Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and affiliated to SPPU, Pune

Curriculum Structure and Detailed Syllabus

M. Tech. Construction Management

(Course 2020)

DEPARTMENT OF CIVIL ENGINEERING

Effective from Academic Year 2021-22

(Updated with minor changes)

Institute Vision

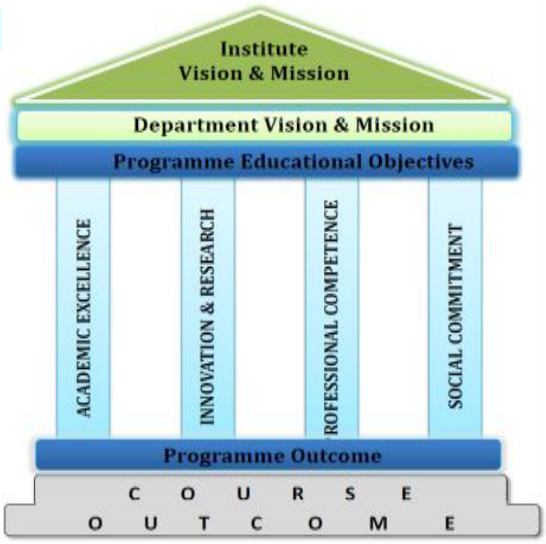
To Serve the Society, Industry and all the Stakeholders through the **Value-Added Quality Education.**

Institute Mission

To serve the needs of society at large by establishing State-of-the-Art Engineering, Management and Research Institute and impart attitude, knowledge and skills with quality education to develop individuals and teams with ability to think and analyze right values and self-reliance.

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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LIST OF ABBREVIATIONS USED IN STRUCTURE

Abbreviations	Course Full Name
PCC	Professional Core Course
PEC	Professional Elective Course
OEC#	Open Elective Course
PROJ	Project, Mini / Minor Projects, Integrated Projects
SEM	Seminar
INTR	Internship
HSMC*	Humanities / Social Science / Management Course
AUDIT*	Audit Course
MOOC	Massive Open Online Courses
H	Hours

Note : * Indicates that these courses are at institute level

 # The Course offered by the other department

CURRICULUM STRUCTURE

STRUCTURE FOR 1ST YEAR M. TECH (CIVIL- CONSTRUCTION MANAGEMENT)

SEMESTER – I

M. Tech. Construction Management			Teaching Scheme				Examination Scheme					
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**IE1**	**IE2**	**ETE**	**TW**	**OR**	**Total**
MCI1401	PCC	**Research Methodology & IPR**	3	-	3	3	20	30	50	-	-	100
MCI1402	PCC	Project Planning and Management in Construction (PPMC)	3	-	3	3	20	30	50	-	-	100
MCI1403	PCC	**Construction Technology (CT)**	3	-	3	3	20	30	50	-	-	100
MCI1404	PEC	Professional Core Lab-I	-	2	2	1	-	-	-	50	50	100
MCI1501	PEC	Professional Elective-I	3	-	3	3	20	30	50	-	-	100
MCI1502	PEC	Professional Elective-II	3	-	3	3	20	30	50	-	-	100
MCI1503	PEC	Professional Elective Lab-I	-	2	2	1	-	-	-	50	50	100
*	OEC	Open Elective-I	2	-	2	2	20	-	30	-	-	50
MCI1405	PCC	Skill Development Lab – I (Software Skill)	-	2	2	1	-	-	-	50	-	50
M1961	Audit	Audit Course – I	1	-	1	-	-	-	-	-	-	-
		Total	**18**	**6**	**24**	**20**	**120**	**150**	**280**	**150**	**100**	**800**

Abbr: Course Abbreviation; **L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE1** – Internal Evaluation-1; **IE2** –Internal Evaluation-2; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam

**** Open Elective code depends upon the subject selection by the student.***

STRUCTURE FOR 1ST YEAR M. TECH (CIVIL- CONSTRUCTION MANAGEMENT)

