



SRI VENKATESWARA COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University, Chennai – 600025)

**M.E. CONSTRUCTION
ENGINEERING AND MANAGEMENT**

***CURRICULUM AND SYLLABUS
REGULATION – 2022
CHOICE BASED CREDIT SYSTEM***

**Chairman
Board of Studies
Faculty of Civil Engineering**

**Chairperson
Academic Council**

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REGULATIONS 2022
CHOICE BASED CREDIT SYSTEM

M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT
CURRICULUM & SYLLABUS FOR SEMESTERS I TO IV

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	MA22187	Statistical Methods for Engineers	BS	4	0	0	4	4	NIL	F
2.	CM22101	Modern Construction Materials	PC	3	0	0	3	3	NIL	F
3.	CM22102	Project Formulation and Appraisal	PC	3	1	0	4	4	NIL	F
4.	CM22103	Construction Equipment and Management	PC	3	0	0	3	3	NIL	F
5.	****	Professional Elective – I	PE	3	0	0	3	3	NIL	M
6.	****	Professional Elective – II	PE	3	0	0	3	3	NIL	M
Practical Courses										
7.	CM22111	Advanced Construction Engineering Laboratory	PC	0	0	2	1	2	NIL	F
8.	CM22112	Technical Seminar	EEC	0	0	2	1	2	NIL	F
Total				19	1	4	22	24		

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	CM22201	Advanced Construction Techniques	PC	3	0	0	3	3	NIL	F
2.	CM22202	Construction Planning Scheduling and Control	PC	3	0	0	3	3	NIL	F
3.	CM22203	Construction Economics and Financial Management	PC	3	0	0	3	3	NIL	F
4.	CM22204	Contract Laws and Regulations	PC	3	0	0	3	3	NIL	F
5.	****	Professional Elective – III	PE	3	0	0	3	3	NIL	M
6.	****	Professional Elective – IV	PE	3	0	0	3	3	NIL	M
7.	GR22251	Introduction to Research Methodology and IPR	MC	2	0	0	2	2	NIL	F
Practical Courses										
8.	CM22211	Construction Project Management Laboratory	PC	0	0	4	2	4	NIL	F
9	CM22212	Statistical Analysis Laboratory for Construction Engineers	PC	0	0	2	1	2	NIL	F
Total				20	0	6	23	26		

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	CM22309	Building Information Modelling: Theory and Practices	PC	3	0	2	4	5	NIL	F
2.	****	Professional Elective – V	PE	3	0	0	3	3	NIL	M
Practical Courses										
3.	CM22311	Practical Training (4 Weeks)	EEC	0	0	0	2	0	NIL	M
4.	CM22312	Project Work (Phase I)	EEC	0	0	12	6	12	NIL	F
Total				6	0	14	15	20		

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Practical Courses										
1.	CM22411	Project Work (Phase II)	EEC	0	0	24	12	24	NIL	F
Total				0	0	24	12	24		

Note: Practical Training of 4 weeks must be completed before the Third semester

LIST OF PROFESSIONAL ELECTIVES (PE) COURSES

PROFESSIONAL ELECTIVE – I

S.No.	Course Code	Course Title	Contact Periods	L	T	P	C
1.	CM22001	Advanced Concrete Technology	3	3	0	0	3
2.	CM22003	Construction Materials and Management	3	3	0	0	3
3.	CM22005	Construction Project Management	3	3	0	0	3
4.	CM22007	Design of Energy Efficient Buildings	3	3	0	0	3

PROFESSIONAL ELECTIVE – II

S.No.	Course Code	Course Title	Contact Periods	L	T	P	C
1.	CM22009	Formwork and Scaffolding Systems	3	3	0	0	3
2.	CM22011	Repair and Rehabilitation of Structures	3	3	0	0	3
3.	CM22013	Principles of Green Building Design	3	3	0	0	3
4.	CM22015	Construction Personnel Management	3	3	0	0	3

PROFESSIONAL ELECTIVE – III

S.No.	Course Code	Course Title	Contact Periods	L	T	P	C
1.	CM22017	Quantitative Techniques in Management	3	3	0	0	3
2.	CM22019	Resource Management and Control in Construction	3	3	0	0	3
3.	CM22002	Risk Management in Construction Projects	3	3	0	0	3
4.	CM22004	Project Safety Management	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV

S.No.	Course Code	Course Title	Contact Periods	L	T	P	C
1.	CM22006	Environmental Impact Assessment for Construction Projects	3	3	0	0	3
2.	CM22008	Integrated Building Service Management	3	3	0	0	3
3.	CM22010	Disaster Management	3	3	0	0	3
4.	CM22012	Lean Construction Practices	3	3	0	0	3

PROFESSIONAL ELECTIVE – V

S.No.	Course Code	Course Title	Contact Periods	L	T	P	C
1.	CM22014	Automation in Construction Industry	3	3	0	0	3
2.	CM22016	Quality Control and Assurance in Construction	3	3	0	0	3
3.	CM22018	Supply Chain Management and Logistics in Construction	3	3	0	0	3
4.	CM22020	Valuation of Real Properties	3	3	0	0	3



OBJECTIVES:

- This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis.

UNIT I ESTIMATION THEORY**12**

Estimators: Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS**12**

Sampling distributions - small and large samples - Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION**12**

Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order co-efficient.

UNIT IV DESIGN OF EXPERIMENTS**12**

Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design - 2² Factorial design.

UNIT V MULTIVARIATE ANALYSIS**12**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Demonstrate consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.	3
CO2	Use statistical tests in testing hypotheses on data.	3
CO3	Analyse the concept of linear regression, correlation, and its applications.	3
CO4	List the guidelines for designing experiments and recognize the key historical figures in the Design of Experiments.	3
CO5	Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan Chand and Sons, 2020.
2. Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, 8th Edition, Cengage Learning, 2014.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.
4. Johnson, R.A. and Wichern, D. W. “Applied Multivariate Statistical Analysis”, 6th Edition, Pearson Education, Asia, 2012.
5. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.



OBJECTIVES:

- To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non-weathering materials, and smart materials

UNIT I STRUCTURAL MATERIALS 9

Wood and Wood Product - Metals - Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminum and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.

UNIT II NON-STRUCTURAL MATERIALS, ACCESSORIES AND FINISHES 9

Introduction of Non-Structural Materials and Criteria for Selection - Types and properties of Water Proofing Materials – Types of Non-weathering Materials and its uses – Types of Polymer Floor Finishes - Paint - Tiles - Acoustic Treatment materials - Dry Walls - Anchors

UNIT III COMPOSITES 9

Types of Plastics – Polymer - Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements – Applications of FRP – Geosynthetics - Bituminous Materials - Glass - Environmental Concerns

UNIT IV SPECIAL CEMENT AND CEMENT CONCRETES 9

Acid resistant cements, expanding cements, Oil-well cement - Concretes - Behavior of concrete – Properties, Advantages, Applications of High Strength, High Performance Concrete, Fibre Reinforced Concrete, Self-compacting concrete, Geopolymer Concrete, light weight concrete – Ferrocement – Ready mix concrete - Bacterial Concrete - Concrete using recycled aggregate

UNIT V SMART AND INTELLIGENT MATERIALS 9

Types & Differences between Smart and Intelligent Materials – Special features – Nano Concrete – Nano Technology in Construction - Case studies showing the applications of smart & Intelligent Materials

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explain the various types of special concretes	3
CO2	Select the different processing of steel and applications of coating	3
CO3	Explain the manufacturing process and applications of polymer composites	3
CO4	Identify the different flooring materials and application of façade materials	3
CO5	Apply the knowledge of smart and intelligent materials in construction field	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Shetty M. S, Concrete Technology: Theory and Practice, S. Chand & Company Ltd., 2019
2. Ganapathy, C. “Modern Construction Materials”, Eswar Press, 2015.
3. N. Subramanian, “Building Materials Testing and Sustainability”, Oxford Higher Education, 2019.
4. Santhakumar. A.R. “Concrete Technology”, Oxford University press, New Delhi, 2006.
5. Ashby, M.F. and Jones D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.



OBJECTIVES:

- To study and understand the formulation, and costing of construction projects, appraisal, finance, and private sector participation.

UNIT I PROJECT FORMULATION 12

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-feasibility report and its clearance, Project estimates and techno-economic feasibility report, Detailed project report – Different project clearances required

UNIT II PROJECT COSTING 12

Project Cash Flows – Principles – Types – New Project and Replacement Project – Biases in Cash flow Estimation – Time Value of Money – Present Value – Future Value – Single amount – Annuity – Cost of Capital – Cost of Debt, Preference, Equity – Proportions - Cost of Capital Calculation – Financial Institutions Considerations

UNIT III PROJECT APPRAISAL 12

NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.

UNIT IV PROJECT FINANCING 12

Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios – financial cost-benefit analysis, social-cost benefit analysis.

UNIT V PRIVATE SECTOR PARTICIPATION 12

Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT- Technology Transfer and Foreign Collaboration - Scope of Technology Transfer

TOTAL: 60 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Prepare a detailed project report for the construction project	3
CO2	Analyze the cash flows for a construction project	3
CO3	Understand the different methods of project appraisal	3
CO4	Perform cost benefit analysis for construction projects	3
CO5	Explain the role of Private Sector Participation in Infrastructure Projects	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1995.
2. Raina V.K, “Construction Management Practice – The inside Story”, Tata McGraw Hill Publishing Limited, 2005
3. Joy P.K., Total Project Management - The Indian Context, New Delhi, Laxmi Publications Pvt. Ltd, First edition 2017.



OBJECTIVES:

- To study and understand the various types of equipment used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

UNIT I CONSTRUCTION EQUIPMENT SELECTION

9

Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis - Safety Management.

UNIT II EQUIPMENT FOR EARTHWORK

9

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders — Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III OTHER CONSTRUCTION EQUIPMENT

9

Equipment for Dredging and Trenching, tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

UNIT IV ASPHALT AND CONCRETING EQUIPMENT

9

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT V MATERIALS HANDLING EQUIPMENT

9

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes - Industrial Trucks

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Develop knowledge on the planning of equipment and selection of equipment	3
CO2	Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment	3
CO3	Develop the knowledge on special construction equipment	3
CO4	Apply the knowledge on asphalt and concrete plants	3
CO5	Apply the knowledge and select the proper materials handling equipment	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Peurifoy, R.L., Schexnayder, C. and Aviad Shapira., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2010.
2. Granberg G.,Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 2001.
4. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 2010.
5. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2019



OBJECTIVE:

To provide a thorough knowledge of material selection through the material testing based on specification.

LIST OF EXPERIMENTS

1. Mix design as per IS for high-strength concrete and High-performance concrete.
2. Flow Characteristics of Self Compacting concrete (U Box, V funnel, J ring, L Box)
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength, and durability.
4. NDT on hardened concrete – Rebound hammer
5. Permeability test on hardened concrete
6. Rapid Chloride Permeability Test (RCPT)
7. Impact resistance of plain and fibre reinforced concrete – drop hammer test.

TOTAL: 30 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Prepare the mix design for the high strength concrete	3
CO2	Analyse the flow characteristics of self-compacting concrete.	3
CO3	Perform the testing of fresh and hardened state of concrete sample.	3
CO4	Perform NDT test on concrete	3
CO5	Perform durability test on concrete	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To work on a specific technical topic in Construction Engineering and Management in order to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

SYLLABUS: The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to construction engineering and management and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Identify latest developments in the field of Construction Engineering	3
CO2	Identify latest developments in the field of Construction Management	3
CO3	Presentation Skills and ability to answer the queries during Interaction	3
CO4	Acquire technical writing abilities for seminars, conferences and journal publications	3
CO5	Use modern tools to present the technical details	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures.
- To gain the knowledge about the rehabilitation and strengthening techniques.
- To learn about the various demolition techniques.

