

**Learning Outcomes based Curriculum Framework
(LOCF)**

For

**Master of Technology in Civil Engineering
(Construction Technology and Management)
Two Year Regular Full-Time
Postgraduate Programme**



**Faculty of Engineering and Technology
Chaudhary Devi Lal University
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1. Faculty of Engineering & Technology

The Faculty covers the professional and academic programmes/courses run in the university teaching department of computer science and engineering, university school of graduate studies, affiliated general degree colleges, institute of computer applications and engineering colleges. BTech and MTech programmes in major disciplines and MCA, MSc Data Science, BSc Data Science, BCA programmes are managed by the Faculty.

2. Learning Outcome based Curriculum Framework

The CBCS evolved into learning outcome based curriculum framework and provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidates.

2.1 Objectives of the programme

After spending two years in their profession Master of Technology C.E. (CTM) Regular Full-Time graduates are expected to:

- apply knowledge and expertise - gained thus far - in problem-solving skills development and maintenance of infrastructure construction, tools, applications; academia and research in local and cross-border settings;
- be well adept in management of infrastructure development projects bearing techno-economical and social-behavioural delimitations; management of educational and research establishment; management of own start-up enterprise.
- exhibit support for peers and leadership by spearheading the projects teams; entrepreneurial skills by conceptualising new projects management technique; contributing to research and academia by way of undertaking research and academic assignments.
- engage in lifelong learning, career enhancement and adapt to changing professional, societal, and environmental needs in a way conforming to his/her position in the profession/vocation;
- develop communication skills necessary to function productively in the given settings to achieve a successful professional/vocational career with academic and professional ethics and social obligations.

2.2 Programme Outcomes (POs)

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs

	with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

2.3 Programme Specific Outcomes (PSOs)

The graduates of the Master of Technology in Civil Engineering (CTM) programme will have/be:

PSO1	Ample knowledge of principles and practices of civil engineering and capability of putting these principles to use in solving infrastructure relevant problems.
PSO2	Working knowledge of using modern methods, tools and technologies like simulation & modelling and CASE tools in development and operations of various flavours of civil engineering applications and in conduct of research.
PSO3	well acquainted in adoption and application of skills gained during research and practice and exhibit a taste for adopting trending construction processes to optimise and solve problems.
PSO4	Working knowledge set for practicing their respective vocation/profession with ethics, integrity, leadership, and social responsibility.
PSO5	Equipped to achieve their career goals in the academia/industry or pursue higher studies and enhance their professional knowledge.

3. Programme Structure

Master of Technology in Civil Engineering (CTM) programme a four-semester postgraduate programme is 80 credits weightage consisting of Core Courses (CC), Discipline Specific Elective Courses (DSC), Skill Enhancement Courses (SEC), and Open Elective Courses (OEC).

Table 1: Master of Technology in Civil Engineering (CTM) Credit Scheme

Sem	Core Courses (CC)		Discipline Specific Elective Courses (DSC)		Skill Enhancement Courses (SEC)		Open Elective Courses* (OEC)		Grand Total Credit
	No. of Course	Total Credit	No. of Course	Total Credit	No. of Course	Total Credit	No. of Course	Total Credit	
I	5	20	01	04	-	-	-	-	24
II	4	16	01	04	-	-	01	04	24
III	2	08	01	04	01	04	01	04	20
IV	-	-	-	-	01	12	-	-	12
Total	11	44	03	12	02	16	02	08	80
% age	-	55.00	-	15.00	-	20.00	-	10.00	100%

* A total of 08 credits are to be earned from other Engineering Departments or from MOOCs.

Table 2: Detailed break-up of Courses' Type (Semester wise)

Semester	Core Courses	Discipline Specific Elective Courses	Skill Enhancement Courses	Open Elective Courses	Total Courses
I	CC1 CC2 CC3 CC4 CC5	DSC1 DSC1(i) to DSC1(iv)	-	-	6
II	CC6 CC7 CC8 CC9	DSC2 DSC2(i) to DSC2(v)	-	OEC1	7
III	CC10 CC11	DSC3 DSC3(i) to DSC3(iii)	SEC1	OEC2	5
IV	-	-	SEC2	-	1

Table 3: Courses: Codes, Titles and Credits

Course Code	Course Title	Workload/Credit			
		L	T	P	Total
Semester I					
MTECH/CE/CTM/1/CC1	CONSTRUCTION MANAGEMENT	4/4	-	-	4/4
MTECH/CE/CTM/1/CC2	INFRASTRUCTURE DEVELOPMENT AND BOT, BOOT PROJECTS,	4/4	-	-	4/4
MTECH/CE/CTM/1/CC3	ESTIMATION TENDERING & BIDDING	3/3	1/1	-	4/4
MTECH/CE/CTM/1/CC4	CONSTRUCTION COSTING AND FINANCIAL MANAGEMENT	3/3	1/1	-	4/4
MTECH/CE/CTM/1/CC5	CONCRETE TESTING LAB.	-	-	8/4	8/4

MTECH/CE/CTM/1/DSC1(i)	TECHNOLOGY MANAGEMENT	4/4	-	-	4/4
MTECH/CE/CTM/1/DSC1(ii)	OPTIMIZATION TECHNIQUES				
MTECH/CE/CTM/1/DSC1(iii)	CONCRETE CONSTRUCTION TECHNOLOGY				
MTECH/CE/CTM/1/DSC1(iv)	PAVEMENT CONSTRUCTION TECHNIQUES				
Semester II					
MTECH/CE/CTM/2/CC6	PROJECT FORMULATION AND APPRAISAL	4/4	-	-	4/4
MTECH/CE/CTM/2/CC7	CONTRACT AND ADMINISTRATION PLANNING	3/3	1/1	-	4/4
MTECH/CE/CTM/2/CC8	BUILDING MAINTENANCE	4/4	-	-	4/4
MTECH/CE/CTM/2/CC9	GEO-TESTING LAB	-	-	8/4	8/4
MTECH/CE/CTM/2/DSC2(i)	RURAL CONSTRUCTION TECHNOLOGY	4/4	-	-	4/4
MTECH/CE/CTM/2/DSC2(ii)	ENVIRONMENTAL ENGINEERING & MANAGEMENT				
MTECH/CE/CTM/2/DSC2(iii)	ADVANCED CONSTRUCTION TECHNOLOGY				
MTECH/CE/CTM/2/DSC2(iv)	ADVANCED CONCRETE MATERIALS				
MTECH/CE/CTM/2/DSC2(v)	GREEN BUILDINGS AND SERVICES				
MTECH/CE/CTM/2/OEC1	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4/4	-	-	4/4
Semester III					
MTECH/CE/CTM/3/CC10	CONSTRUCTION EQUIPMENT	3/3	1/1	-	4/4
MTECH/CE/CTM/3/CC11	COMPUTER APPLICATIONS IN CIVIL ENGG.	-	-	8/4	8/4
MTECH/CE/CTM/3/DSC3(i)	PUBLIC PRIVATE PARTNERSHIP CONCEPTS IN INFRASTRUCTURE	4/4	-	-	4/4
MTECH/CE/CTM/3/DSC3(ii)	RESEARCH METHODOLOGY, PATENT AND IPR				
MTECH/CE/CTM/3/DSC3(iii)	CONTRACTS AND LEGAL ISSUES				
MTECH/CE/CTM/3/OEC2	Students shall complete a 4-credit open elective course offered by other Engineering Departments/MOOCs	4/4	-	-	4/4
MTECH/CE/CTM/3/SEC1	DISSERTATION PART-1 WITH SEMINAR	-	-	08/04	08/04
Semester IV					
MTECH/CE/CTM/4/SEC2	DISSERTATION PART- 2	-	-	24/12	24/12
TOTAL		48/48	4/4	56/28	108/80

Table 4: M.Tech CE CTM Regular Full Time Courses' List

Course Code	Course Title	Credits
Core Courses		
MTECH/CE/CTM/1/CC1	CONSTRUCTION MANAGEMENT	4
MTECH/CE/CTM/1/CC2	INFRASTRUCTURE DEVELOPMENT AND BOT, BOOT PROJECTS,	4
MTECH/CE/CTM/1/CC3	ESTIMATION TENDERING & BIDDING	4
MTECH/CE/CTM/1/CC4	CONSTRUCTION COSTING AND FINANCIAL MANAGEMENT	4
MTECH/CE/CTM/1/CC5	CONCRETE TESTING LAB.	4
MTECH/CE/CTM/2/CC6	PROJECT FORMULATION AND APPRAISAL	4
MTECH/CE/CTM/2/CC7	CONTRACT AND ADMINISTRATION PLANNING	4
MTECH/CE/CTM/2/CC8	BUILDING MAINTENANCE	4
MTECH/CE/CTM/2/CC9	GEO-TESTING LAB	4
MTECH/CE/CTM/3/CC10	CONSTRUCTION EQUIPMENT	4
MTECH/CE/CTM/3/CC11	COMPUTER APPLICATIONS IN CIVIL ENGG.	4
Discipline Specific Elective Courses		
MTECH/CE/CTM/1/DSC1(i)	TECHNOLOGY MANAGEMENT	4
MTECH/CE/CTM/1/DSC1(ii)	OPTIMIZATION TECHNIQUES	
MTECH/CE/CTM/1/DSC1(iii)	CONCRETE CONSTRUCTION TECHNOLOGY	
MTECH/CE/CTM/1/DSC1(iv)	PAVEMENT CONSTRUCTION TECHNIQUES	
MTECH/CE/CTM/2/DSC2(i)	RURAL CONSTRUCTION TECHNOLOGY	4
MTECH/CE/CTM/2/DSC2(ii)	ENVIRONMENTAL ENGINEERING & MANAGEMENT	
MTECH/CE/CTM/2/DSC2(iii)	ADVANCED CONSTRUCTION TECHNOLOGY	
MTECH/CE/CTM/2/DSC2(iv)	ADVANCED CONCRETE MATERIALS	
MTECH/CE/CTM/2/DSC2(v)	GREEN BUILDINGS AND SERVICES	
MTECH/CE/CTM/2/DSC3(i)	PUBLIC PRIVATE PARTNERSHIP CONCEPTS IN INFRASTRUCTURE	4
MTECH/CE/CTM/2/DSC3(ii)	RESEARCH METHODOLOGY, PATENT AND IPR	
MTECH/CE/CTM/2/DSC3(iii)	CONTRACTS AND LEGAL ISSUES	
Skill Enhancement Courses		
M.TECH/CE/CTM/3/SEC1	DISSERTATION PART-1 WITH SEMINAR	04
M.TECH/CE/CTM/4/SEC2	DISSERTATION PART- 2	12
Open Elective Courses		
MTech/CE/CTM/2/OEC1	Students shall complete a 4-credit open elective course offered by other Engineering Departments/ MOOCs	4
MTech/CE/CTM/3/OEC2	Students shall complete a 4-credit open elective course offered by other Engineering Departments/ MOOCs	4
Open Electives Courses offered to the M.Tech. students of other Engineering Departments		
CE/OEC1	CONTRACTS AND LEGAL ISSUES	4
CE/OEC2	GREEN BUILDINGS AND SERVICES	4