SEMESTER – II

M. Tech. Construction Management			Teaching Scheme				Examination Scheme					
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**IE1**	**IE2**	**ETE**	**TW**	**OR**	**Total**
MCI2405	PCC	Construction Contracts Administration and Management (CCAM)	3	-	3	3	20	30	50	-	-	100
MCI2406	PCC	Project Economics and Financial Management (PEFM)	3	-	3	3	20	30	50	-	-	100
MCI2407	PCC	Professional Core Lab-II	-	2	2	1	-	-	-	50	50	100
MCI2504	PEC	Professional Elective-III	3	-	3	3	20	30	50	-	-	100
MCI2505	PEC	Professional Elective-IV	3	-	3	3	20	30	50	-	-	100
MCI2506	PEC	Professional Elective Lab –II	-	2	2	1	-	-	-	50	50	100
*	OEC	**Open Elective –II**	2	-	2	2	20	-	30	-	-	50
MCI2101	HSMC	Skill Development Lab – II (Oral & Written Communication)	-	2	2	1	-	-	-	50	-	50
MCI2701	PROJ	Integrated Mini-Project	-	6	6	3	-	50	-		50	100
M2962	Audit	Audit Course –II	1	-	1	-	-	-	-	-	-	-
		Total	**15**	**12**	**27**	**20**	**100**	**170**	**230**	**150**	**150**	**800**

Abbr: Course Abbreviation; **L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE1** – Internal Evaluation-1; **IE2** – Internal Evaluation-2; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam

**** Open Elective code depends upon the subject selection by the student.***

STRUCTURE FOR IIND YEAR M. TECH (CIVIL- CONSTRUCTION MANAGEMENT)

SEMESTER-III

M Tech. C.M.	Sem – III		TEACHING SCHEME				EXAMINATION SCHEME					
Course Code	**Course Type**	**Courses**	**L**	**P**	**H**	**CR**	**IE-1**	**IE-2**	**ETE**	**TW**	**OR**	**TOTAL**
MCI3702	PROJ	Dissertation Phase - I[Company/ In-house project]	-	20	20	10	100	-	-	-	100	200
MCI3703	SEM	Seminar	-	04	04	02	-	-	-	50	50	100
MCI3801	INTR	Internship[Company /Inhouse project]	-	04	04	02	50	-	-	-	50	100
		OR										
MCI3981	MOOC	MOOCs/ Entrepreneurship	-	04	04	02	50	-	-	-	50	100
		Total	**-**	**28**	**28**	**14**	**150**	**-**	-	**50**	**200**	**400**

*Internship**: -It may be in summer/winter vacation or within semester at least for three months, evaluation after fourth semester**

SEMESTER-IV

M. Tech. C.M.	Sem – IV		TEACHING SCHEME				EXAMINATION SCHEME					
Course Code	**Course Type**	**Courses**	**L**	**P**	**H**	**CR**	**IE-1**	**IE-2**	**ETE**	**TW**	**OR**	**TOTAL**
MCI4704	PROJ	Dissertation Phase – II [Company/ In-house project]	-	24	24	12	200	-	-	-	200	400
MCI4982	MOOC	MOOCs	-	4	4	2	50	-	-	-	50	100
		Total	**-**	**28**	**28**	**14**	**250**	**-**	**-**	**-**	**250**	**500**

Abbr: Course Abbreviation; **L**- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **IE-I** – Internal Evaluation-1; **IE-II** – Internal Evaluation-II; **ETE** – End Term Examination; **TW** – Term Work; **OR** – Oral Exam

PROFESSIONAL ELECTIVE COURSES

Course Code	Elective-I	Course Code	Elective-II
MCI1501A	Sustainable Construction Materials	MCI1502A	Building Services and Maintenance
MCI1501B	Disaster Management	MCI1502B	Value Engineering and Valuation
MCI1501C	Material Management	MCI1502C	Human Resources and Management

Course Code	Elective-III	Course Code	Elective-IV
MCI2504A	Retro Fitting	MCI2505A	Safety Practices in Construction
MCI2504B	Advanced Construction Technology	MCI2505B	Infrastructural Development
MCI2504C	Construction Equipment's and Management	MCI2505C	International Contracting

