(DEEMED TO BE UNIVERSITY)

CIVIL ENGINEERING

M.Tech Construction Technology & Management

2020 & 2021 Admitted Students

CURRICULUM & SYLLABUS

Vision of University

To be a globally renowned university.

Mission of University

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

Vision of Department

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build our nation.

Mission of Department

M1: To provide holistic development of student

M2: To meet the ever-changing needs of civil engineering industry

M3: To be involved in forward looking research

M4: To be involved in consultancy useful to society

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- **PEO1:** Demonstrate knowledge in broad areas of Construction Technology and Management
- **PEO2:** Demonstrate a depth of knowledge in a chosen/focus area of Construction Technology and Management
- **PEO3:** Demonstrate knowledge of contemporary issues in their chosen/ focused area
- **PEO4:** Demonstrate the ability to complete a technical project independently

PROGRAMME OUTCOMES (POs):

On completing the M. Tech. (Construction Technology and Management) – Civil Engineering Programme successfully the students will exhibit the following capabilities:

- **PO1:** Knowledge of a broad range of Construction Technology methodologies and underlying civil engineering, commonly used in the development and analysis of Construction Technology and Management systems
- **PO2:** Knowledge of fundamental design issues relevant to Construction Engineering and an understanding of how to formulate and analyse design solutions in various engineering contexts
- **PO3:** In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques
- **PO4:** Knowledge of basic research and development principles and practices relevant to main stream engineering industry
- **PO5:** Knowledge of key professional, safety and ethical issues arising in modern engineering industry
- **PO6:** Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, masters level, Engineering based projects

MAPPING OF PEO's WITH MISSION STATEMENTS

S.No	Description of PEOs	Key Components of Mission			
		M 1	M 2	M 3	M 4
		To provide holistic development of student	To meet the ever changing needs of civil engineering industry	To be involved in forward looking research	To be involved in consultancy useful to society
PEO 1	Demonstrate knowledge in broad areas of Construction Technology and Management	√	√	√	√
PEO 2	Demonstrate a depth of knowledge in a chosen/focus area of Construction Technology and Management	√	√	√	√
PEO 3	Demonstrate knowledge of contemporary issues in their chosen/ focused area	√	√	√	√
PEO 4	Demonstrate the ability to complete a technical project independently	√	√	√	√

MAPPING OF POs/PSOs with PEOs:

S. No.	Key Components of POs andPSOs	PEO			
		PEO 1	PEO 2	PEO 3	PEO 4
PO1	Knowledge of a broad range of Construction Technology methodologies and underlying civil engineering, commonly used in the development and analysis of Construction Technology and Management systems	√		√	
PO2	Knowledge of fundamental design issues relevant to Construction Engineering and an understanding of how to formulate and analyse design solutions in various engineering contexts	√			
PO3	In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques	√	√		
PO4	Knowledge of basic research and development principles and practices relevant to main stream engineering industry	√			
PO5	Knowledge of key professional, safety and ethical issues arising in modern engineering industry	√	√		
PO6	Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, masters level, Engineering based projects	√		√	√

ACADEMIC REGULATIONS

This document supplements the KLEF rules and regulations to aid all students. It is required that every individual must abide by these regulations.

Note: The regulations stated in this document are subject to change or can be relaxed / modified without prior notice at the discretion of the Hon'ble Vice Chancellor.

Terminology

Academic Council: The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Even and Odd semester.

Y20 Audited Course: It is a course of study which has zero credits and has a "Satisfactory" or an "Unsatisfactory" grade.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F).

Basic Sciences: The courses of foundational nature in the areas of Mathematics, Physics, Chemistry, Biology etc., are offered in this category.

Betterment: Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies: Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.

Branch of Study: It is a branch of knowledge, an area of study or a specific program (like Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering etc.)

Certificate course: It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.

Change of Branch: Change of branch means transfer from one's branch of study to other.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Handout: Course Handout is a document, which gives complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self- learning/ practical/ field work during a semester.

Credit point: It is the product of grade point and number of credits for a course.

Credit Transfer: The procedure of granting credit(s) to a student for course(s) undertaken at another institution.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Degree: A student who fulfills all the Program requirements is eligible to receive a degree.

Degree with Specialization: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.

Y20 Detention in a course: Student who does not obtain minimum prescribed marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.

Engineering Sciences: The courses belonging to basic evolutionary aspects of engineering from Mechanical Sciences, Electrical Sciences and Computing like Engineering Mechanics, Data structures, Network Theory, Signal Analysis etc...

Evaluation: Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honors Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of additional courses within the same program is eligible to receive an Honors degree.

Humanities Elective: A course offered in the area of Liberal Arts.

Industrial Training: Training program undergone by the student as per the academic requirement in any company/firm. It is a credited course.

Industrial Visit: Visit to accompany/firm as per the academic requirement.

Y20: Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

Y20 Make-up Test: An additional test scheduled on a date other than the originally scheduled date. (Describe elaborately)

Y20: An additional test scheduled on a date other than the originally scheduled date.

Management elective: A course that develops managerial skills and inculcates entrepreneurial skills.

Mini project: Mini Project is a credit-based course that a student has to undergo during his/her academic term, which involves the student to explore in a discipline belonging to their research interest within their program area.

Minor Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of courses from another discipline is eligible to receive a minor degree in that discipline.

Multi- Section Course: Course taught for more than one section.

Open Elective: This is a course of interdisciplinary nature. It is offered across the University for all programs.

Over loading: Registering for more number of credits than normally prescribed by the Program in a semester.

Practice School: It is a part of the total program and takes one full semester in a professional location, where the students and the faculty get involved in finding solutions to real-world problems. A student can choose Project/Practice School during his/her 7th or 8th semester of his/her Academic Year to meet the final requirements for a degree.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Professional Core: The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.

Program Educational Objectives: The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

Project: Course that a student has to undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit based course.

Project based laboratory: Project Based Laboratory is a student-centric learning methodology that involve students in design, problem-solving, decision making, and investigative activities;

gives students the opportunity to work in teams, over extended periods of time; and culminate in realistic products or presentations

Re-Appearing: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester/ term of the Program.

Re-Registering: A student desiring to repeat a course is permitted to do so, subject to the regulations contained herein.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.

Semester End Examinations: It is an examination conducted at the end of a course of study.

Single Section Course: Course taught for a single section.

Social Service: An activity designed to promote social awareness and generate well-being; to improve the life and living conditions of the society.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioural.

Substitution of Elective course: Replacing an elective course with another elective course as opted by the student.

Summer term: The term during which courses are offered from May to July. Summer term is not a student right and will be offered at the discretion of the University.

Term Paper: A 'term paper' is a research report written by students that evolves their course-based knowledge, accounting for a grade. Term paper is a written original research work discussing a topic in detail. It is a credit-based course.

Under-loading: Registering for lesser number of credits than normally prescribed by the Program in a semester.

Withdraw from a Course: Withdrawing from a Course means that a student can drop from a course within the first two weeks of the odd or even Semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

CURRICULUM STRUCTURE

SEMESTER-1								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5121	Construction Planning Scheduling and Control	3	0	2	0	4	5
2	20CE5122	Sustainable Construction Materials and Methods	3	0	2	0	4	5
3	20CE5123	Lean Construction Practices	3	1	0	0	4	4
4	20CE5124	Building Information Modelling	3	0	2	0	4	5
5	20CE51E1	Material Procurement Management (PE 1)	3	0	0	0	3	3
	20CE51E2	Green Buildings (PE 1)						
6	20CE51F1	Construction Personnel Management (PE 2)	3	0	0	0	3	3
	20CE51F2	Pre-Engineering Construction and Technology (PE 2)						
7	20IE5149	Seminar	0	0	4	0	2	4
		Total	**18**	**1**	**10**	**0**	**24**	**29**

SEMESTER-2								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5225	Mechanized Construction and Machinery	3	0	2	0	4	5
2	20CE5226	Project Formulation Appraisal	3	1	0	0	4	4
3	20CE5227	Construction Laws and Regulations	3	1	0	0	4	4
4	20CE5228	Quality Management and Safety Management Systems in Construction	3	0	2	0	4	5
5	20CE52G1	Statistical Methods in Construction (PE 3)	3	0	0	0	3	0
	20CE52G2	Project Risk Management (PE 3)						
6	20CE52H1	Emerging Construction Technologies (PE 4)	3	0	0	0	3	3
	20CE52H2	Resource Management and Control in Construction (PE 4)						
7	20IE5250	Term Paper	0	0	4	0	2	4
		Total	**18**	**2**	**8**	**0**	**24**	**25**