1ST SEMESTER

M.Tech/CE/CTM/1/CC1: CONSTRUCTION MANAGEMENT							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:-

After going through the course on Construction Management the students shall be able to:

- i) Understand the concepts and principles of Modern-day Construction
- ii) Understand the Network Techniques, Construction Planning and Management.
- iii) Find the time cost optimization of the projects.
- iv) Understand the site layout, inspection, supervision and quality control.
- v) Implement the safety in construction.
- vi) Implement the labor laws and Acts

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	2	1	2	-	-	-	1	3
CO2	2	1	1	1	1	-	-	-	-	-	2	3
CO3	3	2	1	1	1	-	-	-	-	-	1	3
CO4	1	1	2	2	1	-	1	1	2	2	3	3
CO5	1	1	1	1	1	3	-	2	-	-	1	3
CO 6	1	1	1	1	1	2	-	2	-	-	1	3
Average	1.5	1.2	1.5	1.2	1.2	2.0	1.5	1.7	2.0	2.0	1.5	3.0

UNIT-I

Introduction:

Definition, functions and scope of construction management; scientific methods of management; construction team.

Construction Contracts and Specifications:

Types of construction contracts; contract documents; specifications; general and special conditions; contract management; arbitration and settlement.

UNIT-II

Construction Planning and Network Techniques:

Pre-tender planning; contract planning; planning and scheduling construction jobs by bar charts; Planning and scheduling construction jobs by critical path network techniques; allocation of resources; techniques of development and analysis of PERT/CPM networks for building project, bridge project and industrial shed constructions; updating of network; examples and case studies; Computer software for network analysis

Time-cost Optimization:

Direct cost, indirect cost, total cost; purpose, stages and methods of cost control techniques of time cost optimization; examples and case studies.

UNIT-III

Labour Laws and Acts: Study of various laws and acts related to construction activities

Project Management:

Feasibility study; project reports; progress reports; monitoring and controlling project activities.

Site Layout:

Principles governing site lay out; factors effecting site lay out; preparation of site lay out.

Supervision, Inspection and Quality Control: Supervisor's responsibilities; keeping records; control of field activities handling disputes and work stoppages; storage and protection of construction materials and equipment; testing and quality control.

Purpose of inspection:

Inspection of various components of construction; reports and records; statistical quality control.

UNIT-IV

Safety in Construction:

Safety: importance of safety, accident-prone situations at construction site i.e., safety measures for excavation, drilling/blasting, scaffolding/formwork, hoisting & erection demolition and hot bituminous work.

Fire Safety: Safety record of construction industry, safety campaign

BOOKS AND REFERENCE MATERIALS:

Chitkara, K.K. (2015). Construction Project Management – Planning Scheduling and Controlling, Tata McGraw Hill.

Seetharaman, S. (2006). Construction Engineering and Management, Umesh Publications.

Choudhary, S. (2004). Project Management. Tata McGraw Hill.

Srivastava, V.K. (2014). Construction Planning and Management, Galgotra Publications.

Punmia, B.C.; Khandelwal, K.K. (2002). Project Planning & Control with PERT&CPM, Laxmi Publications.

Kumar, Neeraj Jha (2015). Construction Project Management – Theory and Practice – Pearson.

Gahlot, P.S. &Dhir B.M. (2007). Construction Planning and Management, New Age International.

M.Tech/CE/CTM/1/CC2: INFRASTRUCTURE DEVELOPMENT AND BOT, BOOT PROJECTS							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

- To know the infrastructure development polices available in central and state governments of India
- To understand the benefits and challenges in infrastructure privatization
- To obtain the knowledge of different types of risks in National and International Infrastructure Projects
- To understand the economic constraints and environmental sustainability to development and management plan for critical infrastructure structures essential for the needs of society.
- To study about the integrated framework used for successful infrastructure planning and management.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	1	2	-	-	3	3
CO2	1	1	1	1	1	1	1	1	1	1	1	3
CO3	1	1	1	1	1	2	1	-	-	-	1	3
CO4	1	1	1	1	1	1	3	1	-	-	1	3
CO5	1	1	2	2	3	-	1	-	-	1	2	3
Average	1.0	1.0	1.2	1.2	1.4	1.5	1.4	1.3	1.0	1.0	1.6	3.0

Unit- I

An Overview of Infrastructure Engineering

Overview on infrastructure development polices of central and state governments in India.
Programmes

And initiatives for development of roads, railways, airports, and urban infrastructure in India.

Role of Public and Private Sector

A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization ,Challenges in Privatization ,Water Supply, Power, Infrastructure, Road Transportation Infrastructure in India–Case studies

Unit- II

Infrastructure Planning

Overview of various planning tools-Project appraisal by financial analysis, economic analysis, and Environmental and societal impact assessments – Concept of sustainable infrastructure development.

Infrastructure Implementation Risks

Mapping and Facing the Landscape of Risks in Infrastructure Projects, Core Economic and Demand Risks, Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Challenges in Construction and Maintenance of Infrastructure–Case studies.

Unit- III

Environmental and Social Impact Assessment Aspects

Categories, Attributes and Parameters, Identification of Environmental and Social Impacts over Project Area and over Project Cycle. Special Considerations Involving Land and Water Interrelationships-

Environmental Laws and Regulations

Strategies for Successful Infrastructure Project Implementation Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects. Governments Role in Infrastructure Implementation, An Integrated Framework for Successful

Infrastructure Planning and management- infrastructure management systems and future Directions.

Unit- IV

Private Sector Participation

International projects- Detailed Project Reports (DPR)/Build Own Operate (BOO)/Build Own Operate Transfer (BOOT) Projects/Build Operate and Transfer (BOT)-case studies.

Text Book (s)

1. Mohammed M. Ettouney, Sreenivas Alampalli, (2016) Risk Management in Civil Infrastructure in: Civil Infrastructure Health and Sustainability Series, CRC Press, London.
2. Amareshwar Mishra and G C Tripathi, (2014), Management of Risk in Infrastructure Projects, GABD Publications, New York.
3. Anjaneyulu, Y and Manickam, V, (2012), Environmental Impact Assessment Methodology B.S. Publications, Hyderabad.
4. Jeffrey Delmon (2015), Private Sector Investment in Infrastructure: Project Finance, PPP Projects And PPP Frameworks, Kluwer Law International.

M.Tech/CE/CTM/1/CC3: ESTIMATING, TENDERING AND BIDDING

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

- To understand the various types of estimates and process involved in sanction of budget for a project.
- To study about analysis of rate and standard methods followed by different organizations.
- To attain the knowledge about the specification and its importance in a project.
- To know about the tendering and its process in construction.
- To attain the knowledge about contracts, types of contracts, contract documents and roles and functions of participants to the contract.
- To obtain the knowledge about the conditions of contract, Bidding and Bidding models.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	3	3
CO2	2	1	1	1	1	-	-	-	-	-	2	3
CO3	1	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	-	-	-	-	-	2	3
CO5	1	1	1	1	1	-	-	-	-	-	2	3
CO6	1	1	1	1	1	-	-	-	-	-	1	3
Average	1.2	1.0	1.0	1.0	1.0	-	-	-	-	-	1.8	3.0

Unit:I

Estimation

Project cost estimation –Approximate Estimate and administrative approval-expenditure sanction-Detailed Estimate.

Rate Analysis

Rate analysis –standard methods as followed by government organizations for tendering purposes-as followed by contractor organizations for bidding Purposes.

Unit:II

Specifications

Definitions,relationship with drawings,purpose, benefits,organization of specification, drafting/writing the specifications, types of specifications.

Tendering Process

Preparation of tender documents estimating, pre-qualification, bidevaluation, award of contract, project financing and contract payments, contracts close out and completion, E-tendering.

Unit:III

Contract Agreement

Contracts,types of construction contracts, Evaluation of contract documents, need for documents, present stage of national and international contract documents, roles and functions of participants to the contract.

Conditions of Contract

Clarification by parties to contract, obligations and responsibilities of the parties, protection And indemnification, bonds and insurance, subsurface conditions, inspection of work, change of work, rejected work and deficiencies.

Unit:IV

Bidding

Bidding models and bidding strategies, Owner's and contractor's estimate- Overhead charges - Internationally adopted formulae.

Enlistment of contractors.