UNIT I SUB STRUCTURE CONSTRUCTION**9**

Box jacking - Pipe jacking - Underwater construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking coffer dam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Shoring for deep cutting - well points - Dewatering for underground open excavation.

UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS**9**

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, large span structures – launching techniques for heavy decks, Post tensioning of slab - Aerial transporting – Handling and erecting lightweight components on tall structures.

UNIT III CONSTRUCTION OF SPECIAL STRUCTURES**9**

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, and sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Erection of articulated structures and space decks.

UNIT IV REHABILITATION AND STRENGTHENING TECHNIQUES**9**

Seismic retrofitting - Strengthening of beams, columns, slab and masonry wall - Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening - Sub grade water proofing, Soil Stabilization techniques.

UNIT V DEMOLITION**9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Classify the modern construction techniques used in the sub structure construction.	3
CO2	Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings	3
CO3	Summarize the concepts used in the construction of special structures	3

CO4	Distinguish Various strengthening and repair methods for different cases.	3
CO5	Identify the suitable demolition technique for demolishing a building.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications,2000.
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El - Reedy, 2020.Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Peter H. Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt.Ltd., 2001.Press, 2008.
4. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.



OBJECTIVES:

- To study and understand the concept of planning.
- To impart concepts in Network representation and analysis.
- To impart concepts in Precedence Network analysis.
- To impart concepts in resource scheduling.
- To learn Concepts in project monitoring and controlling

UNIT I CONSTRUCTION PROJECT PERSPECTIVES 9

Basic concepts in the development of construction plans – Choice of technology and construction method – Defining work tasks and Work breakdown structure – Defining Precedence Relationships among Activities – Estimating activity durations – Estimating Resource Requirements for Work Activities – Coding Systems - Planning Project Schedule and Budget.

UNIT II CONSTRUCTION PLANNING 9

Construction planning – Objectives, Principles and Types – Choice of Technology and Construction Method – Defining Work Tasks - Work Breakdown Structure – Defining Precedence Relationships among Activities – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Coding Systems.

UNIT III NETWORK REPRESENTATION AND ANALYSIS 9

Elements of Network - Critical Path Method – PERT network analysis - Construction Schedules – Scheduling Calculations - Float – Slack - AOA and AON diagrams - Scheduling for Activity-on-Arrow and with Leads, Lags, and Windows - Scheduling with Resource Constraints

UNIT IV SCHEDULING TECHNIQUES 9

Types of Project Scheduling – Introduction to Precedence Diagramming Method (PDM) - PDM network representation – Crashing and Time/Cost Trade-offs - Case Illustrations – Computer applications in scheduling, Monitoring, Reporting – Resource Allocation – Leveling

UNIT V PROJECT MONITORING AND CONTROLLING 9

The Cost Control Approach – Objectives – Activity Cost Control – Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows – S-Curve - Performance Control using Earned Value Management Concepts – Schedule and Cost Variance - Project Progress Control

TOTAL: 45 PERIODS

COURSE OUTCOMES:

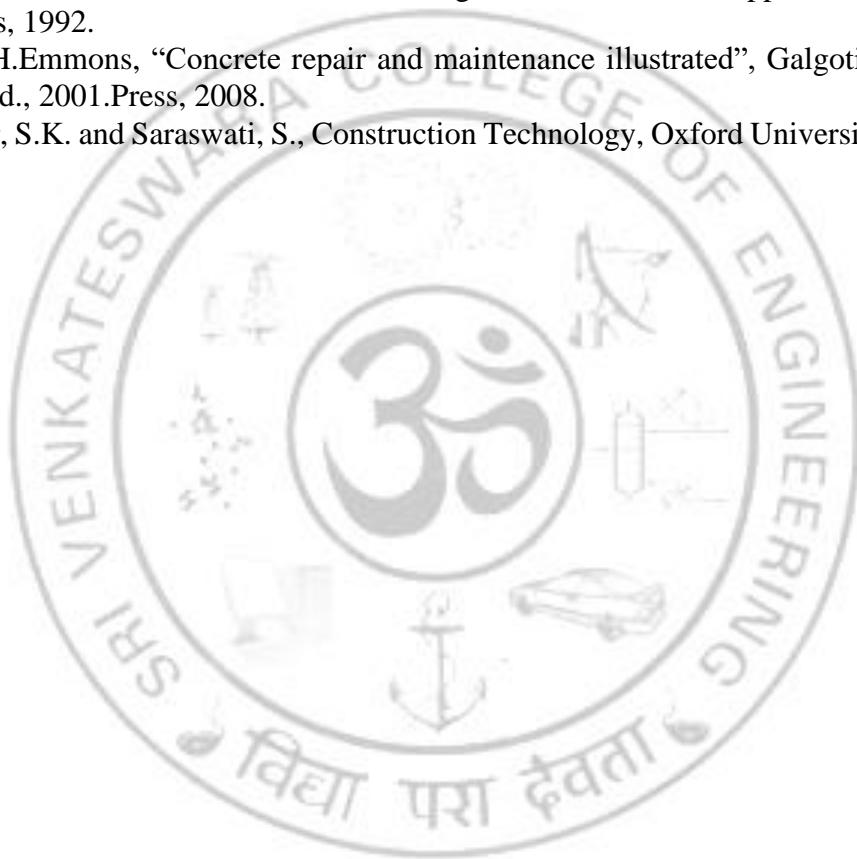
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Understand the scope of project life cycle and apply the general principles of project management	3
CO2	Identify the work task and create an appropriate work breakdown structure for a construction project.	3

CO3	Schedule the construction activities using network diagrams	3
CO4	Select an appropriate scheduling technique to manage time and cost effectively.	3
CO5	Evaluate the project performance using earned value management approach	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications,2000.
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy,2020
3. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
4. Peter H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.



OBJECTIVE:

- To introduce the various aspects of construction economics and finance with the systematic evaluation of cost and benefit associated with different projects.

UNIT I MANAGERIAL ECONOMICS 9

Economics: Concepts and Importances - Managerial Economics - Engineering Economics - Support Matters of Economy related to Engineering - Market demand and supply - Economic law of production - Choice of Technology - Role of Civil Engineering in Industrial Development.

UNIT II CONSTRUCTION ECONOMICS 9

Construction development in Housing, transport, energy and other infrastructures - Economics of ecology, environment, energy resources - Local material selection - Form and functional designs - Construction workers - Construction economics with respect to Urban Problems, Poverty, Migration, Unemployment, Pollution

UNIT III FINANCING 9

The need for financial management - Types of financing - Source of Finance: Financing instruments- Short term borrowing - Long term borrowing - Leasing - Equity financing - Internal and External generation of funds - Assistance from government budgeting support and international finance corporations - Loans to Contractors - Security and risk aspects.

UNIT IV ANALYSIS OF FINANCIAL STATEMENTS 9

Balance Sheet - Profit and Loss account - Cash flow and Fund flow analysis - Ratio analysis - Investment and financing decision - Financial Control - Centralized management

UNIT V ACCOUNTING METHOD 9

Accounting - Cash basis of accounting - Accrual basis of accounting - Percentage completion method - Completed contract method - Accounting for tax reporting purposes and financial reporting purposes - Accounting Standards- Audit - Quality Control.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Understand the concepts of Managerial Economics	3
CO2	Interpret the relationship between the Economic concepts with Construction Economics	3
CO3	Govern the financial system of an organization.	3
CO4	Perform the Financial Statement for a firm	3
CO5	Enumerate the auditing and accounting process	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000
2. Shrivastava, U.K., Construction Planning and Management, 2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi., 2001.
3. Blank, L.T., and Tarquin, A.J Engineering Economy, 4th Edn. Mc-Graw Hill Book Co., 1988
4. Collier C and GlaGola C, Engineering Economics & Cost Analysis, 3rd Edn. Addison Wesley Education Publishers., 1998.
5. Steiner, H.M. Engineering Economic principles, 2nd Edn. McGraw Hill Book, 1996



OBJECTIVES:

- To study the various types of construction contract and their legal aspects and provisions.
- To learn concepts in Tenders.
- To learn concepts in Arbitration and legal requirements
- To study the concepts in labour regulations.

UNIT I CONSTRUCTION CONTRACTS 9

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

UNIT II TENDERS 9

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamil Nadu Transparency in Tenders Act.

UNIT III ARBITRATION 9

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

UNIT IV LEGAL REQUIREMENTS 9

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

UNIT V LABOUR REGULATIONS 9

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Design the construction contracts	3
CO2	Develop a skill for the tendering process.	3
CO3	Explain the duties of the arbitrator.	3
CO4	Develop an idea on the various legal requirements to be met in relation to land and construction.	3

CO5	Identify and apply the provisions provided in the labour welfare schemes.	3
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1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, 2000.
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 3rd Edition, 2013.
3. Ali D. Haidar, Handbook of Contract Management in Construction, Springer Cham, 1st Edition, 2021
4. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 4th Edition 2015.
5. Dharmendra Rautray, Principles of Law of Arbitration in India, Wolters Kluwer, 2018.



OBJECTIVES:

- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.

UNIT I RESEARCH METHODOLOGY 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT II RESULTS AND ANALYSIS 9

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective) and cross verification, correlation with published results, discussion, outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III TECHNICAL WRITING 9

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IIT.

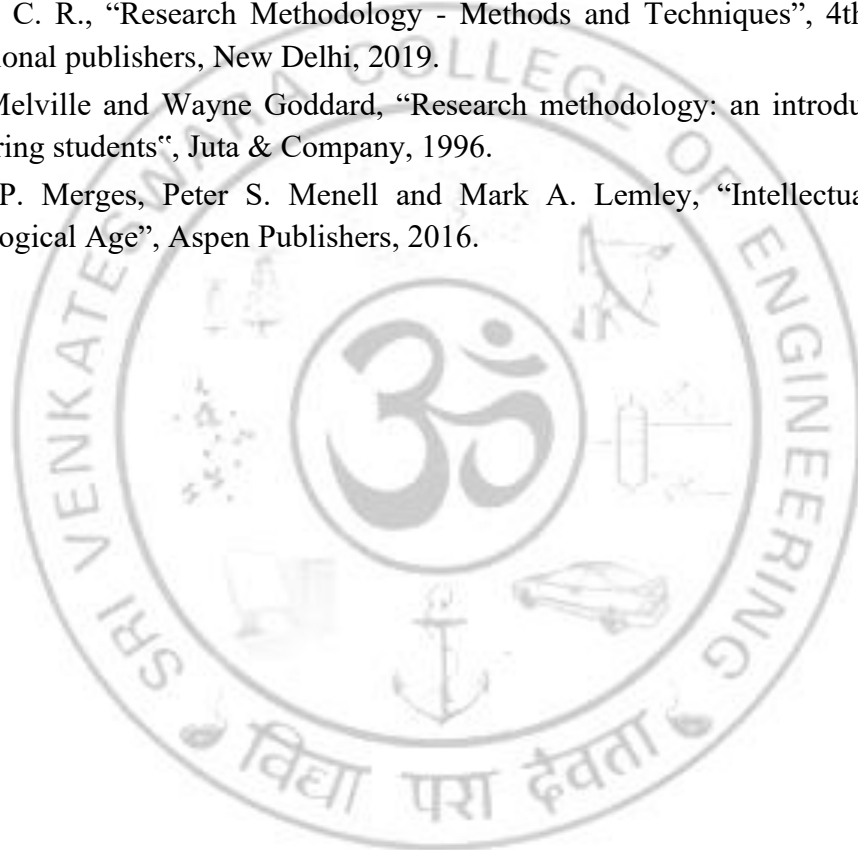
TOTAL: 30 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
CO1	Upon successful completion of the course, the students should be able to Critically evaluate any research article based upon research methodology.	5
CO2	Correlate the results of any research and develop hypothesis, concept, theory and model.	4

CO3	Developing a research proposal, research presentation and review article in the field of engineering.	3
CO4	Enumerate the importance of intellectual property right in research	4
CO5	Develop proposal for patent rights and identify the new developments in IPR.	4

REFERENCES:

1. Ranjit Kumar, "Research Methodology- A step by step guide for beginners", 4th edition, Pearson Education, Australia, 2014
2. Ann M. Korner, "Guide to Publishing a Scientific paper", Bioscript Press, 2008.
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
4. Kothari, C. R., "Research Methodology - Methods and Techniques", 4th Edition, New Age International publishers, New Delhi, 2019.
5. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta & Company, 1996.
6. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.