SEMESTER-3								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
SEMESTER-4								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
		GRAND TOTAL	**36**	**3**	**90**	**0**	**84**	**126**

Course Wise CO – PO Mapping

Course Code	Course Title	Description of the Course Outcome	1	2	3	4	5	6
20CE5121	Construction Planning Scheduling and Control	Understand the concepts of project management for practical application			2	1		
		Apply mathematical logic in the planning and scheduling of a project		1			3	
		Apply concepts to estimate the project cost by using tools			3		3	
		Apply concepts to maintain the construction documents in the project		2	1		1	
		Plan, schedule, and control large-scale programs and individual projects by using Primavera/MS Project Tool				3		1
20CE5122	Sustainable Construction Materials and Methods	Understand concepts of sustainable construction practices			2			2
		Understand basics of sustainable construction materials			2			2
		Design the product's process to achieve sustainability features	2		2			2
		Calculate Life Cycle Assessment of building			2		2	
		Investigate Sustainability aspects of the buildings by using LCA tools	2		1			2
20CE5123	Lean Construction Practices	Understand the elements of traditional construction management				2		
		Understand the integrated applications of various IT tools and case studies	2	2	2		1	

		Apply and analyse construction productivity measuring and improving techniques	3		3	3		1
		Implement lean principles in order to improve the customer value for sustainable project business			2	2		
		Apply and analyse the lean practices				2	2	
20CE5124	Building Information Modelling	Become familiar with the trends, concepts of Building Information Modelling	2			2		
		Learn about Project BIM Execution Planning				2		
		Design the BIM execution process by creating process maps		1		2	2	
		Develop BIM information exchanges			1	2	2	
		Developing BIM Model using Revit Software and submission of project report				2	2	
20CE5225	Mechanized Construction and Machinery	Understanding the basic concepts of Equipment Management and tools	2		3		1	
		Understand various construction equipment and study the efficient utilization of the same using scientific principles	2			1		
		Apply the knowledge for the selection of appropriate equipment	2					1
		Understand the operation of Earthwork and various functions of machinery used for Earth moving, compaction, etc.	2					
		Write field report on machinery operation, cost and productivity by using project management tools like primavera/Candy/SAP etc	2		1			
20CE5226	Project Formulation Appraisal	Understand the concept of project and Identification of best Project by understanding the different feasibility studies	1				1	

		Estimating the cash flows by considering the time value of money.	2				2	
		Identify the best project by analyzing facts related economic, commercial and financial aspects.	1		3			1
		Understand in detail about Private sector partnership in construction projects.	1					
20CE5227	Construction Laws and Regulations	Understand the concept of construction laws and regulations.	1		1			
		Study the current trend toward alternative project delivery systems via contractual arrangements such as design-build and construction management at risk		2			1	
		Investigate how to avoid the possibilities of construction disputes via alternative dispute resolution (ADR)		2				
		Understand the Labor regulations and review construction contracts and specifications		2				1
20CE5228	Quality Management and Safety Management Systems in Construction	Understand the concepts of quality management and the factors influencing construction quality	1		3	1	1	
		Understand quality planning and programs in construction industry	1					
		Acquire knowledge of quality management systems and ISO 9000 family of standards.	2			1		
		Understand and analyses quality circle (QC) concepts for possible implementation to solve construction productivity and quality problems	1	1			1	

		Understand and evaluate safety management principles in construction		2				
20CE51E1	Material Procurement Management	Understand the significance of material management	2		2			
		Integrate important materials functions to both products and services & use MRP, ERP,& PLM managing materials				3		1
		Apply various purchasing method and inventory controlling techniques into practice.				3		
		Use the Material Management tools like TALLY, ERP, SAP in materials planning, procurement, inventory, control, cost control etc.				3		
20CE51E2	Green Buildings	Understand Necessity and importance of Sustainable/ Green Buildings, Grasp the construction practices of a sustainable Buildings.					2	2
		Understanding the Green Building Rating Systems, Water & Energy efficiencies, Reduction in waste material during construction and Building Design	3	3	3			3
		Understanding Air Conditioning and HVAC system design, Salient features of CII Godrej Green Business Center					3	3
		Understanding Indoor Environment Quality and Occupational Health, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,		3				
20CE51F1	Construction Personnel Management	Understand Overview of manpower planning and roles of HR		2	2			
		Understand Detail about the organizations and structure variance for organizations		2	2		2	

		Understand human relations and organizational behavior for working in an organization			2	2		
		Understand welfare measures and laws related to welfare measures and Detail overview of management and development methods	2	2		1		
20CE51F2	Pre-Engineering Construction and Technology	Understand the type of prefabricated elements and its importance			2		2	
		Understand the precast construction procedure			2		2	
		Understand the modular construction practices and its limitations and advantages			2	1	2	
		Apply knowledge in the choice of production setup and manufacturing methods			2	2	2	1
20CE52G1	Statistical Methods in Construction	Apply discrete and continuous probability distribution including requirements mean and variance and making decisions					2	
		Use the concepts of standard deviation, coefficient variance in different types samples and apply the tests			3		3	

		Perform the correlation analysis in various civil engineering projects					2	
		Apply simulation techniques for analysis and mitigation of construction project risks					3	
20CE52G2	Project Risk Management	Identify the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity	2		2			
		Cultivate an idea on effective resource utilization and identify factors affecting job productivity	2			1	2	
		Apply the professional skills acquired in managing a construction project.			2			1
		Gain the ability to attain an equilibrium among Innovation, Technology and Economic feasibility			2			
20CE52H1	Emerging Construction Technologies	Understand the modern construction techniques used in the sub structure construction			2		1	
		Understand the concepts used in the construction of special structures			2	1		
		Apply mechanism/technique for strengthening and repair methods for different cases.			2		2	
		Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for			2		2	

		buildings						
20CE52H2	Resource Management and Control in Construction	Understand overview of the resource planning and management of resources in construction			2	2		1
		Understand in detail about the labor management and optimization	2			2		
		Understand equipment management and effective utilization of the material resources	2			2	2	
		Understand detail about the allocation and levelling of resources with time management			2	2		
20IE5149	Seminar						2	2
20IE5250	Term Paper				3		2	2
20IE6050	Dissertation						2	2

CONSTRUCTION PLANNING SCHEDULING AND CONTROL

Course Code: 20CE5121 **L-T-P-S-S : 3-0-2-0**

Prerequisites: - NIL **Credits: 4**

Course Objective:

The main objective of the course is to understand the Project Management, Management functions, Construction planning, Scheduling and controlling of a Project and project Management System.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand the concepts of project management for practical application	3	2
2	Apply mathematical logic in the planning and scheduling of a project	5	3
3	Apply concepts to estimate the project cost by using tools	5	3
4	Apply concepts to maintain the construction documents in the project	2	3
5	Plan, schedule, and control large-scale programs and individual projects by using Primavera/MS Project Tool	5	4

SYLLABUS:

UNDERSTANDING PROJECT MANAGEMENT:

Project manager, organization structures, Organizing and staffing the project office and team, stages and phases involved in project management, techniques involved in project management

CONSTRUCTION PLANNING:

Project planning, milestone schedules, WBS, Network Techniques, critical path method, project evaluation review technique and Primavera, Resources leveling and smoothing.

CONSTRUCTION SCHEDULING

scheduling procedures, scheduling tools, construction activities in a project and their relationships, NETWORK ANALYSIS - Critical Path Method and Program Evaluation & Review Technique (PERT) and Range Estimating, The Role of the Scheduler in Construction Management, Technology Applications for Scheduling-Software Applications overview-primavera, MS Project Scheduling

COST CONTROL:

Introduction, Understanding Control, The Operating Cycle, Cost Account Codes, Budgets, The Earned Value Measurement System (EVMS)

PROJECT MANAGEMENT INFORMATION SYSTEM:

MIS reporting, Daily, Weekly and monthly reporting, Actual vs. Planned cost reports, Planning & Cost control document.