TextBook(s):

1. JimmieHinze, (2013),Construction Contracts, McGrawHill, NewDelhi
- 2.Will Hughes, Ronan Champion, JohnMurdoch, (2015), Construction Contracts: Lawand Management, Routledge.
- 3.Construction Specifications Institute, (2011), The CSI Construction Contract Administration Practice Guide, Wiley.
4. Brian Greenhalgh,(2016),Introduction to Construction Contract Management, Routledge.

M.Tech/CE/CTM/1/CC4: CONSTRUCTION COSTING AND FINANCIAL MANAGEMENT

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

- To list various methods of measurements of quantities of various construction works and their applications.
- Determine factors of cost variations
- Understand cash flow and funding methods of project.
- List and describe various types of payments in a project and their implementation.
- Know various methods of material classification, their inventory, management and safety aspects.
- Know techniques of cost benefit analysis and comprehend elements of financial statements and fund flows.
- Prepare cash flow statements, balance sheets etc.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	-	-	-	-	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	1	1	1	1	1	-	-	-	-	-	2	3
CO4	1	1	1	1	1	-	-	-	-	-	1	3
CO5	1	1	1	1	1	1	-	-	-	-	2	3
CO6	1	1	1	1	1	-	-	-	-	-	2	3
Average	1.2	1.0	1.0	1.0	1.0	1.0	-	-	-	-	1.6	3.0

Unit:I**Construction Costing:**

Costing of construction Works; different methods of costing, cost elements in a projects; analysis of rates; non-scheduled items of work; cost estimation for a small construction job; purpose, methods

and stages of cost control; cost monitoring; cost forecasting methods; variations in individual items of work and their effect on total contract price; valuation of variations. Methods of measurement of earthwork, RCC, Brickwork, Woodwork joinery, steel and iron work plastering/painting and white/colour washing & painting

Unit:II

Cash Flow:

Determining the funds required for a construction job; preparing cash flow statements; cash in flow and outflow during contract period; project expectations.

UNIT-III

Cash and Payment of Works:

Precautions in custody of cash, imprest account and temporary advance; maintenance of temporary advance; and advance account; different types of payment ,first, running, advance and final payments.

Material Management:

Objectives and scope of material management classification, codification, ABC analysis, standardization and substitution; introduction to inventory control; stores management; organization and lay out; receipt, inspection and issue; care and safety; store records and store accounting.

UNIT-IV

Financial Management

Meaning and scope; financial statement analysis; funds flow analysis; capital budgeting; cost-benefit analysis.

REFERENCE BOOKS:

- i) Mueller,F.W.(1986).Integratedcostandschedulecontrol forconstructionprojects.
JohnWiley
- ii) Gobourne(1973).Costcontrolintheconstructionindustry.
- iii) Scheduleofrates,specificationmanualsetc.fromPWD, CPWD and MES
- iv) Chris Hendrick son and Tung Au(1989).Project Management for Construction
Datta(2008,2ndedition).MaterialManagementProcedures,TextandCases,PrenticeHallofIndia
- vi) Gopalakrishnan,SundaresanP.M(re-print2001)MaterialManagement–and
IntegratedApproach,London PrenticeHallof India.

M.Tech/CE/CTM/1/CC5: Concrete Testing Lab.							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance
Instructions to paper setter for Final Term examination: The term end examination shall be conducted by a panel of one external and one internal examiner. The question paper for practical examination shall be set on the spot.							

Course Outcomes: -After going through the course on Concrete testing students will be able

- To understand the various properties of Cement
- To understand the various test performed on cement at Construction Site.
- To understand the various properties of Aggregates.
- To understand the various properties of Concrete.
- To understand the various test performed on concrete at Construction Site

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	-	-	-	-	-	1	3
CO2	1	1	1	2	1	-	-	-	-	-	1	3
CO3	1	1	1	1	1	1	-	-	-	-	1	3
CO4	1	1	1	1	2	-	-	-	-	-	1	3
CO5	1	1	1	1	1	2	-	-	-	-	1	3
Average	1.0	1.0	1.0	1.2	1.4	1.5	-	-	-	-	1.0	3.0

EXPERIMENT LIST FOR CONCRETE TESTING LAB

- 1 To determine standard consistency of cement.
- 2 To determine the fineness of cement by (a) sieve analysis (b) Blaine's air permeability method
- 3 To determine soundness of given cement sample by Le- Chatlier's apparatus.
- 4 To determine the initial and final setting time of cement.
- 5 To determine the compressive strength of cement
- 6 To determine the specific gravity of cement.
- 7 To determine the moisture content and bulking of the fine aggregates
- 8 To determine the Fineness modulus of coarse and fine aggregates
- 9 To determine the workability of concrete mix by (a) Slump test (b) Compaction factor test (c) Flow table (d) Vee-Bee Consistometer
- 10 To determine cube strength and cylinder strength of concrete of given proportions.

M.Tech/CE/CTM/1/DSC1: TECHNOLOGY MANAGEMENT							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes: After going through the course on Technology Management the learner are expected to know various issues related to:

- i) Business Strategies for implementing New Technologies.
- ii) Technology forecasting and Management Pertaining to Research & Development.
- iii) Management of Intellectual Property Rights.
- iv) Management Role and Skills required for New Technology.
- v) Issues Related to Venture Capital and Technology Development.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	-	-	-	-	-	1	3
CO2	1	1	1	2	1	-	-	-	-	-	1	3
CO3	1	1	1	1	1	1	-	-	-	-	1	3
CO4	1	1	1	1	2	-	-	-	-	-	1	3
CO5	1	1	1	1	1	2	-	-	-	-	1	3
Average	1.0	1.0	1.0	1.2	1.4	1.5	-	-	-	-	1.0	3.0

UNIT-I

Introduction to Technology Management

Introduction to Technology Management

Business Strategy for New Technologies: adding value, gaining competitive advantage, timing and capability development

UNIT-II

Technology Forecasting: Techniques of Forecasting, Technology Forecasting-Relevance, Strategic alliance and Practicality, and Technology transfer.

Management of Research, Development and Innovation: Technology mapping, Comparison of types of R& D Projects and development approaches- radical platform and incremental projects, innovation process.

UNIT-III

Management of Intellectual Property Rights

Strategic value of patents, trade secrets and licensing

UNIT-IV

Managing scientist and Technologists: Identification, Recruitment, Retention, Team work and Result Orientation.

Management Roles and Skills for New Technology

Technology for Managerial Productivity and Effectiveness, Just-in-Time

Venture Capital & Technology Development

REFERENCE BOOKS

- i) Technology and Management, Cassell Educational Ltd., London
- ii) John Humbleton Elsevier; Management of High Technology Research and Development
Charles W.L.Hill/Gareth R.Jones, Strategic Management, Houghton Mifflin Co.
- iii) S.A.Bergin R&D Management, Basil Black well Inc.
- iv) Richard M.Burton & Borge Obel Elsevier Innovation and Entrepreneurship
In organizations

M.Tech/CE/CTM/1/DSC2: OPTIMIZATION TECHNIQUES							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes: After going through the course on Optimization Techniques the students shall be able

- To Understand the Concept of optimization and classification of optimization problems.
- Formulation simplex methods variable with upper bounds.
- To Understand the Point-Estimation.
- To Understand the equality constraints, inequality constraints.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	2	1	2	1	1	-	-	-	-	-	1	3
CO3	2	1	1	1	1	-	-	-	-	-	1	3
CO4	2	1	1	1	1	-	-	-	-	-	1	3
Average	1.8	1.0	1.3	1.0	1.0	-	-	-	-	-	1.0	3.0

UNIT-I

Introduction to Optimization and Numerical Techniques

- Introduction and Engineering applications of optimization.
- Optimal Problem Formulation; Design- Variables. Constraints, Objective function, Variable bounds.
- Introduction to numerical techniques.
- Numerical differentiation and numerical integration.
- Eigen value problem.
- Newton-Raphson's method.
- Computer based numerical analysis.

UNIT-II

Single-variable Optimization

- i) Optimality Criteria
- ii) Bracketing Methods–Exhaustive search and Bounding phase methods
- iii) Region-Elimination Methods-Interval halving method; Fibonacci search method, golden section search method.
- iv) Point-Estimation Method: Successive Quadratic estimation method
- v) Gradient-based Methods: Newton-Raphson method, Bisection method, Secant method, Cubic search method.

UNIT-III

Multivariable Optimization

- i) Optimality Criteria
- ii) Unidirectional Search
- iii) Direct Search Methods: Simplex, Hooks-Jeeves pattern search and Powell's conjugate direction method.
- iv) Gradient-based Methods: Cauchy's (Steepest Descent) method, Newton's method. Conjugate gradient method, variable–metric method.

UNIT-IV

Constrained Optimization

- i) Kuhn-Tucker Conditions
- ii) Transformation Methods: Penalty function method.
- iii) Sensitivity Analysis
- iv) Direct Search for Constrained Minimization: Variable elimination, Complex search and Random search methods.
- v) Linearized Search Techniques: Frank-Wolfe method, Cutting Plane Method, Feasible Direction Method, Generalized Reduced Gradient Method, Gradient Projection Method.
- vi) Integer and Geometric Programming

BOOKS AND REFERENCE MATERIALS

- i) Sastry, S.S. (2009) "Introductory methods of Numerical Analysis", Prentice Hall of India.
- ii) Rao, S.S. (2009, 4th Edition) "Engineering Optimization: Theory and Practices", John Wiley and Sons.
- iii) Kambo, N.S. (2009) "Mathematical Programming Techniques", East West Press.