OBJECTIVES:

- To train the students in utilizing the sophisticated spreadsheets programs,
- To train the students to handle estimation software.
- To train the students to handle the Project management software.

LIST OF EXPERIMENTS

1. Drafting of plan, elevation and section of a residential building.
2. Preparation of detailed and abstract estimate.
3. Estimation of small construction project using CostX software.
4. Planning and Scheduling of a small construction project using Primavera software including reports and tracking.
5. Preparation of project progress reports.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Draft a plan for a construction project	3
CO2	Prepare detailed and abstract estimate of the construction project using software tool	3
CO3	Create work breakdown structure for the construction project	3
CO4	Track the activities and schedule a construction project using software tool	3
CO5	Prepare project progress reports and perform variance analysis.	3

1- Remember, 2- Understand, 3-Apply, 4- Analyse, 5-Evaluate, 6-Create

CM22212

**STATISTICAL ANALYSIS LABORATORY
FOR CONSTRUCTION ENGINEERS**

**L T P C
0 0 2 1**

OBJECTIVES:

- To provide hands on training in data analytical tools.

LIST OF EXPERIMENTS:

1. Descriptive Statistics: Types of data, frequency distribution, Applications (Charts, Graphs etc.)
2. Tests to find frequency and percentage of levels of dataset.
3. Inferential analysis - t- test for single mean, t -test for independent samples, ANOVA.
4. Simple regression and multiple regression.
5. Design of a simple equipment information system for a construction project.
6. Simulation models for project risk analysis.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
CO1	Upon successful completion of the course, the students should be able to Formulate descriptive statistics with charts and graphs using spreadsheet softwares and interpretation of results	3
CO2	Analyse construction management field data using Statistical tools.	3
CO3	Solve Linear Programming Problems and transportation problems by appropriate techniques and evaluate the behaviour under different range of parameters	3
CO4	Perform network analysis and decision making in project management	3
CO5	Solve Construction management problems using decision making tool.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To introduce the fundamental concepts of BIM and creation of BIM model using computer software.

UNIT I BIM: SCOPE AND DEFINITION 9

Introduction – Building Information Modelling (BIM) – Why BIM is important? – Common misunderstandings – Information models – Federated approach – Technology behind BIM – BIM Process – BIM Maturity levels – Benefits and Challenges.

UNIT II FUNDAMENTALS OF BIM 9

Level of Development (LOD) – BIM Dimensions – 3D, 4D, 5D etc., BIM uses in the construction phase - Quantity Take-off, Phase planning, 3D Coordination and Clash detection, Digital layout - BIM and procurement - BIM Coordinator

UNIT III BIM IMPLEMENTATION 9

Types of projects and BIM implementation – BIM Strategy - BIM and project life cycle - Information Delivery Plan - Types and progression of models – BIM Execution Plan (BEP) - Collaboration and coordination using BIM - Asset management using BIM – BIM Implementation checklist

UNIT IV IMPLICATIONS OF BIM 9

Contractual arrangements and related legal issues - Information sharing and collaboration using BIM - Changes in workflow - Inter-organizational aspects of BIM - Implications of BIM on practice - Role of BIM management – Case studies

UNIT V BIM FOR THE CONSTRUCTION INDUSTRY 9

Types of construction firms - Information required from BIM - Development of contractor BIM Model – Clash detection – Quantity Takeoff and Cost estimation - construction analysis and planning – 4D & 5D Modelling using BIM tool - tracking of construction activities

TOTAL: 75 PERIODS
(45 T + 30 P)

PRACTICAL SESSION: 30 PERIODS

- Create a BIM model using computer software.
- Perform Clash detection
- Tracking status and updating
- Quantity Takeoff and cost estimation
- 4D and 5D Modelling

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Summarise BIM scope and definition	3
CO2	Understand the fundamentals of BIM	3
CO3	Analyse how BIM can be implemented in construction projects	3
CO4	Understand the implications of BIM	3
CO5	Perform construction planning and scheduling using BIM tool	3

1-Remember, 2-Understand, 3-Apply, 4-Analyse, 5-Evaluate, 6-Create

REFERENCES:

1. BIM Handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors (second edition) by Chuck Eastman, Paul Teicholz, Rafael Sacks, and Kathleen Liston, second edition, ISBN-13: 978-0470541371 ISBN-10: 0470541377
2. Brad Hardin, BIM and Construction Management - Proven Tools, Methods, and Workflows, John Wiley & Sons, second edition, 2015
3. International BIM implementation guide, Royal Institution of Chartered Surveyors (RICS), 2014.
4. Willem Kymmell, Building Information Modelling, McGraw-Hill Construction, New York, 2008
5. BS 1192:2007, A2:2016 Collaborative production of architectural, engineering and construction information. Code of practice
6. PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling.
7. AEC (UK) BIM Technology Protocol Practical implementation of BIM for the UK Architectural, Engineering and Construction (AEC) industry.

EVALUATION SCHEME:

FA 1 – Theory

FA 2 – Theory

FA 3 – Practical

Summative Assessment – Theory – 60% and Practical – 40%

Observation and Records will be maintained for Practical Sessions

CM22311

PRACTICAL TRAINING (4 Weeks)

L T P C

0 0 0 2

OBJECTIVES:

To train the students in the fieldwork so as to have firsthand knowledge of practical problems related to Construction Management in carrying out engineering tasks

SYLLABUS: The students individually undertake training in reputed engineering companies doing construction during the summer vacation for a specified duration of four weeks. At the end of the training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
CO1	Upon successful completion of the course, the students should be able to Describe the scope and challenges involved in construction projects	3
CO2	Realize the various functions of construction activities	3
CO3	Develop skills in facing and solving the problems experiencing in the Construction Management field	3
CO4	Prepare a comprehensive technical report	3
CO5	Presentation of work carried out in Practical Training	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 90 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Apply the knowledge gained from theoretical and practical courses in solving problems.	3
CO2	Summarize the importance of literature review.	3
CO3	Identify the problem	3
CO4	Solve the identified problem based on the formulated methodology	3
CO5	Interpret and present the findings of the work conducted.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze the research problem.
- To develop skills to discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Discover the potential research areas.	3
CO2	Apply the knowledge gained from theoretical and practical courses to be creative, well planned, organized and coordinated.	3
CO3	Identify the problem.	3
CO4	Solve the identified problem based on the formulated methodology	3
CO5	Interpret and present the findings of the work conducted	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

OBJECTIVES:

- To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS

9

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, testing of aggregates - Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements - Water - Chemical admixtures, Mineral admixture.

UNIT II MIX DESIGN

9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method – Mix design for special concretes - changes in Mix design for special materials.

UNIT III CONCRETING METHODS

9

Process of manufacturing of concrete, methods of transportation, placing and curing, cracking, plastic shrinkage, Extreme weather concreting, special concreting methods - Vacuum dewatering – Underwater Concrete

UNIT IV SPECIAL CONCRETES

9

Light weight concrete Fly ash concrete, Fiber reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self- Compacting Concrete, Geo Polymer Concrete, Waste material-based concrete – Ready mixed concrete.

UNIT V TESTS ON CONCRETE

9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage Durability of concrete. Non-destructive Testing Techniques - microstructure of concrete

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Develop knowledge on various materials needed for concrete manufacture	3
CO2	Apply the rules to do mix designs for concrete by various methods	3
CO3	Develop the methods of manufacturing of concrete.	3
CO4	Explain about various special concrete	3
CO5	Explain various tests on fresh and hardened concrete	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2017.
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2019.
3. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London. Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015



OBJECTIVES:

- To study the various management techniques for successful completion of construction projects.

UNIT I CONSTRUCTION MATERIALS 9

Classification of construction materials – Cement, Sand, Aggregates, Steel, Aluminum, Glass, Bricks, Construction chemicals and admixtures, Water proofing materials and other Miscellaneous materials – Properties, applications, storage and handling

UNIT II MATERIAL MANAGEMENT 9

Introduction to Material Management and its role in construction industry – Functions - Scope and Importance in construction projects, Objectives of material management – Role of materials manager - Factors affecting material management in construction projects – Types of material costs – Direct and Indirect – Material schedule

UNIT III CLASSIFICATION AND CODIFICATION OF CONSTRUCTION MATERIALS 9

ABC, FSN, VED analysis - Procedure and its use, Standardization in materials and their management, Procurement, identification of sources of procurement, vendor analysis - Vendor analysis concept - Material requirement planning (MRP), planning, purchase procedure, legal aspects

UNIT IV INVENTORY MANAGEMENT 9

Need for Inventory – Inventory turnover ratio – Inventory related cost – functions of inventory – Inventory Model – EOQ Model – Factors affecting EOQ, Inventory Planning Process – Planning inventory of repetitive and non-repetitive materials – Lead time, safety stock, working stock – concept of (JIT) - Just in time management – Material Provisioning process

UNIT V STORE MANAGEMENT 9

Store Management - Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, Materials Wastage standard – Quality control on construction materials - Check list

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

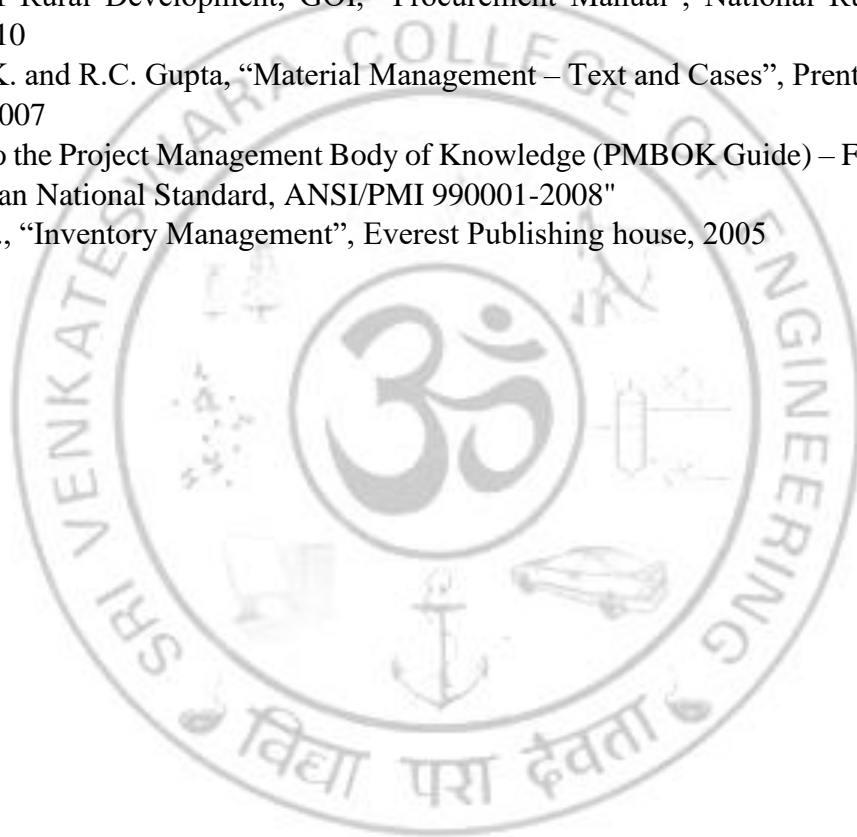
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Understand the properties, applications, storage and handling of different construction materials	3
CO2	Identify the needs and functions of material management	3
CO3	Classify materials, identify sources of procurement and conduct vendor analysis	3
CO4	Perform effective inventory management in construction projects	3

CO5	Manage stores and exercise quality control on materials	3
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1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Kumar Neeraj Jha, Construction Project Management – Theory and Practice, Pearson Publications – Dorling Kindersley (India) Pvt. Ltd
2. Chitkara.K.K, (2014), Construction Project Management, 3rd Edition, McGraw-Hill Publishing Company, New Delhi.
3. Mamlouk. M.S. and Zaniewski. J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 2000.
4. Menon K.S., “Purchasing and Inventory Control”, Wheeler Publication, 1993
5. Ministry of Rural Development, GOI, “Procurement Manual”, National Rural Livelihoods Project, 2010
6. Chitale A.K. and R.C. Gupta, “Material Management – Text and Cases”, Prentice Hall of India Pvt. Ltd., 2007
7. "A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fourth Edition, An American National Standard, ANSI/PMI 990001-2008"
8. Jhamb L.C., “Inventory Management”, Everest Publishing house, 2005



OBJECTIVES:

- To study the various management techniques for successful completion of construction projects.

