital management – International finance - Budgeting and budgetary control – Performance appraisal.	08	CO3
4	Strategic Management and Final Strategies	Introduction to Strategic Management Concepts, Strategy Formation and Implementation, External and Internal Environment Analysis, Financial Strategies	08	CO4
5	Corporate Decision-Making Techniques	Decision and Analytical Tools, Corporate Strategic Events, Leadership and Decision-making, Corporate Social Responsibility	08	CO5

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	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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CE547	**Title of the Course**	Quality & Safety Management in Construction	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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;	08	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;	08	CO2
3	Quality Assurance System	Quality assurance in construction; Systems quality management; Quality standards/codes in design and construction; (ISO:9000);	08	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;	08	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	08	CO5

Reference Books:

B.G. Dale, Managing quality, 4thed., Blackwell Publishing, Oxford, 2003.

D.Reese and J. V. Eidson, Handbook of OSHA construction safety and health,2nd edition., CRCPress,Bocaaton,2006.

F. Harris, R. Mc Caffer and F. Edum-Fotwe, Modern construction management, 6thed., BlackwellPublishing,Oxford,2006

K. Knutson, C. J. Schexnayder, C. M. Fiori and R. Mayo, Construction management fundamentals, 2nd ed.,McGrawHill,NewYork,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 / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
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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Effective from Session: 2023-24							
Course Code	CE548	**Title of the Course**	Modern Construction Techniques	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• To develop understanding about different needs of a building and its modern solutions. • To impart knowledge about latest construction techniques. • To develop understanding about the properties, benefits and application of advanced materials used in construction. • To develop the ability to identify and creatively use latest techniques and materials in construction.						

Course Outcomes	
CO1	Learner will be able to design concrete mix and understand appropriate use of various modern materials for construction and repair.
CO2	Learner will be able to understand the IS provisions for earthquake buildings and able to choose correct building systems and components considering the criteria.
CO3	Learner will be able to evaluate and choose correct construction methodologies in order to optimize project resources.
CO4	Learner will be able to understand the lean construction concept and its application using it various tools.
CO5	Learner will be able to learn the various advanced construction practices and techniques using robotics, automation and sensor based technologies to enhance safety, sustainability and economy.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Advancement in concrete and Materials	Introduction to Concrete mix design, Fiber Reinforced Concrete, Concrete Mix with polymer additives, Self compacting concrete, High strength concrete, Engineered Cementitious Composite (ECC); Modern and smart construction materials, Repair Materials and Techniques	08	CO1
2	Advanced Building Systems	Steel concrete composite building systems, Advancement in RCC and Masonry construction; IS Code provisions for Earthquake resistance construction; Curtain Walls, Building Insulation; Interior and Exterior finishes	08	CO2
3	Construction Methodologies	prefabrication and pre-casting, modular construction, in-situ pre-fabrication, lift slab and tilt up construction; Bubble Slab construction; Type of concrete form works; Prestressing	08	CO3
4	Lean Construction	Introduction - Lean Tools, Advantages of Lean concept in contraction, Application of lean concept, Case studies	08	CO4
5	Construction Automation	Construction Automation- Additive Layer Manufacturing of concrete, BIM, Sensor based technologies in construction safety, Material Testing; Construction Digitalization; Case studies on automation and digitalization; Nondestructive Testing	08	CO5

Reference Books:

Naville and Brooks, Concrete Technology, Pearson Education, 2006.

Lauri Koskela, Mike Kagioglou, Patricia Tzortzopoulos, Lean Construction- Core Concepts and New Frontiers, CRC Press, 2020.

Alan Chamberlain, Automation and Robotics in Construction XI, Elsevier Science, 20123

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:

https://www.brmca.org.uk

https://www.slideshare.net/zishanrkiul/unit-2-ce548

https://www.coursera.org/learn/bim-fundamentals

https://archive.nptel.ac.in/courses/105/106/105106213/

	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**
CO1	3	0	3	0	0	0	1	3	0	0	1	2	1	3
CO2	3	0	0	0	0	2	2	3	0	0	1	1	1	3
CO3	3	0	0	0	0	2	1	0	0	0	2	1	1	3
CO4	3	1	0	0	1	1	1	0	0	0	1	2	1	3
CO5	3	0	0	0	1	1	3	0	0	0	2	2	1	3

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

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	CE552	**Title of the Course**	Research Methodology	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	3	1	0	4
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	To develop critical thinking and understand the concept of gap identification for research. To identify appropriate research methods for a specific research problem and prepare professional research report						

Course Outcomes	
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.
CO2	Develop student's understanding of sampling techniques for research.
CO3	Develop student's understanding of different data collection methods and their suitability.
CO4	Students will gain understanding of analyzing the quantitative data.
CO5	Students will gain understanding of analyzing the qualitative data and will learn how to write a professional research report.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Research and Problem Definition	Meaning, Objective and importance of research, Types of research, research process, Challenges in research, Philosophical worldviews in research.	08	CO1
2	Research Design	Research design, Methods of research design, Selection of a Research Design research process and steps involved, Literature Survey, Bibliometric analysis.	08	CO2
3	Data Collection	Sample Design, Sampling Methods, sampling errors, Classification of Data, Measurement and Scaling, Methods of Data Collection, data preparation.	08	CO3
4	Data Analysis and interpretation	Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.	08	CO4
5	Technical Writing and Reporting of Research	Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Mechanics of writing a report, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism, Oral Presentation.	08	CO5

Reference Books:

C. R. Kothari, Gaurav Garg, Research Methodology : Methods And Techniques, New Age International Publishers; Fourth edition (1 September 2019)

Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ge08/preview

	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	3	1	0	0	0	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
CO3	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0
CO4	3	3	2	3	3	0	0	0	0	0	0	0	0	0	0
CO5	3	3	0	0	0	0	0	3	0	3	0	0	0	0	0

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

Integral University, Lucknow

Effective from Session: 2021-22							
Course Code	CE553	**Title of the Course**	Statistics for Construction Managers	**L**	**T**	**P**	**C**
Year	I	**Semester**	II	0	0	3	2
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• 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	03	CO1
2	Descriptive statistics	Determination of frequency and plotting distribution curve	03	CO2
3	Descriptive statistics	Extracting descriptive statistics from the dataset	03	CO2
4	Descriptive statistics	Measuring the reliability of a dataset	03	CO2
5	Statistical Analysis	Comparing two population mean when variance is known on large sample using z-test	03	CO3
6	Statistical Analysis	Comparing two population mean on small sample using t-test with equal and unequal variance	03	CO3
7	Statistical Analysis	Determination of correlation and covariance in a dataset	03	CO3
8	Statistical Analysis	One way ANOVA test on three or more population for comparing mean	03	CO3

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