Tools:

Primavera/MS Project: Project Scheduling and Project Management Information System

Textbooks:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.

References:

1. Harold Kerzner Project Management CBS Publisers& Distributors 2nd Edition.
2. Frank Harris & Ronald McCaffer Modern Construction Management Blackwell science 4th Edition.
3. Roy Pilcher Principles of Construction Management McGraw Hill London.
4. Calin M. Popescu, ChotchaiCharoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
5. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
6. Willis, E. M., Scheduling Construction Projects, John Wiley & Sons, 1986.
7. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985

List of Topics in Construction Planning, Scheduling and Control Lab using P6.

- **Understanding project management.**
  Types of project, Types of scheduling, Types of relationships, lag (+ve, -ve) ,Flow & network system ,Critical path, predecessor, successor, Early start , Early finish, Late start, Late finish, Float, sample project.
- **Calendars**
  Types of calendar, creating a new calendar, Modify and assign a calendar.
- **Input Structure for a project**
  Organizational Breakdown Structure (O.B.S), Enterprise Project Structure (E.P.S) , A new project , Work Breakdown Structure (W.B.S)
- **Scheduling**
  Forward Scheduling, Backward Scheduling.

  By- Adding activities, Giving Duration, Forward scheduling (Fixed start), Backward scheduling (Fixed Finish)

- **Adjustment of float**
  Change of calendar, Change of Relation and lag, Change of Duration.
- **Basic tools**
  Edit of columns, Codes usage, User Preference, Admin preference, Admin Categories, Various options on Right click.
- **Budgeting**
  Add Recourses, (Type, price/unit), Roles in Resources, Create unit of measure, Assign of resources, Edit of columns in Resource assign area, Additional Expenses, Use of Resource Curve and Drive activity dates option, Effect of currency, Change of rate of Resource.

- **Various Outputs in a project**
  Day to day update, Assignments, Report making, batching of reports, S-curve study, Flow Chart view, Tracking of project status, Work products and Documents.
- **Thresholds, Issues, Risks.**
- **Steps in a activity, Various tools under Dropdown menu.**

SUSTAINABLE CONSTRUCTION MATERIALS AND METHODS

Course Code: 20CE5122 **L-T-P-S: 3-0-2-0**

Prerequisite: NIL **Credits: 4**

Course Objective:

The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as concrete, bricks, and achieving the same through lower carbon cements, superior brick kilns and recycled aggregate minimizing consumption of natural resources including water. The course also explores the evaluation process of sustainable construction by using LCA tools.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand concepts of sustainable construction practices	3,6	2
2	Understand basics of sustainable construction materials	3,6	2
3	Design the product's process to achieve sustainability features	1,3,6	4
4	Calculate Life Cycle Assessment of building	3,5	4
5	Investigate Sustainability aspects of the buildings by using LCA tools	1, 6	5

Syllabus:

Basics of Sustainable construction engineering

Fundamentals of Sustainable Construction Engineering- Sustainability and resources, need, present practices at national and international level, The Sustainability Quadrant- challenges & Issues, Government initiatives.

Sustainable construction Materials

Overview of sustainable construction materials, Consideration of physical, mechanical and thermo physical properties, Selection criteria for design of sustainable construction materials,

Construction Product, Process Design and Development Sustainability of construction resources, process modifications, product performance evaluation.

Sustainability assessment using standard approaches LEED/GRIHA rating evaluation process's-economic feasibility of sustainable construction products, Innovative & customized sustainable product design based on social constraints; tools & aids available for sustainable construction products.

Life Cycle Assessment: Life Cycle Assessment and Costing-Various aspects related to construction cost, present value analysis, life cycle stages, cost calculation & measures, evaluation criteria, uncertainty assessment, sensitivity analysis, break even analysis.

Tools:

Gabi Software/Umberto/Sima Pro: Case study-based approach for analysis of Life cycle Assessment of Building using LCA Tools

Reference Books:

1. Sustainable Engineering Practice ASCE Publication 2010.
2. Hagger Sustainable Industrial Design and Waste Management, Techniz Book 2010.
3. Helmut Rechberger, Practical handbook of Material Flow Analysis, Taylor & Francis. 2010.
4. Michael Z. Hou, Heping Xie, Jeoungseok Yoon Underground Storage of CO2 and Energy Taylor &Francis, 2010.
5. LEED for India: Reference Guide, 2011.
6. Whole Building Life Cycle Assessment: Reference Building Structure and Strategies.

Laboratory experiments:

1. Lab: software learning process (4 Contact Hours)
2. Field Study: Computation of Resources during the Construction Phase (8 Contact Hours)
3. Field Study: Computation of parameters during Utilization phase of Building (4 Contact Hours)
4. Field Survey: Computation of parameters during Demolition phase of Building (2 Contact Hours)
5. Lab: Life Cycle costing (2 Contact Hours)
6. Lab: Life Cycle Environmental Impact Assessment (In terms of Carbon footprint) (4 Contact Hours)

Lean Construction Practices

Course Code: 20CE5123 **L-T-P-S: 3-1-0-0**

Prerequisites: - NIL **Credits: 4**

Course Objective:

The course aims to provide learners with an understanding of lean construction management and how these can be applied to construction projects from design phase through to construction. Furthermore, helps to understand, apply and analyse the productivity measurement systems, lean principles, practices in the construction projects. Additionally, explains the integrated application of lean with various tools and techniques through case studies.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand the elements of traditional construction management	4	2
2	Apply and analyse construction productivity measuring and improving techniques	1,2,3	4
3	Implement lean principles in order to improve the customer value for sustainable project business	1,4	3
4	Apply and analyse the lean practices	3,4	4
5	Understand the integrated applications of various IT tools and case studies	4,5	2

SYLLABUS

TRADITIONAL CONSTRUCTION MANAGEMENT

Project – Management – Project Management – Project vs. Process – Management: Art/Science? – Project objectives – Scientific way of managing project objectives – Project Stakeholders, Construction Project Organisation, Project Phases, Level of effort, Relative ability to influence cost – Project Execution phases (EPC and Fast Track) – Project Scheduling Levels – Need for productivity measurement systems.

CONSTRUCTION PRODUCTIVITY

Productivity-basics – Levels of Productivity Models (economic, project, activity) – Productivity Measurement System – Planning control systems vs. Productivity measurement system – Framework for Productivity improvement – Productivity Analysis – Productivity Reporting – Productivity Assessment – Sources of lost time – Techniques for Measuring and

Improving Productivity – work sampling (tour and crew-based), foreman delay survey, crew-balance charts, process chart

INTRODUCTION TO LEAN AND PRINCIPLES

History of Management Science – Toyota's 14 Management Principles – What is Lean – Core concept of Lean – Fundamental Lean Principles - Types of waste (Muda, Mura, and Muri) – Muda (8 waste) – Types of Muda – Mura and Muri – Tools to find waste (sampling, surveys) – Conventional Construction Management vs. Lean Construction – Lean Research groups, institutes and conferences.

LEAN PROJECT DELIVERY PRACTICES

Flow – Craft vs. Mass vs. Lean Production - Push and Pull Mechanism – Airplane Game (illustrating flow-pull-waste), Behaviour of two systems – bottleneck, WIP, idle times, throughput, cycle time – Discussions – Last Planner System™ / Collaborative Planning System (master, look-ahead, weekly, daily front line plan, productivity measurement), PPC Variance and Root Cause Analysis – Discussions – Value stream mapping (definitions, typical value stream, procedure, symbols) – Example with discussions.

LEAN TOOLS AND CASE STUDIES

Building Information Modeling (BIM) – Location-based Management System (LBMS) – Construction Supply Chain Management – Integrated Lean Project Delivery (ILPD) – Case studies.

TOOLS

VisiLean

Excel

TUTORIALS

1. Productivity measurement systems (PMS)
2. Identification of wastes (Muda)
3. Discuss the Airplane game and its metrics
4. Develop a LPS for your life goals
5. Develop a VSM for a project
6. Introduction to VisiLean and demo

TEXTBOOKS

1. Patricia Tzortzopoulos, Mike Kagioglou and Lauri Koskela (2020), "Lean Construction – Core Concepts and New Frontiers", Routledge, Taylor & Francis Group, London and New York.
2. Alarcon (1997), "Lean Construction", A.A. Balkema Publishers, VT, USA.
3. Liker and Meier (2006), "The Toyota way Fieldbook", McGraw-Hill.
4. Liker and Hoseus (2008), "Toyota Culture The Heart and Soul of the Toyota way", McGraw-Hill.