UNIT I FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT 9

Introduction of construction Project Management – Construction Scope – Construction Project Characteristics – Types of Construction Project - Project development and Life Cycle – Construction Project Management Practice - Roles and Functions and Responsibility of Construction Managers and Major causes of Project failure.

UNIT II PLANNING AND ORGANIZING CONSTRUCTION PROJECT 9

Construction Project organization – Planning Project work Scope and integration Processes - Defining Project Activities - Scheduling Project - CPM, PERT, Precedence Network Analysis – Planning and organizing project resources such as manpower, material, equipment, Time and cost for construction site.

UNIT III DESIGN AND CONSTRUCTION PROCESS 9

Design and Construction as an Integrated System — Innovation, Economic and Technological Feasibility - Design Methodology - Functional Design - Construction Site Environment - Case Studies - Project Clearance requirement, Procedure and Necessary Documentation for Major Works Like Dams, Multistoried Structures, Tunnels.

UNIT IV PROJECT RESOURCES UTILIZATION 9

Labour Productivity - Factors Affecting Job-Site Productivity - Labour Estimation, Allocation and Control - Materials Estimation - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management - Construction Equipment - Choice of Equipment and Standard Production Rates - Estimation of Equipment Requirement

UNIT V PROJECT MONITORING AND CONTROL 9

Project Progress Control – Updating of Project Progress using Bar Chart, Precedence Network - Progress Reports – Monthly Progress Report – Measuring Progress at Site – Typical Reports to aid Progress Review – Stage-wise Completion Cost – EVM – Profit/Loss at Completion – Disputes and Claims – Project Closure – Construction Closure – Contract Closure – Project Managers Closure.

UNIT V PROJECT INFORMATION 9

Types of Project Information - Accuracy and Use of Information - Computerized Organization and Use of Information - Other Conceptual Models of Databases - Centralized - Database Management Systems - Databases and Applications Programs –Information - Transfer and Flow

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

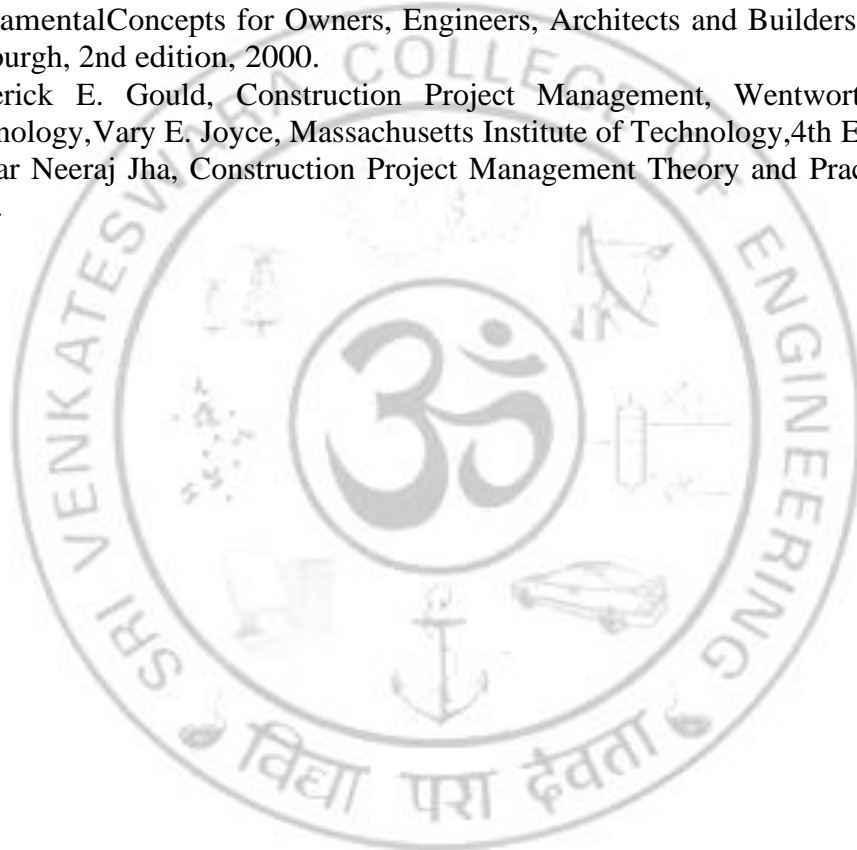
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explain the different phases of project.	3
CO2	Apply the scheduling techniques for planning construction project.	3

CO3	Develop the ability to integrate design and construction Process	3
CO4	Prepare the progress reports and control the cost using Earned value management approach.	3
CO5	Illustrate the project information using different types of database model.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 3rd Edition, 2014.
2. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 2017. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2nd edition, 2000.
3. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 4th Edition, 2013.
4. Kumar Neeraj Jha, Construction Project Management Theory and Practices, Pearson, 2012.



OBJECTIVES:

- To study the concept of energy consumption in buildings and design an energy efficient building

UNIT I INTRODUCTION**9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – Greenhouse Effect – Convection – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Types of Shading Devices.

UNIT II PASSIVE SOLAR HEATING AND COOLING**9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Courtyards – Roof Ponds – Window Ventilation Calculations – Room Organization Strategies - Evaporation and dehumidification.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING**9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Day lighting – Sources and concepts – Building Design Strategies – Case Studies – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings

UNIT IV HEAT CONTROL AND VENTILATION**9**

Hourly Solar radiation – Heat insulation – Terminology – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings - Ventilation – Requirements – Minimum standards for ventilation - Energy Conservation in Ventilating systems – Design for Natural Ventilation

UNIT IV DESIGN FOR CLIMATIC ZONES**9**

Energy efficiency – An Overview of Design Concepts – Embodied Energy – Low Embodied Energy Materials – Design of energy efficient buildings for various zones – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences and office buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

COURSE OUTCOMES:

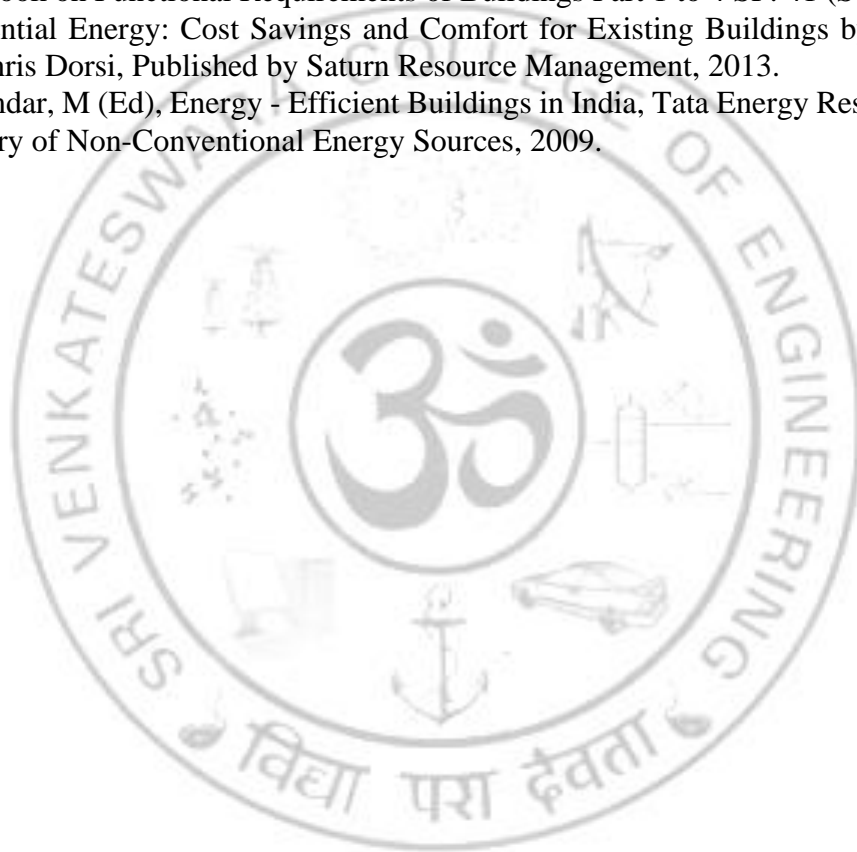
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explain environmental energy supplies on buildings	3
CO2	Explain the passive solar heating, cooling system	3

CO3	Discuss the various aspects of day-lighting and electrical lighting in a building	3
CO4	Predict and design building ventilation and heat control for indoor comfort	3
CO5	Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2018.
2. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 3rd Edition, 2014.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T) 1995
4. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
5. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.



OBJECTIVE:

- To study and understand the various types of formworks, scaffolding and shoring methods and techniques

UNIT I FORMWORK MATERIALS AND ACCESSORIES 9

Introduction – Formwork as a temporary structure - Materials used for formwork, Requirements of good formwork – Economy in formwork – Timber, Plywood, Steel, Aluminium and Accessories - Horizontal and Vertical Formwork Supports - Types - Flying Formwork, Table Form, Tunnel Form, Formwork for Precast Concrete

UNIT II PLANNING AND DESIGN OF FORMWORK 9

Introduction - Forms for foundations, columns, beams, walls, slabs - Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls – Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each

UNIT III FORMS FOR DOMES, TUNNELS AND SLIP FORMS 9

Formwork for domes - Hemispherical, Parabolic, Translational shells - Typical barrel vaults - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction, Slip Forms – Principles - Types - advantages - Functions of various components - Planning - Safety in slip forms

UNIT IV SCAFFOLDING SYSTEM 9

Types of scaffolds - Putlog and independent scaffold - Single pole scaffolds – Truss suspended - Gantry and system scaffolds – timber scaffolds, metal scaffolds and some proprietary scaffolds - Advantages and Limitations - possible causes for collapse of scaffold systems.