M.Tech/CE/CTM/1/DSC3: Concrete Construction Technology							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After going through the course on Concrete Construction Technology the learners are expected to:

- i) Understand the principles of concrete technology and apply them during construction supervision and testing.
- ii) Supervise and manage concrete manufacturing and construction.
- iii) Develop skills in selecting and testing concrete ingredients for certain specific requirements.
- iv) Interpret the test results in accordance with BIS Stipulations.
- v) Plan the quality checks and bring about economy in concrete construction.
- vi) Know the advancements in concrete constructions as also the various types of special concretes.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	1	1	-	-	-	-	2	2	3
CO3	2	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	-	2	-	-	-	1	3
CO5	1	1	1	1	2	-	2	-	-	1	2	3
CO6	1	1	1	1	1	-	2	-	-	-	1	3
Average	1.5	1.0	1.0	1.0	1.2	-	2.0	-	-	1.5	1.3	3.0

UNIT-I

Principles of concrete mix design procedures :

Concrete materials; mix proportioning and early age properties, strength, permeability and durability.

BIS/ACI/British Standards, mix design procedures using fly ash, fibers and design of high-performance concrete.

Inspection and quality control of concrete construction--

Stages, Principles, Checklist, Statistical Controls, Procedures.

Unit-II

Concreting operations

Practices and equipment, batching; mixing; transporting; shuttering and staging; placing and compacting; curing, accelerated curing; finishing and jointing.

Unit-III

Properties and Techniques of Construction for Conventional and Special Concretes

Admixtures, polymers, epoxy resins, pozzolanic materials and flyash, fibre reinforced concrete, lightweight concrete, heavyweight concrete, foam concrete, high performance concrete. Operations, shotcrete, grouting, guniting, underwater concreting, hot and cold weather concrete, pumpable concrete, ready mixed concrete.

Unit-IV

Construction techniques for reinforced concrete

Elements - materials, principles and procedures for beams, slabs, columns, foundations, walls and tanks, design and fabrication of formwork for R.C.C elements, features of slip forming and precautions, details of special shuttering required for lining of tunnel, procedure and precautions.

Pre-stressed concrete construction-

Principle, methods, materials, tools and equipment for the construction of a pre-stressed concrete.

TextBook (s)

1. Gambhir, M.L. (2004). Concrete Technology. New Delhi, Tata McGraw Hill
2. Orchard. (1979). Concrete Technology. London, Applied Science Publishers Ltd
3. Neville, Brooks. (2006). Concrete Technology. England, Addison-Wesley.
4. Raina, V.K. (2005). Concrete for Construction. New Delhi, Tata-McGraw Hill Publishing Co. Ltd.
5. Swamy R.N. (1983). New Concrete Materials. London, Surrey University Press

M.Tech/CE/CTM/1/DSC4: Pavement Material Construction and Maintenance.							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

1. To identify various types of soils and to be able to modify their properties as per requirement.
2. To understand properties of various types of aggregates, bituminous material and cements and their testing.
3. Knowledge of low cost, marginal and waste materials used in road construction.
4. To acquire proportioning and design skills of bituminous mixes.
5. To gain knowledge about different equipments used in highway construction.
6. To know about construction of flexible and rigid pavement layers.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	1	-	-	-	-	3
CO2	1	1	1	1	2	-	1	-	-	-	-	3
CO3	1	1	1	1	1	-	1	-	-	-	-	3
CO4	1	1	2	1	1	-	1	-	-	-	-	3
CO5	1	1	1	1	1	-	-	-	-	-	1	3
CO6	1	1	1	1	1	-	1	-	-	-	-	3
Average	1.0	1.0	1.2	1.0	1.2	-	1.0	-	-	-	1.0	3.0

UNIT-I

Soils: Characteristics of soil, Centrifuge moisture equivalent, Colour, Field moisture equivalent, Grain shape, Linear shrinkage and volumetric change, Particle sizes and distribution, Plasticity, Presence of fines, Specific gravity, State of compaction. Grain or particle size classification, Textural classification,

Highway research Soil classification systems board classification of soils, Indian Standard soil classification Soil stabilizers: Bituminous materials, Cementing agents, Chemical stabilizers Aggregates: Types of road aggregates, Requirements of a good road aggregate, Tests for road aggregates.

UNIT-II

Bituminous Materials: Introduction, Types of Bituminous materials, Tests on Bitumen, Cutback and Emulsions. Paving Mixes: Granular mix design, Design of Bituminous Mix, Marshal Method of bituminous mix design. Fly ash and its characterization. Performance based mix design Approaches. Use of Fly-ash in road embankment and cement concrete mixes, Innovative Materials.

UNIT III

Construction of bituminous pavements: various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of premix carpet, BM, DBM and AC. Mastic asphalt.

Machinery for Earthwork and Construction of Pavements: bitumen boiler, sprayer, pressure distributor, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Machinery involved in construction, slip-form pavers, and joints in CC pavements. **Introduction to various IRC and MORTH specifications.**

Construction of other types of pavements: reinforced cement concrete pavements, prestressed concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements.

UNIT IV

Highway maintenance: pavement distresses, condition and evaluation survey, Present serviceability index, Methods of measuring condition, skid resistance, Principles of maintenance, Methods of structural evaluation. Maintenance operations. Maintenance of WBM, bituminous surfaces and cement concrete pavements. Functional and structural evaluation of pavements, pavement maintenance, maintenance management.

Special problems in construction & maintenance of hill roads, Alignment of hill roads, Construction of hill roads. Maintenance of Hill roads, Drainage –Construction of surface and subsurface drainage system for roads.

TEXT/REFERENCE BOOKS:

1. Khanna and Justo “**Highway Engineering**”- Nemchand & Bros, Roorkee
2. Khanna and Justo, “**Highway Materials Testing**”-Nem Chand and Bros., Roorkee.
3. Peurifoy, R.L., and Clifford, JS “**Construction Planning Equipment and Method**”- McGraw Hill Book Co. Inc.
4. MoRTH ‘**Specifications for Roads and Bridges Works**’- Indian Roads Congress
5. “**Soil Mechanics for Road Engineers**”- HMSO Publication
6. “**Bituminous materials in Road Construction**”- HMSO Publication
7. W.Ronald Hudson, Ralph Haas and Zeniswki “**Modern Pavement Management**”-McGraw Hill and Co.
8. MoRTH “**Manual for Construction and Supervision of Bituminous Works**”-2001.
9. MoRTH “**Manual for Maintenance of Roads**”- 1989.
10. **Maintenance, repair, rehabilitation of rigid pavements**, IRC: SP 83
11. IRC: 42-1994, IRC:15-2002, IRCSP :11-1988, 55-2001, 57-2001, 58-2001, IRC19-1977, 27-1967, 29-1988, 34-1970, 36-1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94-1986, 95-1987, 98-1997, 105-1988.

2ND SEMESTER

M.Tech/CE/CTM/2/CC1: Project Formulation and Appraisal							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: After Completion of this course students will be able

- To understand about the project formulation.
- To be able to work out the costing of construction projects
- To understand the project be able to do the appraisal of Projects with the inherent risks
- To find effective options for develop the finance model of Project through its life cycle
- To identify areas where private sector participation can be motivated

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	1	1	-	-	-	-	-	1	3
CO3	1	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	2	-	-	-	-	-	2	3
CO5	1	1	1	1	1	-	-	-	2	2	1	3
Average	1.2	1.0	1.0	1.0	1.2	-	-	-	2.0	2.0	1.2	3.0

Unit: I

Project Formulation

Capital investments - Generation and Screening of Project Ideas - Project identification- Project evaluation an overview, the project cycle, planning, project selection and appraisal, project quality factors and basic needs the measurement of project performance Project Initiation Capital budgeting – feasibility study– market, technical, financial, economic and ecological – Market and Demand analysis- Detailed technical analysis.

Unit -II

Time Value of Money

Time Value of Money –Future value of single amount, Present value of single amount, Future value of an annuity, Present value of an annuity-Simple interest-Compound interest - project cash Flows. Project Costing Investment Criteria- Discounting criteria-Net present value (NPV), Benefit cost ratio(BCR), internal rate of return(IRR)- Non-Discounting criteria - Pay Back Period, Accounting rate of return(ARR), Urgency - Investment analysis in practice.

Unit-III

Project Appraisal

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.

Unit-IV

Private Sector Participation

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

References Book(s)

1. Harold Kerzner (2013), Project Management: A Systems Approach to Planning, Scheduling, and Controlling , Wiley India, New Delhi
2. United Nations Industrial Development Organization (UNIDO) Manual for the preparation of Industrial Feasibility Studies, (IDSI Reproduction), Bombay, 2007.
3. Mohamed Hegab, (2014), Public Private Partnerships for Highway Projects: Project Selection and Decision Analysis, Create space Independent Publisher, USA.
- 4 Prasanna Chandra, (2014), Projects -Planning Analysis Selection Implementation & Review, Fourth Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.

M.Tech/CE/CTM/2/CC2: Contract and Administration Planning

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes: After Completion of this course students will be able

1. To design sound contracts by training to interpret legal provisions and effectively administer and fulfill the requirements of a contract
2. To be able to effectively administer contract and identify tools available for contract preparation and administration
3. To identify good practice important stages of contract and wordings in contract
4. Understand jurisprudence to effectively administer contracts and a construction organization
5. To interpret the laws like Labour Laws, Tax laws and requirements and guidelines of other national and international legal regulatory bodies

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	-	-	-	-	1	3
CO2	1	1	1	1	2	-	-	-	-	-	2	3
CO3	1	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	1	-	-	-	-	1	3
CO5	1	1	1	1	1	2	-	-	-	-	1	3
Average	1.0	1.0	1.0	1.0	1.2	1.7	-	-	-	-	1.2	3.0

Unit: I

Introduction

Definition of Contract Legal issues in contract – Standard forms of contracts- General and special conditions of contracts- Contract pricing by the client, project management consultants and the contractor, Contract correspondence and contract closure. Construction Contracts Types of contracts, Documents forming a contract, General conditions of Indian contracts – International contracts - Contract administration, Law of Torts - Interpretation of contract in case of inconsistency including case study.