5. Fredrick Harrison and Dennis Lock (2004), “Advanced Project Management”, Gower Publishing Company, VT, USA.

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1. Project Management Institute (PMI) (2017), “A Guide to the Project Management Body of Knowledge (PMBOK)”, 6th Edition.
2. Paul Akers (2014), “2 Second Lean”, FastCap Press.
3. Rother and Shook (1999), “Learning to See – VSM to create value and eliminate muda”, The Lean enterprise institute.
4. Eric Ries (2011), “The Lean Startup”.
5. IS 15883 (Part 1): 2009 – Construction Project Management – Guidelines.
6. IS 15883 (Part 2): 2013 – Construction Project Management – Guidelines, Part 2: Time Management.
7. ISO 21500:2012 – Guidance on Project Management.
8. ISO 9001:2015 – Quality Management Systems.
9. ISO 14001:2015 – Environmental Management Systems.
10. OHSAS 18001:2007 – Occupational Health and Safety Management Systems.
11. Saleh Mubarak (2010), “Construction Project Scheduling and Control”, John Wiley & Sons, Inc.
12. Rory Burke (2003), “Project Management – Planning and Control Techniques”, John Wiley & Sons, Inc.
13. James P. Lewis (2011), “Project Planning, Scheduling & Control”, The MCGraw-Hill Companies.
14. Prof. Koshy Varghese, IIT Madras “NOC: Project Planning and Control (Course Sponsored by Aricent)” – Link: https://nptel.ac.in/courses/105/106/105106149/.
15. Dozzi and AbouRizk (1993), “Productivity in Construction”, Institute for Research in Construction, National Research Council, Ottawa, Ontario, Canada.
16. John Brock (2009), “Applying “Lean Thinking” to project delivery”, White Paper – A Burt Hill Publication.
17. Bertelsen and Koskela (2004), “Construction beyond Lean: A New understanding of construction management”.
18. Howell (1999), “What is Lean Construction”, Proceedings of IGLC-7.
19. Marzouk et al. (2011), “Application of Lean principles to Design Processes in Construction consultancy firms”, International Journal of Construction Supply Chain Management, 1(1), 43-55.
20. Jorgensen and Emmitt (2008), “Lost in transition: the transfer of lean manufacturing to construction”, Engineering, Construction and Architectural Management, 15(4), 383-398.
21. Xin Qiu (2011), “Uncertainty in Project Management based on Lean Construction Implementation”, Advanced Materials Research, 328-330, 194-198.
22. Thomas et al. (1984), “Improving Productivity Estimates by Work Sampling”, Journal of Construction Engineering and Management, 110(2), 178-188.
23. Dasgupta and Varghese, “Investigation of relationship between results of work sampling and productivity measurement”.

24. Jenkins and Orth (2003), “Productivity Improvement through Work Sampling”, AACE International Transactions.
25. Chapter 7: Data gathering for on-site productivity-improvement studies.
26. Tucker (1982), “Implementation of Foreman-Delay Surveys”, Journal of Construction Division, ASCE, 108, 577-590.
27. Crew balance charts – Productivity Improvement in Construction (pg: 220-227).
28. Process flow diagrams - Productivity Improvement in Construction (pg: 228-239).
29. Thomas and Daily (1983), “Crew Performance Measurement via Activity Sampling”, Journal of Construction Engineering and Management, 109(3), 309-321.
30. Yu et al. (2009), “Development of Lean model for house construction using Value stream mapping”, Journal of Construction Engineering and Management, 135(8), 782-790.
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34. Kenley and Seppanen (2009), “Location-based management of construction projects: part of a new typology for project scheduling methodologies”, Proceedings of the 2009 Winter Simulation Conference.
35. Krishnamoorthy (2013), “Case study implementation of last planner system in water supply project”.
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40. Vaidyanathan, K. 2003, 'Value of Visibility and Planning in an Engineer-to-Order Environment' 11th Annual Conference of the International Group for Lean Construction. Virginia, USA.
41. AIA California Council (2007), “Integrated Project Delivery: A guide”.
42. Freire and Alarcon (2002), “Achieving Lean design process: Improvement methodology”, Journal of Construction Engineering and Management, 128(3), 248-256.
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44. Oskouie et al (2012), “Extending the interaction of building information modeling and lean construction”, Proceedings for the 20th Annual Conference of the International Group for Lean Construction.

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47. Popovska et al, “Teaching lean thinking through game: some challenges”.
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51. Tuholski at al. (2009), ““Lean” Comparison Using Process Charts of Complex Seismic Retrofit Projects”, Journal of Construction Engineering and Management, 135(4), 330-339.

BUILDING INFORMATION MODELING

Course Code: 20CE5124 **L-T-P-S: 3-0-2-0**

Prerequisite: NIL **Credits: 4**

Course Objective:

This course covers the essential knowledge a project manager should have to manage projects that are designed, delivered and constructed using Building Information Modeling tools, including Autodesk Revit. A project manager must know the differences between CAD and BIM and how to harness the power of BIM and the opportunities it creates for better design, collaboration, coordination and delivery.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Become familiar with the trends, concepts of Building Information Modeling	1,4	2
2	Learn about Project BIM Execution Planning	4	2
3	Design the BIM execution process by creating process maps	4,5	4
4	Develop BIM information exchanges	4,5	4
5	Developing BIM Model using Revit Software and submission of project report	4,5	4

Syllabus:

Basics of BIM

Fundamentals of Building Information Modeling, BIM, Project Delivery Methods & Trends BIM Adoption & Perceived ROI BIM for FM Concept BIM Proficiency Project Execution Planning

The Uses of BIM

BIM use classification system and structure, the purposes and objectives of BIM, elaborating on the BIM use characteristics, level of development, selection of BIM uses

Project BIM Execution Planning

Overview of the project execution planning procedure for BIM, identifying BIM goals and uses for a project, designing the BIM project execution process

Developing information exchanges

Pulling the information through the project, information exchange worksheet

Define supporting infrastructure for BIM implementation

Project information, project BIM goals / BIM uses, organizational roles and staffing BIM and facility data requirements, delivery strategy / contract

Implementing the BIM project execution planning procedure

Meeting Structure for Developing a BIM Project Execution Plan, Planning Meeting Schedule, Monitoring Progress against the BIM Execution Plan

Tools:

AUTO DESK REVIT SOFTWARE

BIM Engineer Structural RCC

Rivet 3D Modelling with following hands on practice with creation of families for elements and extraction of BOQ, BIM Engineer Architecture

1. Rivet Architecture
2. Preparation of plans,
3. Coordinated Drawings,
4. Clash Reduction,
5. 3D Modelling,
6. Elevations,
7. Extraction of Sections and BOQ.

Reference Books:

7. Eastman, C., Teicholz, P., Sacks, R., & Liston, C. (2011). BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.
8. Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.
9. Krygiel, E., & Nies, B. (2008). Green BIM: successful sustainable design with building information modeling. John Wiley & Sons.
10. Issa, R. R., & Olbina, S. (Eds.). (2015, May). Building Information Modeling: Applications and Practices. American Society of Civil Engineers. •Teicholz, P. (Ed.). (2013). BIM for facility managers. John Wiley & Sons.
11. Kymmell, W. (2007). Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations (McGraw-Hill Construction Series). McGraw Hill Professional.
12. Eynon, J. (2016). Construction Manager's BIM Handbook. John Wiley & Sons.
13. Pittard, S., & Sell, P. (Eds.). (2016). BIM and Quantity Surveying. Routledge.
14. Duell, R., Hathorn, T, and Hathorn, T.R. (2015), Autodesk Revit Architecture 2016 Essentials, Wiley and Sons, Inc.

Material Procurement Management

Course Code: 20CE51E1 **L-T-P-S: 3-0-0-0**

Prerequisite: NIL **Credits: 3**

Course Objective:

The main objective of this course to create procurement plan for a project and effective material management in the construction by using material management tools.