UNIT V SHORING SYSTEM 9

Shoring – Definition, Objectives – Materials used in the shoring system – Installation and Dismantling of shoring system – General requirements - Different types of shoring methods - Raking, flying and dead shores - Shoring System for deep excavation

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Select suitable materials and accessories for formwork connection	3
CO2	Develop a suitable planning and design of formwork system	3
CO3	Apply the knowledge of forms and their erection for domes, tunnels and slip forms	3
CO4	Identify appropriate scaffolding system for construction project.	3
CO5	Identify appropriate shoring system for construction project.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
2. Hurd, M.K., Formwork for Concrete, Seventh Edition, American Concrete Institute, Detroit, 2016
3. Michael P. Hurst, Construction Press, London and New York, 2003.
4. Robert L. Peurifoy and Garold D. Oberlender, Formwork for Concrete Structures, McGraw - Hill, 2010.
5. Kumar Neeraj Jha, Formwork for Concrete Structures, 2017
6. Tudor Dinescu and Constantin Radulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.



OBJECTIVE:

- To understand and formulate the repair and rehabilitation strategies for the RCC Structures.

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures - Service life behaviour - importance of Maintenance, causes and effects of deterioration - Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength, Durability and Microstructure of concrete – NDT techniques – Cracks - different types, causes – Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials - Various repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes - Polymer Concrete and Grouting materials - Bonding agents - Latex emulsions, Epoxy bonding agents, Protective coatings - Protective coatings for Concrete and Steel, FRP sheets

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9

Concrete protection methods – reinforcement protection methods- cathodic protection - Sacrificial anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings - Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring.

UNIT V REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Repair to active cracks, Repair to dormant cracks, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements - Demolition Techniques - Case studies

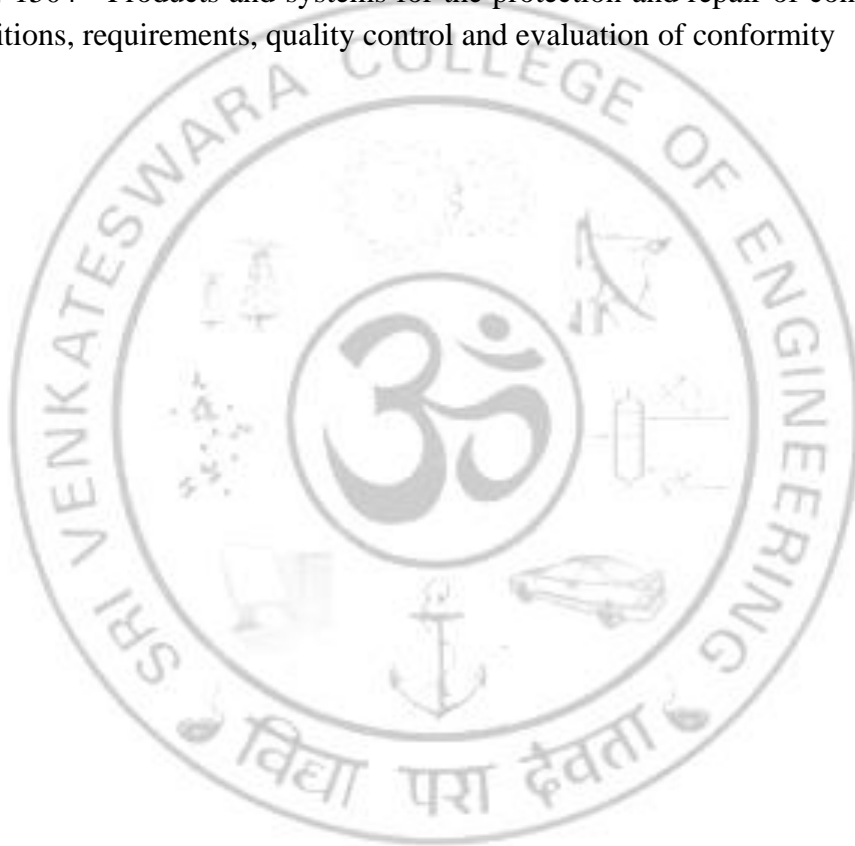
TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explain the importance of maintenance assessment and repair strategies	3
CO2	Acquire knowledge of strength and durability properties and their effects due to climate and temperature.	3
CO3	Understand the recent developments in repair techniques	3
CO4	Explain the techniques for repair and protection methods	3
CO5	Explain the repair, rehabilitation and retrofitting of structures and demolition methods.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann,Elsevier, New Delhi 2012
2. Dov Kominetzky.M.S., - Design and Construction Failures, Galgotia Publications Pvt.Ltd.,2001
3. Ravishankar.K., Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitationof Concrete Structures, Allied Publishers, 2004.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
5. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD, Govt of India, New Delhi – 2002
6. BS EN 1504 - Products and systems for the protection and repair of concrete structures -Definitions, requirements, quality control and evaluation of conformity



OBJECTIVE:

- To impart knowledge on the principle and design of green buildings considering all energy saving concepts.

BASICS OF GREEN BUILDING AND ASSESSMENT**UNIT I METHODS****9**

Introduction of green building, Concept of green building, History of green building, Need of green building in present scenario, Importance of green building Merits and demerits, Classification of green building, Assessment methods Global assessment and certification, Local assessment, LEED India GRIHA (Green Rating for Integrated Habitat Assessment)

UNIT II PRINCIPLES AND ELEMENTS OF DESIGN OF GREEN BUILDING**9**

Principles and elements of design of green building; Sustainability: concept and reality - Climate responsive process of design: Climatic zones, design sequence, shelter or form, land form, vegetation, water bodies, street widths, open spaces, ground character, plan form, orientation, roof form Shading devices and their effect

UNIT III THERMAL PERFORMANCE OF BUILDING SECTIONS**9**

Thermal comfort inside the building: Factors affecting, indices, cooling and heating requirement, Heat transmission through building sections, thermal performance of building sections, simple calculation for U value and insulation thickness, Day lighting and Ventilation

UNIT IV WATER CONSERVATION AND OTHER GREEN BUILDING ASPECTS**9**

Water conservation: 3 R's for water conservation, rain water harvesting, low flow fixtures, grey water recycling Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials - Concept of carbon emission and its reduction.

UNIT V BUREAU OF ENERGY EFFICIENCY**9**

Bureau of energy efficiency: Functions, policies, guidelines, Energy Conservation Building Code, Study of existing green buildings - Introduction to energy efficiency softwares, carbon calculators

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

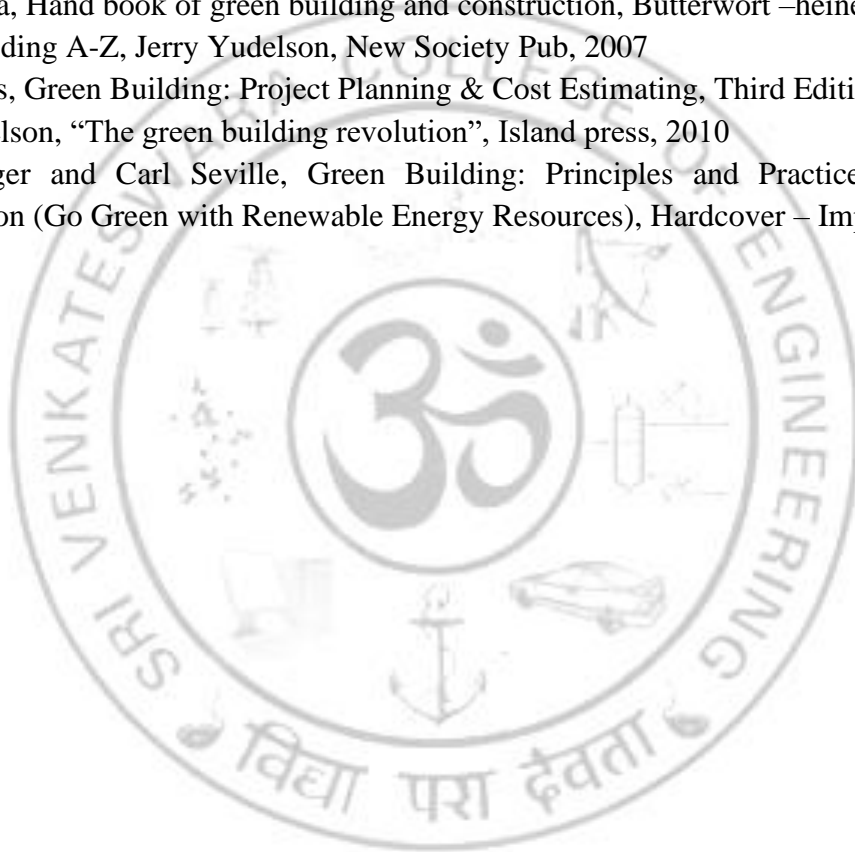
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Summarise the basics of green buildings and the assessment methods.	3
CO2	Enumerate the principles and elements of design of green buildings.	3
CO3	Describe about the thermal performance of building sections, lighting and ventilation in buildings.	3

CO4	Describe the water conservation techniques and sustainable materials.	3
CO5	Enumerate the guidelines of the energy conservation building code, model tools used to calculate energy efficiency.	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Dr. Dinesh Kumar Gupta, Vaibhao K. Sonarkar, Energy Conservation and Building, Nirali Prakashan publishers 2019.
2. Abe Kruger and Carl Seville, "Green building: principles and practices in residential construction", Cengage learning, 2012.
3. Sam Kubba, Hand book of green building and construction, Butterworth –heineman, 2012
4. Green Building A-Z, Jerry Yudelson, New Society Pub, 2007
5. R.S. Means, Green Building: Project Planning & Cost Estimating, Third Edition, 2010
6. Jerry Yudelson, "The green building revolution", Island press, 2010
7. Abe Kruger and Carl Seville, Green Building: Principles and Practices in Residential Construction (Go Green with Renewable Energy Resources), Hardcover – Import, 2012



OBJECTIVE:

- To understand the various aspects of manpower management and to help the student further develop their management, team building and leadership skills so as to increase their effectiveness in their job performance on international projects

UNIT I MANPOWER PLANNING**9**

Manpower planning and forecasting – Recruitment, selection process-Sources- Induction - Orientation and Training -Manpower Planning process - Organising, Staffing, directing, and controlling — Factors influencing supply and demand of human resources – Role of HR manager – Personnel Principles.

UNIT II ORGANISATION**9**

Elements of an organisation- Management process in organisations - Planning- Organising - Staffing - Directing - Controlling – Delegation of authority – responsibility – accountability – lines and staff organisation Workforce diversity- international dimensions of Organisation - Organisational structure- determinants of organisational design

UNIT III HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR**9**

Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership - Engineer as Manager – aspects of decision making – Significance of human relation and organizational – Individual in organization – Motivation – Personality and creativity – Group dynamics, Team working – Communication and negotiation skills.

UNIT IV WELFARE MEASURES**9**

Establishing Pay plans - Basics of compensation - factors determining pay rate - Current trends in compensation - Job evaluation – Incentives - Practices in Indian organisations - Statutory benefits - non-statutory (voluntary) benefits - Insurance benefits - retirement benefits and other welfare measures to build employee commitment – Laws related to welfare measures.