Unit-II

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 – Tamilnadu Transparency in Tenders Act.

Arbitration

Comparison of Actions and Laws – Agreements – Appointment of Arbitrators – Conditions of Arbitration – Arbitration Tribunals - Powers and Duties of Arbitrator – Enforcement of Award – Arbitration and Conciliation Act 1996 - Arbitration case study.

Unit-III

Legal Requirements

Insurance and Bonding – Types of Bonds - Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes- Claims and disputes - Dispute resolution techniques.
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-IV

Labour Regulations

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes – Workmen’s Compensation Act 1923 – Indian Factory Act 1948 – Tamil Nadu Factory Rules 1950 – Child Labour (Prohibition and Regulation) Act, 1986 - Other Labour Laws and Regulations.

References

1. Joseph T. Bockrath and Fredric L. Plotnick, (2013), Contracts and the Legal Environment: for Engineers and Architects, 7th Edition, McGraw Hill, New Delhi
2. Markanda P.C. , Naresh Markanda and Rajesh Markanda, (2016), Law Relating to Arbitration and Conciliation, 9th Edition, Lexis Nexis, New York.
3. Martin Brook (2016), Estimating and Tendering for Construction Work, 5th Edition, Routledge, Taylor & Francis.
4. Govt of India, Central Public Works Department, CPWD Works Manual 2014.
5. Jimmie Hinze, (2013), Construction Contracts, 3rd Edition, McGraw Hill.
6. Sharma M.R., (2013), Fundamentals of Construction Planning & Management S.K. Kataria & Sons, New Delhi.

M.Tech/CE/CTM/2/CC3: Building Maintenance							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

- Become aware about the principles of maintenance
- Diagnose the causes of various types of defects in structures.
- Plan and schedule the maintenance of structures as per maintenance management techniques.
- Develop capabilities in field practices for repairs of structures.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	1	1	1	1	1	-	-	-	-	-	2	3
CO4	1	1	1	1	1	-	-	-	-	-	1	3
Average	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	1.3	3.0

Unit: I

Principles of Maintenance:

Importance of maintenance, deterioration and durability, factors affecting decision to carryout maintenance, maintenance and GNP, agencies causing deterioration, effect of deterioration agencies on materials. Design and Economic Consideration in Maintenance Factors to reduce maintenance at design stage, consideration of maintenance aspects in preparing tender document and specifications, sources of error in design which enhances maintenance, importance of working drawings and schedules, provision of access for maintenance and its importance at design stage. Economic consideration in maintenance: physical life, functional life, economic life of different types of buildings, discounting technique for assessment of economic life.

UNIT-II

Maintenance Management:

Definition, organization structure, work force for maintenance, communication needs, building inspections, maintenance budget and estimates, property inspections and reports, specification for maintenance jobs, health and safety in maintenance, quality in maintenance, maintenance manual and

their importance. Materials for Maintenance: Compatibility of repair materials, durability and maintenance, types of materials, their specification and application, criteria for selection of material, use of commercially available materials in maintenance.

UNIT-III

Investigation and Diagnosis for Repair of Structures:

Basic approach to investigations, physical inspection, material tests, non destructive testing for diagnosis, estimation of actual loads and environmental effects, study of design and construction practices used in original construction, retrospective analysis and repair steps.

Maintenance Problems and Root Causes:

Classification of defects, need for diagnosis, type of defects in building elements and building materials defect location, symptoms and causes.

UNIT-IV

Remedial Measures for Building Defects:

Preventive maintenance and special precautions- considerations, preventive maintenance for floors, joints, wet areas, water supply and sanitary systems, termite control, common repair techniques, common methods of crack repair. Repair of existing damp proofing systems in roofs, floors- and wet areas. Protection, repair and maintenance of RCC elements. Repair, maintenance of foundations, basements and DPC. Repair of finishes. Repair of building joints. Repair of water supply and sanitary systems, underground and over head tanks. Common strengthening techniques. Maintenance of Industrial Floors--

Maintenance of Multistorey Buildings:

Special features for maintenance of multi-storied buildings, including fire protection system, elevators booster pumps, generator sets.

REFERENCE BOOKS

- i) Gahlot P.S. & Sharma, Sanjay. Building Defects and Maintenance Management, Publishers New Delhi.
- ii) Housing Defects reference Manual, The Building Research Establishment. E.& F.N.SPON
- iii) Ransom W.H. Building Failures: Diagnosis and Avoidance, New Age Publications (P) Ltd.
- iv) Eidridge H.J., Common Defects in Buildings Her Majesty's Stationery Office, London
- v) Panchdari A.C. , Maintenance of Buildings, New Age International(P)Limited Publishers.
- vi) Govt of India, Central Public Works Department, CPWD Works Manual 2014.

M.Tech/CE/CTM/2/CC3: GEO-TESTING LAB.							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	02	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance
Instructions to paper setter for Final Term examination: The term end examination shall be conducted by a panel of one external and one internal examiner. The question paper for practical examination shall be set on the spot.							

Course Outcomes:

- To understand the classification of soil based on test results and interpret engineering behavior based on test results.
- To evaluate settlement characteristics of soils.
- To understand shear strength characteristics of soils.
- To understand the bearing capacity of soil.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	-	3
CO2	1	1	1	1	1	-	-	-	-	-	-	3
CO3	1	1	1	1	1	-	-	-	-	-	-	3
CO4	1	1	1	1	1	-	-	-	-	-	-	3
Average	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	3.0

List of Experiments:

- Conduct of Standard Penetration Test and estimation of bearing capacity for shallow foundation case.
- Determination of shear strength characteristics by field tests like in situ vane shear test, pocket penetrometer etc.
- Determination of shear strength characteristics by laboratory tests (Direct Shear Test).
- Determine unconfined compression strength of cohesive soil.
- Recommend a field investigation programme to obtain design data.
- Computation of bearing capacity and settlement for given conditions of soil, depth and type of foundation and loading.
- Determine Relative Density of Soil.
- Visit to construction site and preparation of report.
- Conduct Tri-axial test on soil.
- Conduct Plate load test on soil for foundation design.

REFERENCES:

- Arora K.K. (2014) – Soil Mechanics and Foundation Engineering. Standard Publishers Distributors.
- BC Punmia (2005) Soil Mechanics & Foundations – Laxmi Publications

M.Tech/CE/CTM/2/DSC1: RURAL CONSTRUCTION TECHNOLOGY							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes: After Completion of this course students will be able

- To understand appropriate technology in the area of housing,
- To understand water supply Sanitation,
- To understand rural roads construction and
- To understand minor irrigation works etc.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	-	3
CO3	1	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	-	-	-	-	-	-	3
Average	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	1.0	3.0

UNIT-I

Rural Development Planning and Concept of Appropriate Technology: Scope; development plans; various approaches to rural development planning; concept of appropriate technology. Rural development programme/ projects.

UNIT-II

Rural Housing:

Low cost construction materials for housing; Architectural considerations for individual and group housing; Composite material - ferro-cement & fly ash, autoclaved calcium silicate bricks and soil-stabilized un-burnt brick; Plinth protection of mud walls; design consideration and construction of: non-erodable mud plaster, Water-proof and fire-retardant roof treatment for thatch roofs. Pre- cast stone masonry; rat-trap bond for walls; Panels for roof, ferro-cement flooring / roofing units, Thin R.C. ribbed slab for floors & roofs, pre-cast R.C. channel, Unit for flooring/roofing scheme, pre-cast R.C. flooring/ roofing scheme-Pan roofing scheme; manual & power scaffold hoist, lifting device for prefab components; Earthquake resistant measures for low cost houses.

UNIT-III

Water Supply and Rural Sanitation:

Sources of water. BIS & WHO water standards. Quality, Storage and distribution for rural water supply works; basic design principles of treatment-low cost water treatment technologies; Hand

pumps-types, installation operation, and maintenance of Mark-II hand pumps; conservation of water; rainwater harvesting; drainage in rural areas, design of low cost waste disposal systems; design and construction of low cost latrines: 2 pit pourflush water seal, VIP latrines, septic tank etc; Biogas technology; low cost community & individual Garbage disposal systems, Ferro- cement water storage tanks.

UNIT-IV

Low Cost Roads and Transport:

Broad categories of Pavement Layers, types of Granular Sub-Bases and Bases, Bituminous Construction, Surface Treatments for roads in rural areas. Detailed features and Quality Control of Modified Penetration Macadam, Soil Stabilization, Lime, Lime-Flyash and Cement Treated Course. Crusher-run-Macadam. Use of local materials. Flexible Pavement: Design factors, Basic Principles, Guidelines for Surfacing for Rural Road. CBR method for Design of Flexible Pavement. PMGSY – highlights of Scheme.

Low Cost Irrigation:

Design Consideration and construction of tube-well, drip & sprinkler irrigation systems. Watershed and catchments area development - problems and features of watershed management, watershed structures.