Mapping of Course Outcomes to Program Outcomes: The students will be able

CO No.	Course Outcomes	PO	BTL
1	Understand the significance of material management	1,3	2
2	Integrate important materials functions to both products and services & use MRP, ERP,& PLM managing materials	4	3
3	Apply various purchasing method and inventory controlling techniques into practice.	4	3
4	Use the Material Management tools like TALLY, ERP, SAP in materials planning, procurement, inventory, control, cost control etc.	4	3

Syllabus

Importance of Materials Management: Importance of material management and its role in construction industry-scope, objectives and functions, Integrated approach to materials management, Role of materials manager

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

Inventory and Stores Management:

(a) Inventory Management – Inventory Control techniques. EOQ, Advantages and limitation of use of EOQ, Periodic ordering, order point control, safety stock, stock outs, application of AC analysis in inventory control, concept of (JIT)- Just in time management, Indices used for assessment of effectiveness of inventory management.

(b) Stores Management: Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.

Quality Control and use of MMS: Quality Control – Conventional methods of quality control of Construction materials. Statistical method of quality control, sampling techniques quality control in process. Quality management and its economics. Use of (MMS) – Materials Management Systems in materials planning, procurement, inventory, control, cost control etc. Application of software in MM such as TALLY, ERP, SAP etc.

Reference Books

1. Purchasing and Inventory Control- by K. S. Menon, Wheeler Publication.
2. Materials Management, P.Gopalkrishnan, Prentice Hall
3. Handbook of materials management, P.Gopalkrishnan, Sundershan, Prentice Hall.
4. Inventory Management, L.C.Jhamb, Everest Publ.

GREEN BUILDINGS

Course Code: 20CE51E2 **L-T-P-S: 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Course Objective:

The objective of this course is to expose the student to concepts of embodied, operational and life cycle energy, minimizing energy consumption by optimal design. The course also intends to make student aware of ECBC, LEED, GRIHA etc.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand Necessity and importance of Sustainable/ Green Buildings, Grasp the construction practices of a sustainable Buildings.	5,6	2
2	Understanding the Green Building Rating Systems, Water & Energy efficiencies, Reduction in waste material during construction and Building Design	1,2,6	3
3	Understanding Air Conditioning and HVAC system design, Salient features of CII Godrej Green Business Center	5,6	3
4	Understanding Indoor Environment Quality and Occupational Health, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,	3	2

Syllabus:

Introduction

What is Green Building, why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building, Important Sustainable features for Green Building,

Green Building Concepts and Practices

Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation;

Green Building Opportunities and Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, LEED India Rating System and Energy Efficiency,

Green Building Design

Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximize System Efficiency, Use of Renewable Energy Sources. Ecofriendly captive power generation for factory, Building requirement,

Air Conditioning

Introduction, CII Godrej Green business center, Design philosophy, Design interventions, Energy modeling, HVAC System design, Chiller selection, pump selection, Selection of cooling towers, Selection of air handing units, Precooling of fresh air, Interior lighting system, Key feature of the building. Eco-friendly captive power generation for factory, Building requirement.

Material Conservation

Handling of non-process waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture;

Indoor Environment Quality and Occupational Health: Air conditioning, Indore air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of IAQ, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,

Tools:

Design Builder/OpenBuildings/eQuest : Assessment and optimization of building energy requirements.

Textbooks:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Handbook by Tomwoolley and Samkimings, 2009.

Reference Books:

1. Complete Guide to Green Buildings by Trish riley
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

Case Study

Students must visit minimum of 5 construction Sites practicing green building principles and shall submit the reports on various green building materials and green building practices that are being implemented with respect to building rating systems by IGBC and LEED.

CONSTRUCTION PERSONNEL MANAGEMENT

Course Code : 20CE51F1 **L-T-P-S : 3-0-0-0**

Prerequisites: - Nil - **Credits: 3**

Course Objective: Primary objective of this course is to Introduce the elements of human behavior and their impact on construction personnel management and to explore fundamentals of human behavior under varying stress conditions and apply the studied behavior pattern to manpower planning in organizational setups

Course Outcomes (CO): students will be able to

CO No:	CO	PO	BTL
1	Understand Overview of manpower planning and roles of HR	**2,3**	**2**
2	Understand Detail about the organizations and structure variance for organizations	**2,3,4**	**2**
3	Understand human relations and organizational behavior for working in an organization	**3,4**	**2**
4	Understand welfare measures and laws related to welfare measures and Detail overview of management and development methods	**1,2**	**2**

Syllabus:

MANPOWER PLANNING

Manpower Planning process, Organizing, Staffing, directing, and controlling – Estimation, manpower requirement – Factors influencing supply and demand of human resources – Role of HR manager – Personnel Principles.

ORGANISATION

Requirement of Organisation – Organisation structure – Organisation Hierarchical charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection strategies – Placement and Training.

HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR

Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership-Engineer as Manager – all 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.

WELFARE MEASURES

Compensation – Safety and health – GPF – EPF – Group Insurance – Housing - Pension – Laws related to welfare measures.

MANAGEMENT AND DEVELOPMENT METHODS

Wages and Salary, Employee benefits, Employee appraisal and assessment – Employee services – Safety and Health Management – Special Human resource problems – Productivity in human resources – Innovative approach to designing and managing organization – Managing New Technologies – Total Quality Management – Concept of quality of work life – Levels of change in the organizational Development – Requirements of organizational Development – System design and methods for automation and management of operations – Developing policies, practices and establishing process pattern – Competency up gradation and their assessment – New methods of training and development – Performance Management.

Text Books:

1. Carleton Counter II and Jill Justice Coutler, The Complete Standard Handbook of Construction Personnel Management, Prentice-Hall, Inc., 1989.

References:

1. Charles D Pringle, Justin GooderiLongenecter, Management, CE Merril Publishing Co. 1981.
2. Dwivedi R.S, Human Relations and OrganisationalBehaviour, Macmillian India Ltd.,2005.
3. Josy.J. Familaro, Handbook of Human Resources Administration, McGraw-Hill International Edition, 1987.
4. Memoria,C.B., Personnel Management, Himalaya Publishing Co., 1997.

Pre-Engineering Construction and Technology

Course Code: 20CE51F2 **L-T-P-S : 3-0-0-0**

Prerequisites: - Nil - **Credits: 3**

Course Objective:

The main objective of the course is to understand production, construction design and stability of precast concrete structures. Various design and construction aspects considered in this course is precast beams, columns, shear walls and roof girder and connections

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand the type of prefabricated elements and its importance	3,5	2
2	Understand the precast construction procedure	3,5	2
3	Understand the modular construction practices and its limitations and advantages	3,5	2
4	Apply knowledge in the choice of production setup and manufacturing methods	3,4,5	3

Syllabus

General Principles of Prefabrication

Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames.

Precast Systems: Design Principles- Large Panel System - Frame System-Slab-Column System with Shear Wall- Precast sandwich Panels, Prestressed concrete solid flat slabs, Hollow core slab/panels, Prestressed concrete Double “T”, Bridge, Precast segmental Box Girders, Specifications and Seismic considerations

Modular Construction Practices: Introduction to Modular Construction, Modular coordination, Modular Standardization, Modular System Building, Limitation and Advantages of Modular Construction

Production and Hoisting Technology

Choice of production setup – manufacturing methods –stationary and mobile production – planning of production setup – storage of precast elements – dimensional tolerances – acceleration of concrete hardening. Equipment's for hoisting and erection – techniques for erection of different types of members like beams, slabs, wall panels and columns – vacuum lifting pads

References:

1. CBRI, Building materials and components, India, 1990
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
3. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
4. Structural design manual, Precast concrete connection details, Socie

MECHANIZED CONSTRUCTION AND MACHINERY

Course Code: 20CE5225 **L-T-P-S: 3-0-2-0**

Prerequisites: - NIL **Credits: 4**

Course Objective: To develop the skills to understand about the mechanized construction machinery, through standard types of equipment, earthmoving equipment, pumping equipment, pumping equipment and all certain construction handling equipment. Every project has one specific purpose, it starts at some specific moment and it is finished when its objectives have been fulfilled. Similarly management increases the productivity through equipment and skill.