UNIT V MANAGEMENT AND DEVELOPMENT METHODS**9**

Management Development - On-the-job and off-the-job - Performance appraisal in practice. Managing careers: Career planning and development – Developing policies, practices and establishing process pattern – Competency upgradation and their assessment – New methods of training and development – Performance Management.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

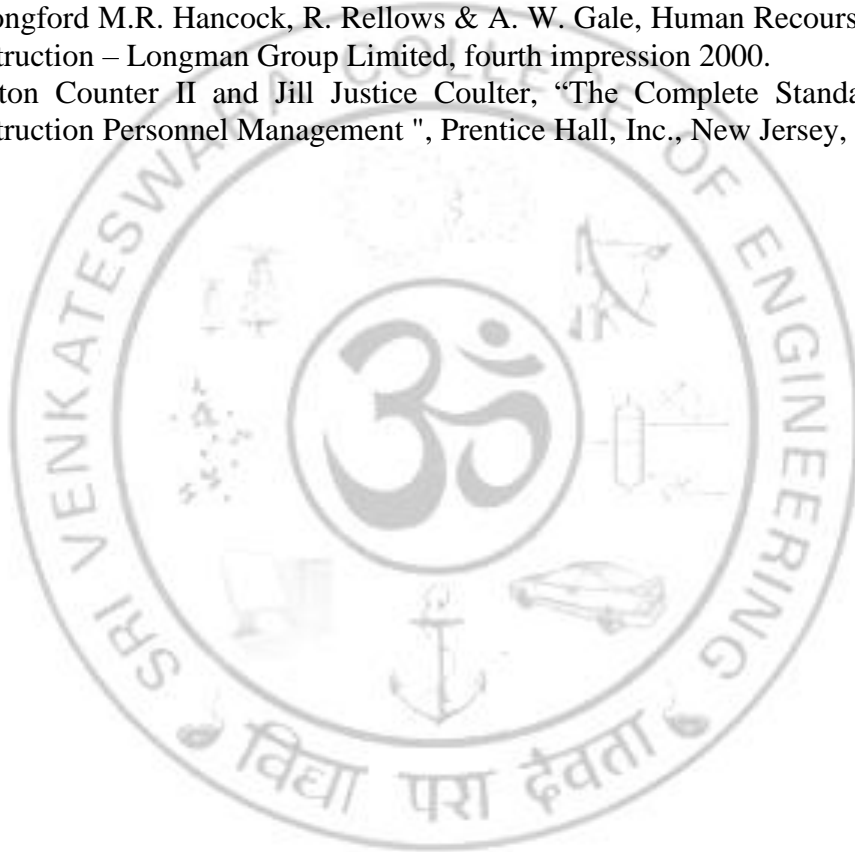
CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Demonstrate practices and techniques for evaluating performance, structuring teams, coaching and mentoring people.	3
CO2	Explain the role of the leader and leadership principles and attitudes	3
CO3	Demonstrate an understanding of professional and ethical responsibilities;	3

CO4	Demonstrate commitment to quality, timeliness, and continuous improvement.	3
CO5	Interpret their future managerial role, with emphasis on the management of the humanresources and with a multi-cultural perspective	3

1- Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. Charles D Pringle, Justin Gooderilongenecter, Management, CE Merril Publishing Co. 2001.
2. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillian India Ltd.,2005.
3. Josy,J, Familiaro, “Handbook of Human Resources Administration”, McGraw-Hill Intemational Edition, 2007
4. D. Longford M.R. Hancock, R. Rellows & A. W. Gale, Human Recourse Management in Construction – Longman Group Limited, fourth impression 2000.
5. Carleton Counter II and Jill Justice Coulter, “The Complete Standard Handbook of Construction Personnel Management ”, Prentice Hall, Inc., New Jersey, 1989.



OBJECTIVES:

- To study the various quantitative methods applied to the elements of management, the effect of production management, finance management, decision theory, and managerial economics.

UNIT I OPERATIONS RESEARCH

9

Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems.

UNIT II PRODUCTION MANAGEMENT

9

Inventory Control - EOQ Model - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.

UNIT III FINANCIAL MANAGEMENT

9

Working Capital Management – Compound Interest and Present Value methods – Discounted CashFlow Techniques – Capital Budgeting.

UNIT IV DECISION THEORY

9

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

UNIT V MANAGERIAL ECONOMICS

9

Cost Concepts – Break-even analysis – Pricing Techniques – Game theory - Applications.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Apply the knowledge of science and engineering fundamentals in learning the concept of operations research and its practical applicability for solving challenges in construction.	3
CO2	Identify, formulate, plan and schedule construction engineering projects	3
CO3	Apply the knowledge of financial management and cost concepts	3
CO4	Design the required man, material, equipment, cost and time as per needs by proper decision rules.	3
CO5	Analyze the cost by break-even analysis and modern construction management software	3

REFERENCES:

- Frank Harrison, E., The Managerial Decision-Making Process, Houghton Mifflin Co., Boston, 1999.
- Vohra, Nd., Quantitative Techniques in Management, Fifth Edition, Tata McGraw-Hill Company Ltd, 2017.
- Levin, R.I, Rubin, D.S., and Stinson J., Quantitative Approaches to Management, McGrawHill College, 1993.
- Tang S.L., Irtishad U.Ahmad, Syed M.Ahmed, Ming Lu, Quantitative Technique for Decision making in Construction, Hongkong University Press, HKU, 2004.

CM22019 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION L T P C
3 0 0 3

OBJECTIVES:

- To impart the concepts of resource planning
- To understand the concept of labor management and time management.
- To explain the concepts of material requirements and equipment planning.
- To impart the concepts of resource allocation and resource leveling in construction.

UNIT I RESOURCE PLANNING 9

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

UNIT II LABOUR MANAGEMENT 9

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour - Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour – Labour Productivity

UNIT III MATERIALS AND EQUIPMENT 9

Material: Time of purchase, the quantity of material, sources, Transportation, Delivery, and Distribution – Construction Equipment - Planning and Selection - cost, Time, Source, and handling.

UNIT IV TIME MANAGEMENT 9

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control.

UNIT V RESOURCE ALLOCATION AND LEVELLING 9

Resource list - Resource Allocation - Resource Leveling and Smoothing – Problems – Time -cost trade-off, Value Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Identify the different types of resources in a construction industry	3
CO2	Evaluate the labour productivity and the influencing factors	3
CO3	Calculate the equipment output and the operation condition of construction equipment	3
CO4	Describe the terms of cash inflow, cash outflow, and balance sheet	3
CO5	Categorize the time and cost-related information in a construction sector.	3

REFERENCES:

1. Sharma, S C., Construction equipment management, Khanna publishers, Delhi, 2016.
2. Kumar Neeraj Jha Construction project management, Pearson publishers, 2015.
3. Andrew, D., Szilagg, Hand Book of Engineering Management, 1982.
4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1996.
5. Paul Netscher, Construction Project Management: Tips and Insights, Panet Publications, 2017.

OBJECTIVE:

- To study and understand the various safety concepts and requirements applied to construction projects.

UNIT RISK CONCEPTS 9
I

Definitions of risk - Importance and types of risk - Elements of risk management - Causes of risk - Principles of risk management - managing risk in the public and private sectors - Risk management process – Factors affecting risk management

UNIT II PLANNING FOR RISK 9

Components of risk management - Planning for risk management - Project charter - Risk management policies - roles and responsibilities - revisiting the work breakdown structure - risk management plan - risk registers - creating the risk management plan - risk analysis – tracking - Risk Management Framework

UNIT III RISK IDENTIFICATION 9

Identifying risk - preparing for risk identification - risk categories - referring to historical information - reviewing project documents - brainstorming - the Delphi technique - SWOT - diagrammatic techniques

UNIT IV RISK RESPONSE AND COMMUNICATION 9

Preparing for risk response - creating risk response - result of risk response planning - risk monitoring and control – risk communication - informing public about risk and responding to express concerns – risk evaluation process

UNIT V RISK MANGEMENT ASPECTS 9

Risk planning and management case studies - engineering contracts, project delivery - strategies and international project risk - management of risk in construction industry - dealing with uncertainties - risk mitigation techniques - Risk management in computer software

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Apply the knowledge of risk concepts and principles in the construction projects	3
CO2	Formulate an appropriate risk management plan for construction projects.	3
CO3	Identify the project risks using suitable methodologies and the ability to apply them in practice.	3
CO4	Understanding the need for risk response and communication	3
CO5	Apply the knowledge of risk management practices in the construction industry.	3

REFERENCES:

1. PMP Project Management Professional Study Guide, Joseph Phillips, McGraw – Hill
2. Bruce Barkley, Project Risk Management (Project Management)
3. John R. Schuyler, Risk and Decision analysis in Projects (Cases in project and program management series)
4. Chris Chapman and Stephen Ward, Project Risk Management: Processes, Techniques and Insights.
5. Dale F. Cooper, Stephen Grey, Geoffrey Raymond, and Phil Walker, Project Risk Management Guidelines: Managing Risk in Large projects and Complex Procurements.
6. William G. Ramroth, Risk Management for Design Professionals.
7. James B. Atkins and Grant A. Simpson, Managing Project Risk: Best Practices for Architects and Related Professionals.



OBJECTIVE:

- To study and understand the various safety concepts and requirements applied to construction projects.

UNIT I CONSTRUCTION ACCIDENTS**9**

Accidents and their causes – Human Factors in Construction Safety – Costs of Construction Injuries -Unsafe acts and conditions - Occupational and Safety Hazard Assessment – Legal Implications.

UNIT II SAFETY PROGRAMMES**9**

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives - Safety in Construction Contracts – Substance Abuse – Safety Record Keeping

UNIT III DESIGNING FOR SAFETY**9**

Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers - Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual obligation – Project Coordination and Safety Procedures – Workers Compensation.

UNIT IV HEALTH MANAGEMENT IN CONSTRUCTION SITES**9**

Occupational Health - Effects of Material Handling on Health - Health Hazards in Construction Site - Disease Prone Environment in Construction Site - Precautionary Measures - Health Monitoring and Treatment - Safety Measures during Material Handling

UNIT V OWNERS AND DESIGNERS OUTLOOK**9**

Occupational Safety and Health Administration Manuals, Laws and Act – Indian Practices Owners and Designers – Roles and responsibility in ensuring safety – Preparedness – Role of the designer in ensuring safety – Safety clause in the design document.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Develop knowledge on accidents and their causes.	3
CO2	Develop knowledge about safety programs and job-site safety assessments	3
CO3	Apply the knowledge of contractual obligations	3
CO4	Explain about designing for safety and safety procedures	3
CO5	Develop the knowledge of owners' and designers' responsibilities.	3

REFERENCES:

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
3. Sathyanarayanan Rajendran and Mandi Kime, Construction Project Safety-Management Best-Practices Handbook, 2013.
4. Safety, Health and Environmental Handbook, CPWD, 2019.
5. Bhattacharjee S.K. Safety Management in Construction (Principles and Practice), Khanna Publishers, New Delhi 2011



OBJECTIVES:

- To impart the knowledge and skills required for understanding the various impacts of infrastructure projects on the environment.
- To impart knowledge about prediction and assessment of EIA.
- To impart the knowledge of health and socio-economic impact assessment.
- To impart the knowledge and expose the students to the various methodologies available to assess.
- To impart the knowledge to develop the skill to prepare Environmental Impact assessment report

UNIT I INTRODUCTION TO EIA 9

Sustainable Development challenges and needs - Key approaches for Impact Assessment – EIA Approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.

UNIT II PREDICTION AND ASSESSMENT 9

Prediction and Assessment: tools - impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - Identification, Prediction and Evaluation of Impacts on Biodiversity - Techniques of Biodiversity impact assessment - EIA Report Preparation - Environmental Management Plan: Preparation and implementation - Mitigation and Rehabilitation plans - Post Project Audit.

UNIT III HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Health Assessment: Impact of Environment on Health - Developing framework for Health impact analysis, tools, and techniques - Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment - Land acquisition: Legal aspects, Resettlement & Rehabilitation, and Development.

UNIT IV INTEGRATED ANALYSIS 9

Integrated Analysis of Environmental, Social, and Health Impacts - Challenges for Integrated Approach - Scope for Integrated approach in economic analysis - CBA, Social CBA, and Cost-effectiveness Analysis - Analytic Hierarchy process-based Approach - Emerging Dimensions and Future Directions.