REFERENCE BOOKS:

- i) Madhav Rao A.G., D.S.Ramachandra Murthy, Appropriate Technologies for low cost Housing Oxford and IBH Publishing Co. Pvt .Ltd.
- ii) CBRI, Roorkee, Advances in Building Materials and Construction.
- iii) Satyanarayana Murthy C., Design of Minor Irrigation and Canal Structures. Wiley Eastern Ltd.,
- iv) Park K. Preventive and Social Medicine, M/s. Banarsi Das Bhanot.
- v) Yash PalBedi, A Hand book of Preventive and Social Medicine; Delhi, Atam Ram & Sons,
- vi) Document on Rural Road Development in India Volume1& 2. New Delhi, Central Road Research Institute,

M.Tech/CE/CTM/2/DSC2: ENVIRONMENTAL ENGINEERING & MANAGEMENT

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After going through course on Environmental Engineering & Management the students are expected to:

- To create awareness about harmful effects of pollution and to take preventive steps for controlling the pollution.
- To help the students to acquire knowledge with reference to various sources of pollution and planning of remedial measures to control pollution.
- To identify environmental problems and solutions through organized research.
- To develop environmental scientists and engineers and sensitize them towards environmental issues.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	3	-	-	-	-	3
CO2	1	1	1	1	1	1	2	-	-	-	-	3
CO3	1	2	1	1	1	1	2	-	-	-	-	3
CO4	1	1	1	1	1	1	3	-	-	-	-	3
Average	1.0	1.3	1.0	1.0	1.0	1.0	2.5	-	-	-	-	3.0

UNIT-I**Environment & Ecology**

Definition and understanding of concepts, ecosystem, energy flow in ecosystem, water, carbon and nitrogen cycle, community's inter-relationships in an ecosystem.

Domestic and industrial Pollution:

Sources, Standards for disposal of wastewater and industrial effluents, basic unit operations in control of waste water pollution, C.P.C.B./M.O.E.F. for abatement of Industrial Pollution and Pollution Control/Treatment methods and technologies .

UNIT-II

Type of Pollutants and Protection of Environment Water Pollution:

Sources, causes and measurement of water pollutants in surface and ground water, water quality criteria for various uses of fresh water, river basin studies for surface water pollution control, biochemical oxygen demand, effect of oxygen demanding wastes on rivers.

Air Pollution:

Definition, principle materials causing pollution, types of air contaminants, their sources and ill effects on living and nonliving materials, permissible limits. air pollution control - basic principles, natural self cleansing, pollution control methods and various engineering devices to control particulate and gaseous pollutants, controlling air pollution from automobiles.

Noise Pollution:

Definition, sources of noise and its units, adverse effects of noise pollution, sound pressure level and its measurement, octave band and its importance; noise pollution control measures.

Solid Waste Pollution:

Sources, public health aspects, solid waste management and disposal methods including E-waste.

UNIT-III

Degradation of Land Resources:

Deforestation: Forest land, deforestation and its effects on land use and environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation problems, erosion, salinization, water logging, land use management & planning.

Global Environmental Problems

Global warming, green house effect, ozone depletion, acid rain, oil pollution, radiation hazard and control, global climate change.

UNIT-IV

Environmental Management System; International cooperation and Laws:

Main clauses and basic steps for EMS certification. Environmental Laws/Acts.

Environment Impact Assessment:

Definition and its importance for environment management, constituents of environment impact assessment, project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies.

Environment pollution.

Cleaner Production Technologies

Need and benefits, cleaner production techniques and options, zero impact manufacturing initiatives CDM and carbon credits/case studies.

REFERENCE BOOKS:

- i) Rowe, Peavy, Techobanoglous. Environmental Engg. Tata McGraw Hill.
- ii) Davis, Mackenzie L, Environmental Engg. Tata McGraw Hill.
- iii) Kapoor, Baljeet S.. Environmental Engg. An overview, Khanna Publishers.
- iv) Masters, Gilbert H.. Environmental Engineering and Science, Prentice Hall of India Pvt. Ltd.
- iv) Panday, G.N, Carney GC. Environmental Engineering, Tata McGraw Hill.

M.Tech/CE/CTM/2/DSC3: ADVANCED CONSTRUCTION TECHNOLOGY

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After going through this course, students will be able to:

- Understand the necessity and behaviour of the composite construction (Steel and Concrete) and their application.
- Understand need for recycling in road construction and various/technologies and procedures related.
- Various types of special foundations and their suitability and application areas.
- Various aspects of high rise construction and special methods/techniques deployed in it.
- Special aspects for design and construction of tall chimneys.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	1	1	1	1	2	-	2	-	-	-	1	3
CO4	1	1	2	1	2	1	-	-	-	-	1	3
CO5	1	1	2	1	1	-	-	-	-	-	1	3
Average	1.0	1.0	1.4	1.0	1.4	1.0	2.0	-	-	-	1.0	3.0

UNIT-I

Advance Technologies:

Composite Structures in Buildings:

Introduction to steel - concrete composite construction - theory of composite structures –Comparison of composite and non-composite, Introduction to steel - concrete - steel sandwich construction. Materials in composite construction, Composite columns: Types-Design of concrete encased columns, concrete filled tubular columns . Earthquake resistant design of masonry structures.

New Technologies in Road and Bridges:

Recycling of Pavements – purpose, usage of old material, reclaiming bitumen , usage of granular material . Cold Mix Technologies, Warm Mixes

UNIT-II

Special Foundations:

Necessity for special foundations, Problems in expansive Soils , Loose sand deposits and organic soils, Black cotton soils - soil potential to expand and related soil properties , measures to counteract the problems in expansive soils. ;Frost action and measures to counter the related problems. Foundations for chimney, cooling towers, telecommunication/transmission towers, foundations for underground structures, coastal and off shore structures in different soil conditions, gravity platforms, Raker. dewatering and its various methods.

UNIT-III

High Rise Construction:

High rise buildings; architectural & structural aspects; special features of construction; tall chimneys, components, design aspects; slip form method , lift slab method; special problems of high rise construction.

Prefabricated Construction:

Advantages of pre fabricated construction; Basic elements , selection of structuralelements; design aspects; assembly of precastelements; jointing , modular co-ordination and tolerances; structural systems for buildings; single and multi- storey building systems; methods and equipments for handling and placement. Applications for rural and military areas

UNIT-IV

Advanced Construction Materials:

Geo-synthetics: various, types; geo-textiles, geo-grids, geo-membranes, geo-cell, geo- composites; functions and general applications, advantages, properties of geo- textiles, epoxy , resins, polymers, grouts and anchors, special flooring materials, sealants and adhesives, protective coatings. Micro-Silica in Concrete

REFERENCES:

- i) Naiman P Kurian (1982) Modern Foundations - Introduction to Advanced Techniques Tata McGraw Hill
- ii) Kurian NP (2005, 3 edition). Design of Foundation Systems, Alpha Science Publisher Narosa Publications
- iii) Fang H Sai-Yang (2013) Foundation Engineering Handbook, CBS Publishers
- iv) Sarkar & Sarswati. (2012) Construction Technology, Oxford University Publishers.
- v) Johnson R.P, (2004, 3rd addition) Composite Structures of Steel and Concrete, UK. Blackwell Scientific Publications.
- vi) Owens, G.W. and Knowels. P (2012, 7th edition), Steel Designers Manual (Fifth edition), Steel Concrete Institute, UK. Oxford Blackwell Scientific Publications.
- vii) Nethercot, D.A. (2003). London. Composite Construction, Spon Press.

M.Tech/CE/CTM/2/DSC4: ADVANCED CONCRETE MATERIALS							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance
Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.							

Course Outcomes:

- To study mechanical properties of fibre reinforced concrete used in highways and bridges.
- To understand use of pozzolanic material in modern highway construction.
- To acquire knowledge of polymer concrete and ferro cement in highway construction.
- To study significance of high performance concrete in highway construction

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	1	1	1	2	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	-	-	-	-	-	1	3
Average	1.0	1.0	1.0	1.3	1.0	-	-	-	-	-	1.0	3.0

UNIT-1

FIBRE REINFORCED CONCRETE:

Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures, Properties of Freshly mixed FRC, Mechanics and properties of Fibre reinforced concrete, Composite Material approach, Application of fibre reinforced concrete.

FERRO CEMENT: Constituent materials and their properties, Mechanical properties of ferro cement, Construction techniques and application of ferro cement

UNIT-II

FLY ASH CONCRETE:

Classification of Indian Flyashes, Properties of Flyash, Reaction Mechanism, Proportioning of Flyash concretes, Properties of Flyash concrete in fresh and hardened state, Durability of flyash concrete.

POLYMER CONCRETE: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete.

UNIT-III

HIGH PERFORMANCE CONCRETE: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.

GEOPOLYMER CONCRETE: Mechanism of Geopolymer Concrete, Ingredients of geopolymer concrete, mix proportioning, permeability, durability and applications

UNIT-IV

LIGHT WEIGHT CONCRETE: Properties of light weight concretes, Pumice concrete, Aerated cement mortars, No fines concrete, Design and applications of light weight concrete.

HEAVY WEIGHT CONCRETE: Properties of heavy weight concrete, design and applications of heavy weight concrete, Self-compacting concrete.

References:

1. Concrete, its Properties and Microstructure by P.K. Mehta, and P.J.M. Monterio.
2. Ferrocement by B.K. Paul, and R.P. Pama
3. Fibre Reinforced Concrete by Bentur and Mindess.
4. Flyash in Concrete by Malhotra and Ramezaniapur

M.Tech/CE/CTM/2/DSC5: GREEN BUILDINGS AND SERVICES

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After going through the course on Green Buildings and Services, the students shall be able to:

- Understand the issues of environmental degradation on account of Buildings Sector.
- Understand the Concept of Green Buildings and its importance.
- Learn the Design factor of Green Buildings.
- Be able to apply the concepts to Building Design & Rehabilitation.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	3	-	-	-	1	3
CO2	1	1	1	1	1	-	3	-	-	-	1	3
CO3	1	1	2	1	1	-	3	-	-	-	1	3
CO4	1	1	2	1	1	-	3	-	-	-	1	3
Average	1.0	1.0	1.5	1.0	1.0	-	3.0	-	-	-	1.0	3.0

UNIT-I

Introduction to Green Buildings

Definition of Green Building, Benefits of Green Building, Components/features of Green Building – Site selection, Energy Efficiency, Water Efficiency, Material Efficiency, Indoor Air Quality.

Design Features for Green Building Construction

Site selection strategies, landscaping, building form, orientation, building envelope and fenestration – material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, Waste reduction during construction.