CO No:	Course Outcome CO	PO	BTL
CO1	Understanding the basic concepts of Equipment Management and tools	**1,4**	2
CO2	Understand various construction equipment and study the efficient utilization of the same using scientific principles	**1,4**	2
CO3	Apply the knowledge for the selection of appropriate equipment	**4**	3
CO4	Understand the operation of Earthwork and various functions of machinery used for Earth moving, compaction, etc.	**1**	2
CO5	Write field report on machinery operation, cost and productivity by using project management tools like primavera/Candy/SAP etc	**2**	3

Syllabus:

Equipment Management:

Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, interest on capital, Manpower, Spare parts etc., Documentation, Logbooks, History Books, Periodical MIS Report

Construction Equipment:

Understanding basics, Capacity, Function & Efficiency of All Machinery, involving all machinery data, power use, fuel consumption and labor utilization. Special equipment, cost of owning and operating equipment, Work cycle time of any machine with corrective factors, depreciation of equipment, operative cost, inventory cost control, higher/rental- a) Average Investment value, b) Annual Ownership Cost, factors affecting selection of construction equipment, balancing of equipment. Study of equipment with reference to available types and their types and their capacities, factors affecting their performance

Fundamentals of Earth Work Operations - Earth Moving Operations-Types of Earthwork Equipment - Tractors, Motor Graders, Scrapers, Front end Loaders, Earth Movers – capacity calculations.

Equipment for compaction - Types of pumps used in Construction - Equipment for Grouting - Pile Driving Equipment- Equipment of Erection and demolition.

Equipment for Earthmoving Machinery, Concreting Equipment, Material Handling Equipment such as cranes, boom, lift and maintenance transportation Equipment's.

Screening equipment

Crushers – Feeders - Screening Equipment - Batching and Mixing Equipment – Hauling equipment - Pouring and Pumping Equipment – Ready mixed concrete carriers.

Textbooks:

1. Construction planning, Equipments and methods. R.L.Peurify, TMH, 1996

Reference:

1. "Construction Equipment and its Planning and Applications", Mahesh Varma, Metropolitan Book Co.(P) Ltd., New Delhi. India.
2. Construction Machinery and Equipment in India". (A compilation of articles Published in Civil Engineering and Construction Review) Published by Civil Engineering and Construction Review, New Delhi, 1991

List of Experiments supposed to finish in Open Lab Sessions:

Lab session no	**List of Experiments**
1	Introduction to the construction phases and equipment's specially used in construction sites
2	Tractors and Attachments in construction
3	Forklift in construction and utilization of equipment
4	Bulldozers in construction
5	Clamshell as Construction equipment
6	Drilling Equipment in construction
7	Roller Compactors as Construction equipment
8	Concreting Equipment's for Construction
9	Dragline as Construction equipment
10	Road construction & special equipment
11	Hydraulic excavators in construction sites
12	Trenching machines in construction

PROJECT FORMULATION AND APPRAISAL

Course Code: 20CE5226 **L-T-P-S : 3-1-0-0**

Prerequisites: - NIL **Credits: 4**

Course Objective: The objectives of this course are to:

• Introduce students to the concept of project and idea formulation;

• Enhance the understanding of students on project management and appraisal

COURSE OUTCOMES (COs):

CO No	Course Outcome (CO)	PO	Blooms Taxonomy Level (BTL)
CO1	Understand the concept of project and Identification of best Project by understanding the different feasibility studies	1,2	2
CO2	Estimating the cash flows by considering the time value of money.	4	3
CO3	Identify the best project by analyzing facts related economic, commercial and financial aspects.	2,4	3
CO4	Understand in detail about Private sector partnership in construction projects.	1	2

Syllabus:

Project Formulation

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

Project Costing

Project Cash Flows – Time Value of Money – Cost of Capital

Project Appraisal

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

Project Financing

Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios

Private Sector Participation

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

References:

1. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation, Review,Tata McGraw Hill Publishing Company Ltd., New Delhi. 2006.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan, India Ltd., 1992.
3. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1987.
4. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.

LIST OF REPORTS THAT STUDENT CAN MAKE:

S.NO	TOPICS
1	Feasibility Analysis of sample project
2	Financial Analysis of sample project
3	Pre-Investment Analysis of sample project
4	Preparation of Project Report of sample project
5	Project Costing Cost of Capital
6	Technical Appraisal and Commercial Appraisal of sample project
7	Financial Appraisal of sample project - 1
8	Financial Appraisal of sample project - 2
9	Project Financing and Financial Institutions
10	Private sector participation in Infrastructure Development Projects
11	Technology Transfer and Foreign Collaboration

CONSTRUCTION LAWS AND REGULATIONS

Course Code: 20CE5227 **L-T-P-S : 3-1-0-0**

Prerequisites: - NIL **Credits: 4**

Course Objective:

The objective of the course is to expose students in understanding contract laws and regulations so that adequate knowledge on formulating and managing construction contracts is gained. Course includes the elements of concluding and administering contracts also it will make student achieve awareness on arbitrations and legal procedures. Students will be gaining knowledge of labour regulations and their impact on managing of contracts

Mapping of Course Outcomes to Program Outcomes: The students will be able

CO No.	Course Outcomes	PO	BTL
1	Understand the concept of construction laws and regulations.	2,5	2
2	Study the current trend toward alternative project delivery systems via contractual arrangements such as design-build and construction management at risk	3	2
3	Investigate how to avoid the possibilities of construction disputes via alternative dispute resolution (ADR)	1,4	3
4	Understand the Labor regulations and review construction contracts and specifications	2,5	3

Syllabus:

Construction Contracts

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

Tenders

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 – Andhra Pradesh Transparency in Tenders Act.

Arbitration: 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.

Legal Requirements

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.

Labour Regulations

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 – Andhra Pradesh Factory Act – Child Labour Act - Other Labour Laws.

Tools: MS Word, Spread Sheets and Excel and PPT

Field Study Report: Includes Discussions and Expert Talk

1. Types of Contracts, Suitability
2. Study of Contract Documents
3. Standard Contract Document
4. Evaluation of Tender from Technical, Contractual and Commercial Points of View
5. Potential Contractual Problems – World Bank Procedures and Guidelines
6. Agreements
7. Insurance and Bonding
8. Custom Duties and their Influence on Construction Costs
9. Property Law, Agency Law
10. Local Government Laws for Approval
11. Social Security
12. Welfare Legislation
13. Insurance and Safety Regulations

Textbooks

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India,
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001.

References:

1. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.
2. Kwaku, A., Tenah, P.E. Jose M.Guevara, P.E., Fundamentals of ConstructionManagement and Organisation, Printice Hall, 1985.M.M.Tripathi Private Ltd., Bombay, 1982. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) PrivateLimited, 2006.

QUALITY MANAGEMENT AND SAFETY MANAGEMENT SYSTEMS IN CONSTRUCTION

Course Code: 20CE5228 **L-T-P-S: 3-0-2-0**

Prerequisites: - NIL **Credits: 4**

Course Objective: This course provides complete understanding on quality planning, quality assurance, quality control and safety management. The fundamental reason for the course is to impart knowledge and skill for the construction students to achieve success in quality management system (QMS) by understanding and evaluating quality management principles as a formalized system that has documents, processes, procedures, and authorities, responsibilities and for achieving quality policies and objectives

Course Outcomes (CO): students will be able to

CO No:	CO	PO	BTL
1	Understand the concepts of quality management and the factors influencing construction quality	1,3,4	2
2	Understand quality planning and programs in construction industry	3,4	2
3	Acquire knowledge of quality management systems and ISO 9000 family of standards.	1,3,4	2
4	Understand and analyses quality circle (QC) concepts for possible implementation to solve construction productivity and quality problems	1,3,4	3
5	Understand and evaluate safety management principles in construction	2,4	5

Syllabus:

Quality Management: Introduction – Definitions and objectives – Factors influencing construction quality –Responsibilities and authority – Quality plan – Quality Management Guidelines – Quality circles.

Quality Systems: Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

Quality Planning: Quality Policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi's concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures -Processes and products – Total QA / QC programmed and cost implication.

Quality Assurance And Quality Improvement Techniques: Objectives – Regularity agent, owner, design, contract and construction oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals, Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, –Stability methods and tools, optimum design – Reliability testing, Reliability coefficient and reliability prediction - Life cycle costing – Value engineering and value analysis. Quality Improvement Tools and Techniques.