UNIT V IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES 9

Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material Production - Material Processing - Service Sectors - Physical Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
CO1	Upon successful completion of the course, the students should be able to Apply the knowledge of science and engineering fundamentals to sustainable development challenges.	3
CO2	Explain the identification, prediction, and evaluation of impacts that will be caused by projects or industries on biodiversity.	3
CO3	Identify the legal requirements of environmental impact assessment for projects.	3
CO4	Develop the ability to perform integrated analysis by considering environmental, social, and health impacts.	3
CO5	Select appropriate methods for environmental impact assessment for Infrastructure and environmental service.	3

REFERENCES

1. Anjaneyulu, Yerramilli, and Valli Manickam, "Environmental impact assessment methodologies", Hyderabad: BS Publications, Third Edition 2022.
2. Lawrence, D.P., "Environmental Impact Assessment — Practical Solutions to recurrent problems", Wiley-Interscience, New Jersey, 2003.
3. Petts, J., "Handbook of Environmental Impact Assessment', Vol., I and II, Blackwell Science, London, 1999.
4. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York, 1996.
5. World Bank – Source Book on Environmental Impact Assessment, 2010

OBJECTIVES:

- Familiarize students with urban forms and urban street patterns. Highlight development guidelines and planning aspects for buildings with an emphasis on fire-fighting and fire protection. Introduce building services and maintenance aspects.

UNIT I URBAN FORMS, STREET SYSTEMS AND NEIGHBOURHOOD 9

Components of urban forms, methods of measurement, case studies - Planning of urban forms - ULB's - JNNURM, Smart City-Urban Street system, street forms – Concepts - Neighborhood Module - Layout of a neighborhood.

UNIT II FUNCTIONAL PLANNING 9

Development Control Guidelines, Functional planning of buildings, Cluster Planning - Circulation - Optimization of space - Spatial analysis, heuristic procedures

UNIT III ENGINEERING SERVICES 9

Engineering services in building system - Lighting, Ventilation and Psychometric charts, Air Conditioning, Lifts & Escalators, Cold and Hot water systems - Waste water systems - Design principles, Electrical systems - Accessories of wiring - Types of insulation – electrical layout for building

UNIT IV FIRE RESISTANCE 9

Causes and Effects of fire - Standard for fire safety - Fire-Resisting Properties of Building Materials - General Requirements of Fire Resisting building as per NBC - Fire resistance/Firefighting and extinguishing systems - Means of escape, alarms, etc - Space requirements – Guidelines.

UNIT V MAINTENANCE MANAGEMENT 9

Building Maintenance – Maintenance of floorings, Doors & Windows, Paintwork, Brickwork – Cracks and Remedial measures in concrete – Checking building leakage - Types of maintenance – Scheduled and contingency maintenance – Maintenance strategy and inspection frequencies - MIS for building maintenance

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Plan layout in a neighbourhood	3
CO2	Explain the functional planning of buildings.	3
CO3	Understand the engineering services in building system.	3
CO4	Plan for fire safety requirements.	3
CO5	Manage the facilities by MIS.	3

REFERENCES

1. Mike Jenks, Colin Jones-Dimensions of the Sustainable City –Springer
2. D. Chapman-Creating Neighbourhoods and Places in the Built Environment.
3. Stephen Marshall-Streets and Patterns.
4. David. V. Chadderton-Building Services Engineering, 5th edition.
5. M. Bhatti-Practical Optimization Methods - With Mathematica Applications-Springer.
6. Ruhul Amin Sarker, Charles S. Newton-Optimization Modelling, A Practical Approach.
7. Barrie Chanter, Peter Swallow-Building Maintenance Management -Wiley-Blackwell.
8. Time Saver Standards for Architectural Design Data.
9. NBC 2005 - National Building Code.
10. SP 32 (1986) – Lighting and Ventilation.
11. SP 30 (2011) – National Electrical Codes.
12. SP 35 – Handbook on water supply and Drainage
13. IS 14665 (2000)- Part I, Part II, Part IV- Lifts
14. IS 1172 (Reaffirmed 2002) -Code for basic Requirement for Water Supply, Drainage and Sanitation
15. IS 2065 (Reaffirmed 1996) - Code of Practice for Water Supply in Buildings.
16. IS 1742 (Reaffirmed 2002) - Code of practice for building drainage
17. IS 12183 (Reaffirmed 2004) - Code of Practice for Plumbing in Multi-Storeyed Buildings.
18. IS 13727 (Reaffirmed 2004) - Cluster Planning for Housing.
19. IS 15105 (2002)- Code of Practice for Fire Sprinklers.
20. IS 1641 to IS 1646- Code of Practice for Fire Safety in Buildings.
21. IRC 73-1980 - Geometric Design for Rural (Non-Urban)
22. IRC 86-1983 – Geometric Standards for Urban Roads in Plains

UNIT I NATURAL DISASTERS **9**

Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche.

UNIT II MAN MADE DISASTERS **9**

Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, nuclear disaster- Forest Fire - Oil fire - accident in Mines.

UNIT III GEOSPATIAL TECHNOLOGY **9**

Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation - disaster mapping.

UNIT IV RISK ASSESSMENT AND MITIGATION **9**

Hazards, Risks and Vulnerabilities - Disasters in India, Assessment of Disaster Vulnerability of a location and vulnerable groups - Preparedness and Mitigation measures for various Disasters - Mitigation through capacity building - Preparation of disaster management plans.

UNIT V DISASTER MANAGEMENT **9**

Legislative responsibilities of disaster management- Disaster management act 2005 - post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development - Post Disaster, Emergency support functions and their coordination mechanism - Role of engineers in disaster management.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Identify natural and manmade disasters	3
CO2	Explain in detail about causes and effects of natural and manmade disasters.	3
CO3	Apply geospatial techniques (including GIS) that can enhance vulnerability assessments	3
CO4	Identify and analyse the factors that give rise to differential vulnerabilities and levels of community resilience and suggest necessary mitigation plans	3
CO5	Assess and manage these vulnerabilities through disaster planning and policy -making	3

REFERENCES

1. R. Subramanian, "Disaster Management" Vikas Publishing House Pvt. Ltd, New Delhi, 110055, 2018.
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd.,
3. Disaster Management in India- A Status Report- Published by the National Disaster Management Institute, Ministry of Home Affairs, Govt. of India, 2004.

4. Murthy D. B. N., "Disaster Management: Text and Case Studies", Deep and Deep Publications (P) Ltd., New Delhi, 2007.
5. Sundar I. and Sezhiyan T., "Disaster Management", Sarup and Sons, New Delhi, 2007.
6. Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
7. Khanna B K, "All You Wanted to Know About Disasters", New India Publishing Agency, New Delhi, 2005.
8. Ramana Murthy, "Disaster Management", Dominant, New Delhi, 2004.
9. Rajdeep Dasgupta, "Disaster Management and Rehabilitation", Mittal Publishers, New Delhi, 2007.



OBJECTIVES:

- To impart knowledge about the basics of lean construction.
- To impart knowledge about the lean principles.
- To impart knowledge about the lean construction tools and techniques.
- To understand about the basics of lean implementation in the construction industry.

UNIT I INTRODUCTION**9**

Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems – Productivity in Construction – Daily Progress Report - State of the industry for its management practices – construction project phases - Essential features of contemporary construction management techniques - Problems with current construction management techniques

UNIT II LEAN MANAGEMENT**9**

Introduction to lean management – Toyota's management principle-Evolution of lean in the construction industry - Production theories in construction – Lean construction value - Value in construction - Target value design – Lean project delivery system- Forms of waste in the construction industry – Waste Elimination.

UNIT III CORE CONCEPTS IN LEAN**9**

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV LEAN CONSTRUCTION TOOLS AND TECHNIQUES**9**

Value Stream Mapping – Work sampling – Last planner system – Flow and pull-based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT V LEAN CONSTRUCTION IMPLEMENTATION**9**

Lean construction implementation- Enabling lean through information technology – Lean in design -Design Structure Matrix Location Based Management System - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach

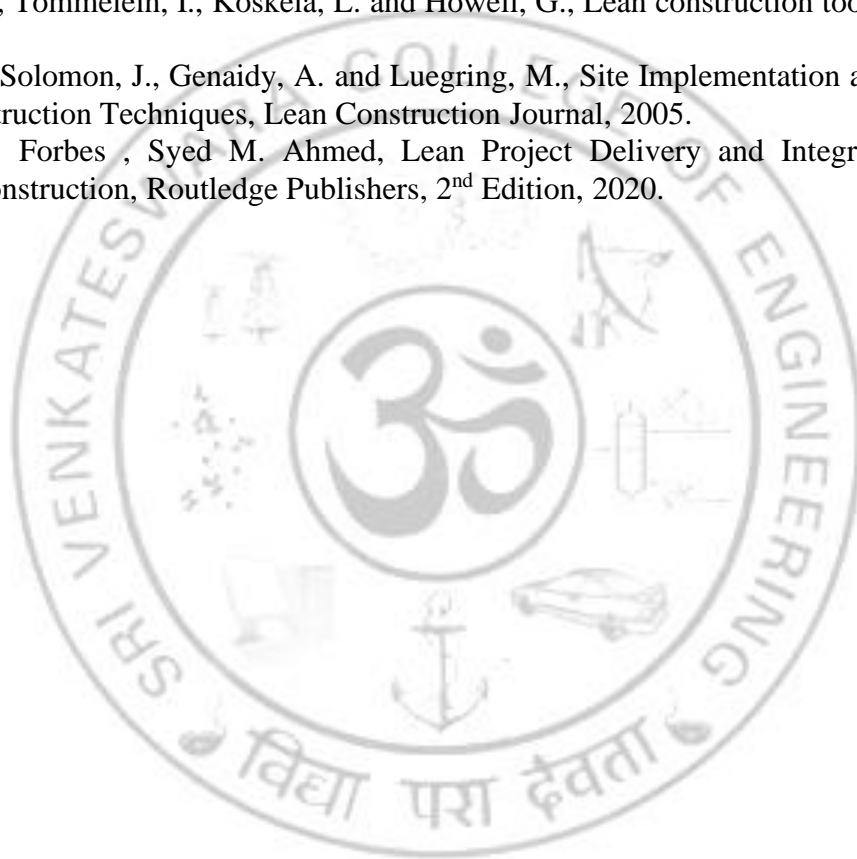
TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explains the contemporary management techniques and the issues in the present scenario.	3
CO2	Apply the basics of lean management principles and their evolution from the manufacturing industry to the construction industry.	3
CO3	Develops a better understanding of core concepts of lean construction tools	3

	and techniques and their importance in achieving better productivity.	
CO4	Apply lean techniques to achieve sustainability in construction projects.	3
CO5	Apply lean construction techniques in design and modeling	3

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site Implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.
6. Lincoln H. Forbes , Syed M. Ahmed, Lean Project Delivery and Integrated Practices in Modern Construction, Routledge Publishers, 2nd Edition, 2020.



OBJECTIVES:

- Understand the basics of building management system and automation at off and on-site projects. Highlight the application of robotics in construction industry.

UNIT I BUILDING MANAGEMENT SYSTEM AND AUTOMATION 9

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS - Review and analysis of state-of-art in construction automation - Field sensors actuators, controllers, non-destructive evaluation, data acquisition - examples of sensors in existing automated equipment

UNIT II OFF AND ON-SITE AUTOMATION IN CONSTRUCTION 9

Off - site automation in construction Information processing (computer applications), materials processing, case study (concrete batch plant) - Existing and prototype equipment for construction – case study (concrete placement and finishing), final product design session.