UNIT-II

Water and Waste Water Management

Compliance, fixtures, rainwater harvesting and techniques, water and waste water management, solid waste management.

Energy Management

Appliances, compliance energy performance, solar water heating system, use of renewable energy options. High performance glass, other energy saving options, provisions of ECBC, insulating materials.

UNIT-III

Eco-friendly Materials

Various types of eco-friendly materials, use of recycled materials like: flyash bricks, recycled ceramic tiles, recycled glass tiles, porcelain tiles, natural terracotta tile, wood, steel, aluminium and renewable materials, agri fibre, linoleum, salvaged material – properties and applications. Recycling of aggregate, use of plastic, recycled material

Indoor Air Quality

Natural air ventilation systems, different types of low VOC materials, day lighting.

UNIT-IV

Rating Systems and Certification for Green Building

Different rating of rating like lead, systems and their special features. Criteria, compliance, appraisal for rating systems. Case study on rating of green buildings.

References:

- i) Sharma, S.K., Gupta Himmi, Singh Balkar (2014), Proceeding of Training Programme on Energy Efficient & Green Buildings, New Delhi, Excel India Publishers.
- ii) Sabnis, Gajanan M. (2013) Green Building with Concrete, Sustainable Design & Construction, New Delhi, Taylor & Francis Group.
- iii) Ministry of Power, Govt. of India. (2008). Energy Conservation Building code 2007, New Delhi, Bureau of Energy Efficiency.
- iv) Indian Green Building Council. (2014). IGBC Green Homes Rating System.
- v) Boyle, Godfrey (2013). Renewable Energy: Power for a Sustainable Future, Oxford University Press.
- vi) Kumar, Pradeep, Tyagi, Amit Kumar. Managing Energy Efficiently in Hotels and Commercial Buildings, TERI Publications.
- vii) Halpeth, M.K; Kumar, T Senthil and Harikumar, G. Light Right – A Practising Engineer's Manual on Energy Efficient Lighting, TERI Publications
- viii) Pachauri, R.K and Abeyratne, Shyamala. From Sunlight to Electricity – Solar Photovoltaic Applications, TERI Publications.

3RD SEMESTER

M.Tech/CE/CTM/3/CC1: CONSTRUCTION EQUIPMENT							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After Completion of this Course student will be able

- To Understand general process/methods for constructing industrial, heavy civil, and commercial projects
- To proper selection, application, utilization, and productivity of heavy equipment
- To Understand terminology and units of measurements related to equipment usage in industrial, heavy civil, and commercial projects
- Understand standard designations, sizes, and graduations of equipment
- To understand the theoretical and practical aspects of project management techniques to achieve project goals

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	2	3
CO2	1	1	1	1	1	-	-	-	-	-	2	3
CO3	2	1	1	1	1	-	-	-	-	-	2	3
CO4	2	1	1	1	1	-	-	-	-	-	2	3
CO5	1	1	1	1	1	-	-	-	-	-	3	3
Average	1.4	1.0	1.0	1.0	1.0	-	-	-	-	-	2.2	3.0

Unit I

Introduction:

Construction economy; Factors affecting the selection of construction equipment; rolling resistance, effect of grade on required tractive effort, effect of altitude and temperature on the performance of internal combustion engines, drawbar pull, rimpull and acceleration, owning and operating cost of equipment.

Earth Moving Equipment:

Crawler and wheel tractors-their functions, types and specifications; grade-ability, bull dozers and their use; tractor pulled scrapers, their sizes and output; effect of grade and rolling resistance on the output of tractor pulled scrapers; earth loaders; placing and compacting earth fills.

Power shovels - functions, selection, sizes, shovel dimensions and clearances, output, Draglines – functions types ,sizes ,output, Clamshells; Safe lifting capacities and working ranges of cranes; Hoes ,trenching machines, types and production rates calculation of production rates of equipment; examples.

Unit II

Hauling Equipment:

Trucks; capacities of trucks , balancing the capacities of hauling units with the size of excavator; effect of grade and rolling resistance on the cost/performance of hauling equipment.

Compaction Equipment:

Roller class: sheep's foot rollers, pneumatic tyre rollers, steel wheel rollers, vibrating rollers ,gridtype rollers-their applications.

Unit III

Drilling, Blasting and Tunneling Equipment:

Definition of terms ,bits, jackhammers, drifters, wagon drills, churn drills, piston drills, blast hole drills, shot drills, diamond drills; Tunneling equipment; selecting the drilling method and equipment; selecting drilling pattern; rates for drilling rock, air compressors.

Unit IV

Piling Equipment:

Pile hammers, selecting a pile hammer loss of energy due to impact, energy losses due to causes other than impact. Equipment for bored and cast in-situ piles

References:

- i) Verma, Mahesh Construction equipment and its planning and applications, Metropolis BookCo. Ltd.
- ii) Peurifouy RL: Construction Planning Equipment and Methods, Tata McGraw Hill.
- iii) Jagman Singh : Heavy construction Planning ,Equipment and Methods, Oxford and IBH
- iv) Franklin John A. and Maurice B. Dusseault Rock Engineering, Tata McGraw Hill
- v) Christian John ; Management, Machines and Methods in Civil Engineering, John Wiley andSons.
- vi) Frank Harris, Modern Construction Equipment and Methods, John Wiley and Sons.

M.Tech/CE/CTM/3/CC2: Computer Applications in Civil Engg.							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Practical	02	04	Lab Work	70	30	3 Hours	TEE/ Practical File
Instructions to paper setter for Final Term examination: The term end examination shall be conducted by a panel of one external and one internal examiner. The question paper for practical examination shall be set on the spot.							

Course Outcomes:

After Completion of this Course student will be able.

- To plan and execute the Project structure.
- To analyze the technical aspects of road Projects.
- To understand the required for design of pavement.
- To analyze the design of Project.
- To perform the estimation task of any project.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	1	-	-	-	-	-	3	3
CO2	1	1	2	1	1	-	-	-	-	-	3	3
CO3	1	1	2	1	1	-	-	-	-	-	3	3
CO4	1	1	2	1	1	-	-	-	-	-	3	3
CO5	2	1	2	1	1	-	-	-	-	-	3	3
Average	1.2	1.0	2.0	1.0	1.0	-	-	-	-	-	3.0	3.0

List of Experiment

1. Planning and Scheduling of Multi Storied building by using Primavera.
2. Planning and Scheduling of Road Projects by using Primavera.
3. To design horizontal alignment of road by using MX Road.
4. To Perform Vertical alignment by using MX Road.
5. To Perform Calculations for Flexible Pavement Design by using IIT Pave.
6. To Design of Flexible Pavement by using IIT Pave.
7. To Prepare a model of box type structure (2x2) using STAAD Pro.
8. To analyze and design three storied building by using STAAD Pro.
9. To Prepare BOQ of a building using any Estimation software.
10. To Prepare BOQ of a flexible pavement using any Estimation software.

M.Tech/CE/CTM/3/DSC1: Public Private Partnership Concepts in Infrastructure							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After Completion of this Course student will be able

- To understand the essence of public-private partnership and its theoretical roots.
- To develop abilities of economic analysis of a project.
- To analyze the institutional environment necessary for the development of PPPs
- To understand the main stages of the PPP-project life cycle.
- To explain various financial and contract management issues involved in PPP projects.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	1	-	-	-	3
CO2	1	1	1	1	1	-	-	1	-	-	-	3
CO3	1	1	1	1	1	-	2	-	-	-	-	3
CO4	1	1	1	1	1	-	-	-	-	-	-	3
CO5	1	1	1	1	1	-	-	-	-	-	3	3
Average	1.0	1.0	1.0	1.0	1.0	-	2.0	1.0	-	-	3.0	3.0

UNIT I

Economic analysis: different methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, risk and uncertainties and management decision in capital budgeting. Examples of economic analysis for different types of road improvement measures, pavement options, construction of bypasses and upgrading of intersections. Project priorities, methods of dealing with uncertainties.

UNIT II

PPP concepts: Basic concepts of Public Private Partnerships and Built-Operate-Transfer Models: BOT(Toll), BOT(Annuity), Shadow Tolls, DBFO concepts, maintenance – operate – and transfer models. Concerns of various stakeholders – government, concessionaire, lenders and road users. Legal and financial framework. Viability gap funding.

UNIT III

Risk Allocation and Mitigation: Identification, allocation and mitigation of risks in delivery of BOT projects in road sector. Rights and obligations of parties. Rights of lenders. Model Concession Agreement. Dispute resolution mechanism.

Procurement of PPP projects: Preparation of Feasibility Reports covering technical, social and environmental aspects (for 2lane/4lane/6lane/Expressway) including procurement of consultancy services. Technical schedules for inviting bids for selection of sponsor. Preparation of RFQ, RFP. Bidding criteria. Selection of sponsor. Award of concessions. Pre-construction activities viz. Land

Acquisition, Rehabilitation and resettlement of project affected persons, tree cutting, environment management plan, utilities shifting, etc.

UNIT IV

Financial Issues: Financial assessment (by Government, by prospective bidders and by selected sponsor). Revenue and traffic projections. Cash flow Models including cost recovery, sensitivity analysis. Financial structuring, debt and equity aspects, financial close. Shareholders agreement. Case Studies.

Contract Management: Principles of contract management for PPP projects. Basic differences between FIDIC conditions of contract and Model Concession Agreement. Selection and Role of Independent Engineer.