Safety Management Systems: Fundamental of safety management, construction safety, safety in scaffolding and working platform, welding and handling, excavation work, concreting and cementing work. Building construction, TAC and NBC rules, High rise building. Evolution of modern safety concept- Safety policy - Safety Organization. Safety survey, safety inspection, safety sampling, Safety Audit. Concept of an accident, Reportable and non reportable accidents, unsafe act and condition principles of accident prevention, Overall accident investigation process. Risk management

References:

1. Hutchins.G, ISO 9000: A Comprehensive Guide to Registration, Audit Guidelines and
   Successful Certification, Viva Books Pvt. Ltd., 1994.
2. James, J.O' Brian, Construction Inspection Handbook – Total Quality Management, Van
   Nostrand, 1997.
3. John L. Ashford, The Management of Quality in Construction, E &F.N.Spon, 1989.
4. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, McGraw Hill, 2001.
5. Kwaku.A., Tena, Jose, M. Guevara, Fundamentals of Construction Management and Organisation, Reston Publishing Co., Inc., 1985.
6. Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longm.

List of Experiments supposed to finish in Open Lab Sessions:

Lab session no	List of Experiments
1	Procurement of materials and equipment used in construction
2	Preparation of specifications for incoming construction materials (Field Visit)
3	Quality tests on construction materials (Concrete Lab)
4	Preparation of specifications for execution (Deviations from plan to execution in terms of Structure)
5	Preparation of specifications for finished structure (Deviations from plan to execution in terms of architecture) (Field Visit)
6	Establishment of identification and traceability of materials in a residential project
7	Establishment of inspection and test status in a residential project
8	Formation of Safety audit in a high-rise building
9	Calibration of equipment in a residential project (Field Visit)
10	Preparation of guidelines for safety in the construction area

STATISTICAL METHODS IN CONSTRUCTION

Course Code: 20CE52G1 **L-T-P-S: 3-0-0-0**

Prerequisite: NIL **Credits: 3**

Course Objective:

The objective of this course is to collect, process, summarize, and analyze valid, scientific data for various aspects of construction requirements. The implementation of the statistical data either correlation or simulation can be applicable to predict and mitigate uncertainties in construction.

Mapping of Course Outcomes to Program Outcomes: The students will be able

CO No.	Course Outcomes	PO	BTL
1	Apply discrete and continuous probability distribution including requirements mean and variance and making decisions	5	4
2	Use the concepts of standard deviation, coefficient variance in different types samples and apply the tests	5	3
3	Perform the correlation analysis in various civil engineering projects	5	4
4	Apply simulation techniques for analysis and mitigation of construction project risks	5	3

Syllabus:

Probability: Probability theory and its importance: Definition of probability, Rules of Probability, The Baye‘s theorem. Random variable. Probability distribution. Mean or Expectation of Random variable. Properties of Mean of Expectation.

Distributions: Theoretical probability Distributions: Binomial Distribution, Poisson Distribution. Normal Distribution, Exponential Distribution, Beta, Gamma

Sampling: Sampling and sampling distribution: Probability samples, Non-probability Samples, sample Random sampling, other sampling schemes, sampling distribution and Standard error, some Sampling and Quality control. Use of concepts of standard deviation, Coefficient of variance, range in quality control of concreting and similar such activities.

Testing: Testing Hypothesis: Sampling of distribution – Test based on Normal Distribution, Students test, chi-square, K-S test for goodness of fit and distribution. Analysis of variance one Way & two way classification

Correlation Analysis: Correlation types, co-efficient. Bi-variate Frequency Distribution, Scatter Diagram, Correlation Analysis, Practical applications in civil engineering projects. Regression Analysis: Regression and Multivariate Analysis, Multiple Regression Analysis Nonlinear Regression. Use of regression analysis in Construction Projects.

Simulation: Simulation – Types, case studies in construction using simulation Techniques, simulation software‘s used. Griffi‘s waiting line Method, Concept of Downtime Cost of Equipment, Cox and Nunally Model, Failure Cost Profile (FCP), LID.

Applications: Use of mathematical models based on probabilistic and statistical methods, Simulation in risk identification, analysis and mitigation of project risks. EOQ in civil Engineering, Sensitivity analysis, ABC analysis.

TEXTBOOKS:

1. Applied Statistics and Probability for Engineers---Montgomery and Runger—Wiley,India.
2. Probability and Statistics for Engineers –Miller, Freund-Hall, Prentice India Ltd. 2009
3. Applied Mathematics for Engineers and Physiscists-pipes and Harvill. McGraw Hill International Edition, 1970

References:

1. Sampling techniques-Cochran, Wiley Series, 2008.
2. Statistics-Concepts and Controversies-David S. Moore-Freeman Company, New York.
3. Reliability Principles and practices-Calabro-McGraw Hill Book Company, 1963
4. Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley, 1989.
5. Applied Statistics for Civil and Environmental Engineers by Kottegoda.- Stratford Books

PROJECT RISK MANAGEMENT

Course Code: 20CE52G2 **L-T-P-S: 3-0-0-0**

Prerequisite: NIL **Credits: 3**

Course Objective

This course covers the area of risk management in the project context. It highlights the importance of risk management and the need for project managers to think ahead in this regard. It contains essential risk management theory and concepts as applicable to project environments including project risk planning, preparation and response. It also overviews the areas of risk identification, assessment, monitoring and control. Qualitative and quantitative risk analysis techniques will be presented to students within this course.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Identify the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity	1,3	2
2	Cultivate an idea on effective resource utilization and identify factors affecting job productivity	1,5	2
3	Apply the professional skills acquired in managing a construction project.	3	3
4	Gain the ability to attain an equilibrium among Innovation, Technology and Economic feasibility	3	3

Syllabus:

Risk analysis

General – Importance of Risk, types of risks, quantifiable and un-quantified risks. Micro, market, project level risk analysis approach. Risk analysis and Management for projects (RAMP) – Identifying risk events. Probability distribution. Stages in

Investment, life-cycle; determination of NPV and its standard deviation for perfectly co-related, moderately co-related and un-correlated cash flows. Dealing with uncertainties

Sensitivity analysis, scenario analysis simulation, decision tree analysis, risk profile method, certainly equivalent method; risk adjusted discount rate method, certainty index method, point estimated method.

Use of risk prompts, use of Risk Assessment tables, details of RAMP process, utility of Grading of construction entities for reliable risk assessment. Risk Mitigation – by elimination, reducing,

transferring, avoiding, absorbing or pooling. Residual risk, mitigation of un-quantified risk. Coverage of risk through CIDC's MOU with the Actuarial Society of India

through risk premium such as (BIP) – Bidding Indemnity Policy (DIMO) – Delay in meeting obligation by client policy, (SOC) – Settlement of claims policy (LOP)- Loss of profit policy (TI). Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy.

Reference Books

1. Project Risk Analysis And Management Guide By John Bartlett APM Publishing Limited, 2004 2nd Edition
2. Industrial Engineering And Management Of Manufacturing Systems.- Dr.Surendra Kumar Satya Prakashan
3. RAMP Handbook By Institution Of Civil Engineers And The Faculty And Institute Of Actuariesthomas Telford Publishing, London.
4. Construction Engineering And Management – Seetharaman.
5. Projects Planning Analysis Selection Implementation And Review – Prasanna Chandra.
6. Construction Project Management, K. K. Chitkara, Tata Mcgraw Hill Publ.
7. Construction Management Practice, Dr.V.K.Raina, Shroff Publ.
8. Projects, Prasanna Chandra, Tata Mcgraw Hill Publ.
9. Project Management, K.Nagarajan, New Age International
10. www.cidc.in

EMERGING CONSTRUCTION TECHNOLOGIES

Course Code: 20CE52H1 **L-T-P-S : 3-0-0-0**

Prerequisites: - Nil - **Credits: 3**

Course Objective:

This course covers the complete understanding of advanced construction techniques in sub structure super structure and repair construction Course will create awareness on tall structure construction elements and techniques used for large span structures. Course also covers about the recent and advancement in construction techniques. The course also covers the recent advancement in concrete manufacturing and its application.