UNIT III BUILDING AUTOMATION 9

Introduction to building automation systems – components– Heating, ventilation, and air conditioning (HVAC) – Lighting – Electrical systems water supply and sanitary systems– Fire safety – security -Communication and office automation system - Water pump monitoring & control - Control of Computerized HVAC Systems.

UNIT IV ROBOTICS IN CONSTRUCTION 9

Automation and robotic technologies for customized component, module and building prefabrication - Elementary technologies and single – Task construction robots - Site automation robotic on-site factories.

UNIT V CONSTRUCTION ROBOTS 9

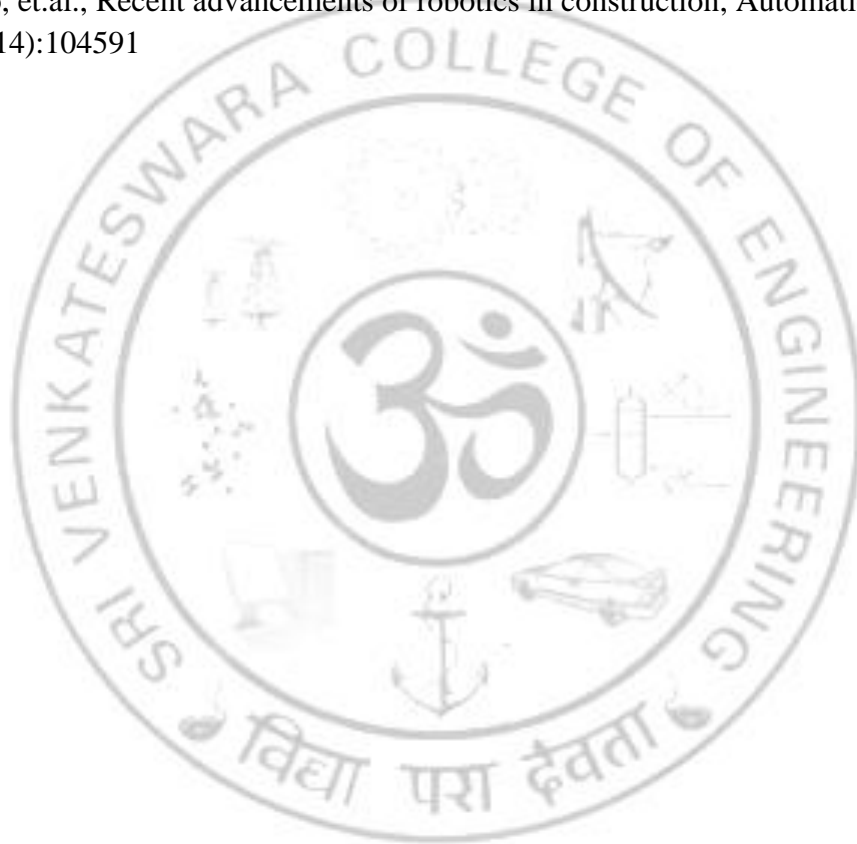
Selecting robot - Activated concrete cutting robot, concrete floor finishing robot - Ceiling panel positioning robot - Exterior wall painting robot - safety and training - case studies.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Understand the application of building management system and automation in on- and off-site projects	3
CO2	Solve the construction issues through robotic techniques	3
CO3	Application of computer in construction Information processing	3
CO4	Understand the concepts of Communication and office automation system	3
CO5	Application of Robotics in construction projects	3

REFERENCES

1. Javad Majrouhi Sardroud, (2011), “Automated Management of Construction Projects”, LAP Lambert Academic Publishing.
2. Wang Shengwei, (2010), “Intelligent Buildings and Building Automation” Taylor & Francis Group.
3. Majrouhi Sardroud Javad, (2014), “Automation in Construction Management” Scholars' Press.
4. HongleiXu and Xiangyu Wang, (2014), “Optimization and Control Methods in Industrial Engineering and Construction (Intelligent Systems, Control and Automation: Science and Engineering)” Springer.
5. Akinradewo et.al., A Review of the Impact of Construction Automation and Robotics on Project Delivery, IOP Publishing Ltd
6. Bo Xiao, et.al., Recent advancements of robotics in construction, Automation in Construction, 144 (2014):104591



OBJECTIVE:

To study the concepts of total quality management and apply the international standards in the construction projects.

UNIT I QUALITY MANAGEMENT

9

Quality: Necessity for improving Quality in the context of Global Challenges - Concept of Quality Control, Quality Assurance, Quality Management and Total Quality Management (TQM).

UNIT II QUALITY STANDARDS, METHODS & TECHNIQUES

9

Study of various Quality Standards in Construction Related to building materials and other inputs for construction processes, methods and techniques for construction outputs, products and services.

UNIT III QUALITY MANAGEMENT

9

Managing Quality in various projects stages from concept to completion by building quality into design of structures, Inspection of incoming material and machinery, in process quality inspections and tests.

UNIT IV QUALITY ASSURANCE AND CONTROL

9

Designing of quality manuals, checklists and inspection reports, installing the quality assurance System, monitoring and control - Quality Assurance Department and quality control responsibilities of the line organization - Quality in foundations and piling work, structural work, concreting, electrical system building facilities, waste recycling and maintenance.

UNIT V INTERNATIONAL STANDARDS

9

Developing quality culture in the organization - Training of people, Bench - marking quality. Quality circles - Study of ISO 9000, ISO 14000 and QS 9000 standards and certification procedures - BIS, BS, Indian standards, British, American standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Explain the concept of quality management guidelines, and quality circles	3
CO2	Apply the quality standards for preparing Quality system documents.	3
CO3	Explain the skill of preparing inspection procedures for quality planning	3
CO4	Select the techniques and tools for Quality Assurance and Control in Construction Industry	3
CO5	Achieve the knowledge of quality improvement techniques	3

REFERENCES:

1. Quality Planning and Analysis - J M Juran and Frank Gryna, Tata McGraw Hill Book Co. Ltd., Delhi, 2014, 6th Edition.
2. Managerial Breakthrough - J M Juran, Tata McGraw Hill Book Co. Ltd., Delhi, 1995, 3rd Edition.
3. Total Quality Control - A V Fiegenbaum, Tata McGraw Hill Book Co. Ltd., Delhi, 2004, 4th Edition.
4. The Six Sigma Way - Peter Pande and others, Tata McGraw Hill Book Co. Ltd., Delhi, 2014.
5. Quality is Free - Phil Crosby, Tata McGraw Hill Book Co. Ltd., Delhi, 2001, 4th Edition.



OBJECTIVES:

- To gain knowledge about construction supply chain management.
- To understand the concepts of strategic perspectives.
- To understand the concepts of integrated data management.
- To understand the concepts of construction logistics and sustainability.
- To understand the concepts of logistics operations.

UNIT I INTRODUCTION**9**

Definition of Logistics and SCM: Evolution, Scope, Importance - Supply chain stages and decision phases process view of a supply chain - Supply chain flows - Examples of supply chains- Competitive and supply chain strategies - Drivers of supply chain performance - Framework for structuring drivers - Obstacles to achieving fit

UNIT II STRATEGIC PERSPECTIVES**9**

Challenge of construction logistics - Aggregating global products for just-in-time delivery to construction sites – Construction Logistics – Supply of bulk materials – Effective management of a construction project supply chain – Construction supply chain management strategy.

UNIT III INTEGRATED DATA MANAGEMENT**9**

Impact of BIM and new data management capabilities on supply chain management in construction Data management for integrated supply chains in construction

UNIT IV CONSTRUCTION LOGISTICS AND SUSTAINABILITY**9**

Role of logistics in achieving sustainable construction – Resource efficiency benefits of effective logistics

UNIT V LOGISTICS OPERATIONS**9**

Role of the construction logistics manager – Third-party logistics operators in construction – Managing construction logistics for confined sites in urban areas - Consolidation centers in construction logistics – Delivery management systems

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Describe the conceptual and theoretical backgrounds of Supply Chain Management and logistics	3
CO2	Apply the strategy in logistics functions ranging from planning to execution and control.	3
CO3	Identify the Impact of BIM and new data management capabilities on supply chain management in construction.	3
CO4	Analyze the implications of various strategic choices and decide on a better course of action.	3
CO5	Understand the role of construction logistic Managers and Delivery management systems.	3

REFERENCES:

1. Greger Lundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.
2. Supply Chain Management, Strategy, Planning, and Operation – Sunil Chopra, Peter Meindl, and Kalra, Pearson Education, 2011
3. Chitalend A. K. and Gupta R. C. (2014), Materials Management: A Supply Chain Perspective - Text and Cases, PHI India, New Delhi
4. A. Ravi Ravindran, Donald P. Warsing, Supply Chain Engineering: Models and Applications, CRC Press, 2012.
5. G Srinivasan, Quantitative Models in Operations and Supply Chain Management, PHI Learning (P) Ltd, New Delhi, 2010
6. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, Logistics, PHI 2010



OBJECTIVE:

- To understand the procedures to value building properties using standard methods.

UNIT I VALUATION OF LAND AND BUILDING 9

Cost, Price and Value - Purposes and Methods of Valuation - Concepts of Valuation of Land and Building - Valuation by Direct Sales Comparison Method, Land and Building Method and Rent Capitalization Method.

UNIT II FIXATION OF FAIR RENT 9

Lease hold Properties - Lease, Rent and Licence, Reversion - Valuation of Lessor' Rights and Lessee's Rights - Building Rent - Fixation of Fair Rent as per Tamil Nadu Buildings (Lease & Rent Control) Act - The Tamil Nadu Regulations of Rights and Responsibilities of Landlords and Tenants Act 2017.

UNIT III VALUATION OF APARTMENTS 9

Related Definitions - Composite Rate - Different Methods of Valuation - Stage Value of a flat -Joint Venture Agreement - Real Estate (Regulation and Development) Act 2016 and its significance in Valuation

UNIT IV VALUATION FOR BANKS 9

Purposes - Valuation of Building under Construction, Ready Built House, Flats under construction, Ready built Flats – Valuation of under SARFAESI (Securitisation and Reconstruction of Assets and Enforcement of Security Interest) Act 2002 - Insolvency and Bankruptcy Code (IBC) 2016 and its Implications on Valuation - Compliance to International Valuation Standards

UNIT V VALUATION FOR TAXATION 9

Valuation for Income Tax - Cost of Construction - Valuation for Capital Gains Tax - Section 50C of Income Tax Act - Exercise Using of Excel Spread Sheet for Valuation of Cost of Construction by all the Methods.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

CO	CO statements	RBT level
	Upon successful completion of the course, the students should be able to	
CO1	Summarise the principles and methods of valuation	3
CO2	Determine the Rent for rental and leasehold premises	3
CO3	Perform valuation for apartments as per regulations	3
CO4	Perform valuation for banks as per regulations	3
CO5	Perform valuation for taxation purpose	3

1-Remember, 2- Understand, 3- Apply, 4- Analyse, 5- Evaluate, 6- Create

REFERENCES:

1. K. Divakar, "Valuation of Immovable Properties - Basics for Beginners", Published by Vahini Divakar, Coimbatore, 2019.
2. Rangwala S.C. (Late) and Ketki B. Dalal, "Valuation of Real Properties" Charotar Publishing House Pvt. Ltd. Anand, Gujarat, 10th Edition 2020.
3. Kanagasabapathy, B., "Practical Valuation, Volumes IX, X, XII, XIII, XIV & XV" No 1, Prestige Flats, Reynolds Road, Trichy
4. Ashok Nain, "Valuation Principles & Procedures, Dew Drops Education Pvt. Ltd., July 2010.
5. Gopinatha Rao, C.H., Valuation Practice of Immovable Properties, Chennai, 17th Edition 2014.