Recommended References:

1. Kadiyali L.R. “**Traffic Engineering and Transport Planning**”-Khanna Publishers, New Delhi
2. Ian G. Heggie, “**Transportation Engineering Economics**”-McGraw Hill Book Co.
3. JotinChisty.C and Kent Lall B “**Transportation Engineering An Introduction**”- PHI, New Delhi.
4. Prasanna Chandra “**Financial Management**”-Tata McGraw, New Delhi.
5. Woods, K.B., Berry, D.S. and Goetz, W.H., “**Highway Engineering**”-McGraw Hill Book Co.
6. Hewes, C.I. and Oglesby, C.H., “**Highway Engineering**”-Asia Publishing House.
7. “**Road User Cost Study in India**”- Final Report, Central Road Research Institute, New Delhi, 1982.
8. Ministry of Road Transport and Highways, “**Road Development Plan for India**”- 2001-2021, Indian Roads Congress, New Delhi, 2002.

M.Tech/CE/CTM/3/DSC2 RESEARCH METHODOLOGY AND IPR							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

- To understand research problem formulation and analyze research related information.
- To motivate students to follow research ethics.
- To realize importance of Computer, Information Technology as well as ideas, concept, and creativity.
- To understanding IPR and its role in research work and investment in R & D.
- To Prepare a well-structured research paper and scientific presentations

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	1	-	-	-	-	-	1	3
CO2	1	1	2	2	-	-	-	2	-	-	-	3
CO3	1	1	2	2	2	-	-	-	-	-	1	3
CO4	1	1	2	2	2	1	-	-	-	-	1	3
CO5	1	1	2	2	2	-	-	-	-	-	1	3
Average	1.0	1.2	2.0	2.0	1.8	1.0	-	2.0	-	-	1.0	3.0

Unit I

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.

Unit II

Effective literature studies approaches, analysis Plagiarism, Research ethics, 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 III

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 IV

Patent Rights: 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 IITs.

References:

- Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”
- Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction” Model Curriculum of Engineering & Technology PG Courses [Volume -II] [15]
- Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
- Mayall , “Industrial Design”, McGraw Hill, 1992.
- Niebel , “Product Design”, McGraw Hill, 1974.
- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
- Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

M.Tech/CE/CTM/3/DSC3: Contracts and legal issues							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After Completion of this Course student will be able

- To understand the execution of work.
- To understand the documents of contract.
- To understand the unit of measurement used at construction site.
- To understand the Laws and act used in Construction.

CO-PO Mapping Matrix for Course												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	2	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	3	-	-	-	-	1	3
Average	1.3	1.0	1.0	1.0	1.0	3.0	-	-	-	-	1.0	3.0

UNIT I

Execution of Works – Direct execution by Department – Muster Roll (form 21) – Piece work agreement – Work Order. Execution through contractor – Definitions – Types of contracts – Lump sum contract, Item rate contract, Cost plus fixed fee contract, Cost plus percentage contract, Special contracts.

UNIT II

Contract document – Conditions of Contract – Tender notice – Bidding procedure – Scrutiny and acceptance of tender, award of contract – Earnest money deposit and Security deposit - Termination of contract. Disputes – Settlement through arbitration – Indian Arbitration Act 1940 – Clauses and advantages of arbitration.

UNIT III

Specifications – Importance, Design and Writing of Specifications – Types of Specifications – General, Detailed, Standard, Special, Restricted and Manufacturer's specifications. Accounts – Advances, Earnest money and Security deposits, First and final bills, Fines, Recovery, Closing of accounts.

UNIT IV

Labour legislation – Factory Act 1948, Contract Labour Act 1970, Trade Union Act, Minimum

Wages Act 1948, Workmen Compensation Act 1923, Industrial Disputes Act 1947. Labour Welfare – Labour welfare fund act 1965, Employees State Insurance act 1948, Incentives. Labour welfare measures. Recent updation and amendments

Reference Books:

1. Construction Management and Accounts by B.L.Gupta and Amit Gupta
2. Construction Management and Projects by B.Sengupta and H Guha
3. Construction Planning and Management by P.S.Gelhot and BM Dhir.

MTECH/CE/CTM/3/SEC1 DISSERTATION PART-1 WITH SEMINAR,

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Courses	04	08	Discussions	-	100	-	Seminar with Synopsis

Instructions to paper setter for Final Term Examination: A panel of internal examiners will evaluate the student on the basis of seminar and synopsis submission.

4TH SEMESTER

MTECH/CE/CTM/3/SEC1 DISSERTATION PART-2,							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Skill Enhancement Courses	12	24	Discussions	300	-	-	Thesis submission and Presentation

Instructions to paper setter for Final Term Examination: A panel of external and internal examiners will evaluate the student on the basis of Thesis submission and Presentation.

CE/OEC1: CONTRACTS AND LEGAL ISSUES

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/Assignment/Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After Completion of this Course student will be able

- To understand the execution of work.
- To understand the documents of contract.
- To understand the unit of measurement used at construction site.
- To understand the Laws and act used in Construction.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	-	-	1	3
CO2	1	1	1	1	1	-	-	-	-	-	1	3
CO3	2	1	1	1	1	-	-	-	-	-	1	3
CO4	1	1	1	1	1	3	-	-	-	-	1	3
Average	1.3	1.0	1.0	1.0	1.0	3.0	-	-	-	-	1.0	3.0

UNIT I

Execution of Works – Direct execution by Department – Muster Roll (form 21) – Piece work agreement – Work Order. Execution through contractor – Definitions – Types of contracts – Lump sum contract, Item rate contract, Cost plus fixed fee contract, Cost plus percentage contract, Special contracts.

UNIT II

Contract document – Conditions of Contract – Tender notice – Bidding procedure – Scrutiny and acceptance of tender, award of contract – Earnest money deposit and Security deposit - Termination of contract. Disputes – Settlement through arbitration – Indian Arbitration Act 1940 – Clauses and advantages of arbitration.

UNIT III

Specifications – Importance, Design and Writing of Specifications – Types of Specifications – General, Detailed, Standard, Special, Restricted and Manufacturer's specifications. Accounts – Advances, Earnest money and Security deposits, First and final bills, Fines, Recovery, Closing of accounts.

UNIT IV

Labour legislation – Factory Act 1948, Contract Labour Act 1970, Trade Union Act, Minimum

Wages Act 1948, Workmen Compensation Act 1923, Industrial Disputes Act 1947. Labour Welfare – Labour welfare fund act 1965, Employees State Insurance act 1948, Incentives. Labour welfare measures. Recent updation and amendments

Reference Books:

1. Construction Management and Accounts by B.L.Gupta and Amit Gupta
2. Construction Management and Projects by B.Sengupta and H Guha
3. Construction Planning and Management by P.S.Gelhot and BM Dhir.

CE/OEC1: GREEN BUILDINGS AND SERVICES

Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Compulsory Theory	04	04	Lecture	70	30	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final Term Examination: Final Term examination shall cover the whole content of the course. Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Outcomes:

After going through the course on Green Buildings and Services, the students shall be able to:

- Understand the issues of environmental degradation on account of Buildings Sector.
- Understand the Concept of Green Buildings and its importance.
- Learn the Design factor of Green Buildings.
- Be able to apply the concepts to Building Design & Rehabilitation.

CO-PO Mapping Matrix for Course

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	3	-	-	-	1	3
CO2	1	1	1	1	1	-	3	-	-	-	1	3
CO3	1	1	2	1	1	-	3	-	-	-	1	3
CO4	1	1	2	1	1	-	3	-	-	-	1	3
Average	1.0	1.0	1.5	1.0	1.0	-	3.0	-	-	-	1.0	3.0

UNIT-I**Introduction to Green Buildings**

Definition of Green Building, Benefits of Green Building, Components/features of Green Building – Site selection, Energy Efficiency, Water Efficiency, Material Efficiency, Indoor Air Quality.

Design Features for Green Building Construction

Site selection strategies, landscaping, building form, orientation, building envelope and fenestration – material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, Waste reduction during construction.

UNIT-II

Water and Waste Water Management

Compliance, fixtures, rainwater harvesting and techniques, water and waste water management, solid waste management.

Energy Management

Appliances, compliance energy performance, solar water heating system, use of renewable energy options. High performance glass, other energy saving options, provisions of ECBC, insulating materials.

UNIT-III

Eco-friendly Materials

Various types of eco-friendly materials, use of recycled materials like: flyash bricks, recycled ceramic tiles, recycled glass tiles, porcelain tiles, natural terracotta tile, wood, steel, aluminium and renewable materials, agri fibre, linoleum, salvaged material – properties and applications. Recycling of aggregate, use of plastic, recycled material

Indoor Air Quality

Natural air ventilation systems, different types of low VOC materials, day lighting.

UNIT-IV

Rating Systems and Certification for Green Building

Different rating of rating like lead, systems and their special features. Criteria, compliance, appraisal for rating systems. Case study on rating of green buildings.

References:

- i) Sharma, S.K., Gupta Himmi, Singh Balkar (2014), Proceeding of Training Programme on Energy Efficient & Green Buildings, New Delhi, Excel India Publishers.
- ii) Sabnis, Gajanan M. (2013) Green Building with Concrete, Sustainable Design & Construction, New Delhi, Taylor & Francis Group.
- iii) Ministry of Power, Govt. of India. (2008). Energy Conservation Building code 2007, New Delhi, Bureau of Energy Efficiency.
- iv) Indian Green Building Council. (2014). IGBC Green Homes Rating System.
- v) Boyle, Godfrey (2013). Renewable Energy: Power for a Sustainable Future, Oxford University Press.
- vi) Kumar, Pradeep, Tyagi, Amit Kumar. Managing Energy Efficiently in Hotels and Commercial Buildings, TERI Publications.
- vii) Halpeth, M.K; Kumar, T Senthil and Harikumar, G. Light Right – A Practising Engineer's Manual on Energy Efficient Lighting, TERI Publications
- viii) Pachauri, R.K and Abeyratne, Shyamala. From Sunlight to Electricity – Solar Photovoltaic Applications, TERI Publications.