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No.	Course Outcomes	PO	BTL
1	Understand the modern construction techniques used in the sub structure construction	3	2
2	Understand the concepts used in the construction of special structures	3	2
3	Apply mechanism/technique for strengthening and repair methods for different cases.	3,5	3
4	Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings	3,5	3

Syllabus:

GFRC Facade Panels System, Prefabricated Building, Vertical ICF Wall, Mechanical Concrete, Filterpave systems, FRP Rebar, FRP Deck: Rehabilitation of a Steel Truss Bridge, Concrete Lumber, Bone-shaped Short Fiber Composite, Slurry Infiltrated Mat Concrete, Alternative Material Dowel Bars for Rigid Pavement Joints, Snap Joint Technology for Composite Structures, Superpave System,

Modular FRP Composite Bridge Deck, Composite Column Reinforcement, Rapid In situ Load Testing, Carbon Fiber Reinforced Polymer (CFRP), Polymer Concrete Pipes, Use of Composite Piping Offshore, Recycled Plastic Composite Railroad Ties. High Performance Steel (HPS), Embedded Galvanic Anodes, DIS Seismic Isolator, Hydraulic Vibratory Pile Driver, Soft Trencher, Deep Mixing Method for Ground Improvement, Mortar less Concrete Block System, Post-tensioned Steel Structure

Attachment of Steel Decking using Mechanical Fasteners and Powder Actuated or Pneumatic Tools, Seismic Isolation Bearings, Bridge Lock-up Device System, Adjustable Steelwork Connectors, Precast Hybrid Moment Resistant Frames, Precast Concrete Beam to Column System (BSF)

Low Temperature Concrete Admixture, Use of Recycled Tire Rubber in Concrete, Steel Free Concrete Bridge Deck, Rapid Repair Products, Concrete Restoration & Protection System, Precast Inverted T Beam, Conductive Concrete, Smart Concrete.

Rapid Drying Concrete, Rapid-1 Hardening Accelerator Concrete Admixture, Reactive Powder Concrete, Mellose non-dispersible Underwater Concrete, Segment Precast Floating Draw Span, Self-Placing Concrete, Shrinkage Reducing Admixture for Concrete, Corrosion Inhibitors for Reinforced Concrete, High Performance Concrete(HPC).

Text Books:

1. Levitt. M., Precast concrete - Materials, Manufacture Properties and Usage, Applied Science Publs. 1982,
2. Konex.T., Handbook of Pre-cast Construction, Vol.1.2&3.

References:

3. Richardson,J.G., Pre-cast concrete Production, Cement and Concrete Association, London, 1973.
4. MadhavaRao.A-G., Modern Trends in Housing in Developing Countries, Oxford & UBH Publishing co., 1985. -
5. Lewicki.B., Building with Large Pre-fabrications, Elsevier Publishers.
6. Large Panel Prefabricated Constructions, Proc. of Advance Course conducted by SERC, Madras.
7. Bruggeling, A.S.G., &Huyghe.G.F., Prefabrication with Concrete, A.s.A., Balkema Publishers, Netherland, 1991.

RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION

Course Code: 20CE51H2 **L-T-P-S:3-0-0-0**

Prerequisites: Nil **Credits: 3**

Course Objective:

This course studies the resources required for construction like material, equipment, labour and time and comprehend the effective management of the same towards fruitful completion of the project and understanding of various systems and methods related to management of resources and levelling of resources.

Course Outcomes (CO): Student shall be able to

CO No:	CO	PO	BTL
1	Understand overview of the resource planning and management of resources in construction	**3,4**	**2**
2	Understand in detail about the labor management and optimization	**1,4**	**2**
3	Understand equipment management and effective utilization of the material resources	**1,4,5**	**2**
4	Understand detail about the allocation and levelling of resources with time management	**3,4**	**2**

Syllabus

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

Labor Management: Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labor, Classes of Labor, Cost of Labor, Labor schedule, optimum use Labor.

Materials and Equipment: Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

Time Management, Resource Allocation and Leveling: 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. Time-cost trade off, Computer

application – Resource leveling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management.

Textbooks:

1. Andrew,D., Szilagg, Hand Book of Engineering Management, 1982.
2. Harvey, A., Levine, Project Management using Micro Computers, Obsorne -McGraw Hill C.A.Publishing Co., Inc. 1988.Industry, Granda Publishing Ltd., 1980.

Reference:

1. James.A.,Adrain, Quantitative Methods in Construction Management, American Elsevier Publishing Co., Inc., 1973.
2. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd.

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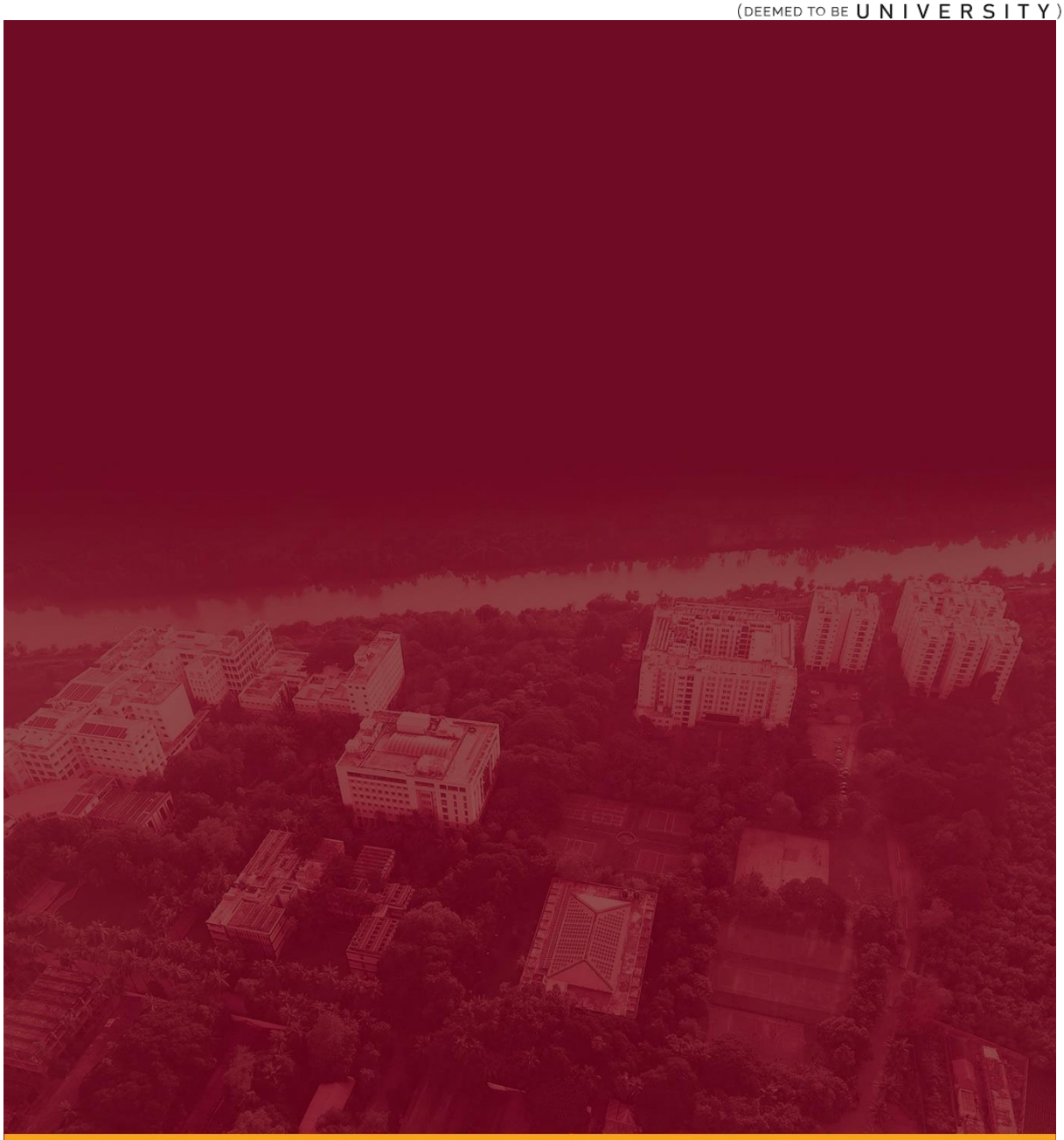

KONERU LAKSHMAIAH EDUCATION FOUNDATION

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