AUDIT COURSES (Common to all Programs)

Course Code	SEM-I	Course Code	SEM-II
M_1961A	Constitution of India	M_2962A	Team Building &Leadership
M_1961B	Value Education	M_2962B	English for Research writing
M_1961C	Stress Management	M_2962C	Disaster Management

LIST OF OPEN ELECTIVES

OFFERED BY CIVIL- CONSTRCTION MANAGEMENT

Course Code	Open Elective – I	Course Code	Open Elective -II
MCI1601A	Project Management and Finance	**MCI2602A**	Contracts, Tendering and Arbitration
CI1601B	Green Technology	**MCI2602B**	Total Quality Management
		MCI2602C	Operation Research

Course Syllabus

SYLLABUS CONTENT WITH TEACHING AND EVALUATION SCHEME

Course Syllabus
Semester-I

Program: M. Tech. Civil-construction Management					Semester: I	
Course: Research Methodology and IPR					Code: MCI1401	
Teaching Scheme/ Week			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Project and seminars in undergraduate

Objectives:

1. To select and define appropriate research problem and parameters with appropriate methodology.
2. To understand statistical techniques for the specific perspective data in an appropriate manner.
3. To make predictions and decisions for the data set using open-source software.
4. To understand the mathematical modeling and its predicting capability.
5. To learn the various steps in research writing and publication process
6. To introduce fundamental aspects of Intellectual property Rights

Outcomes: After learning the course, the students should be able to:

1. Define a research problem and use appropriate research methodology
2. Examine data using different hypothesis tests and make conclusions about acceptance or rejection of sample data.
3. Analyze numerical data, using standard procedures of probability theory to predict the performance.
4. Develop a mathematical model and analyze the prediction capabilities
5. Write a research paper and research proposal.
6. Write a concept note and prepare to file an IP.

Detailed Syllabus:

Unit	Description	Duration (Hrs)
1.	**Research Problem and Research Design** Objectives, Motivation, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Criteria of Good Research Definition and Feasibility study of research problem, Sources of research problem, Meaning of Hypothesis, Characteristics of Hypothesis, Errors in selecting a research problem, Concept & need of research design	6
2.	**Applied Statistics** Measures of Variability: Standard Deviation, variance, Quartiles, Interquartile Range Inferential Statistics: Statistical Significance (p values), Pearson's r test, t- test, Chi square test, ANOVA (Analysis of variance)	6
3.	**Probability** Sampling, Types of Sampling, Probability Distribution: Binomial Distribution, Poisson Distribution, Normal Distribution, Case Study: Develop a model for Prediction and Decision Making for the data set using open-source software	6
4.	**Mathematical Modeling and prediction of performance** Types of Modeling, Types of solutions to mathematical models, Steps in Setting up a computer model to predict performance of experimental system, Validation of results, Multi-scale modeling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Sensitivity analysis.	6
5.	**Research Report writing and Publication** Research Report: Dissemination of research findings, outline and structure of	6

	research report, different steps and precautions while writing research report, methods and significance of referencing. Publishing Research work: Selection of suitable journal for publishing research work, Open access Vs Subscription Journals, Identifying indexing of selected journals, Impact factor of the journal, structure of research paper, Check for plagiarism of the article, Research paper submission and review process.	
6	**Intellectual property Rights** Definition of IPR, Classification of IP, Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents. Prior Art Search, Patentability Criteria, Patent Filing Procedure, Forms and Fees, Case Study of Patent, Copyright.	**6**
	Total	**36**

Textbooks:

1. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, 2nd Edition, 1985
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition.,2010.
3. Ramakrishna B and Anil Kumar H S., Fundamentals of IPR, Notion Press, 2016
4. Virendra Kumar Ahuja, IPR in India, LexisNexis Butterworths Wadhwa Nagpur, 2017

Reference Books:

1. Stuart Melville and Wayne Goddard, Research methodology: An Introduction for Science & Engineering students
2. S.D. Sharma, Operational Research, Kadar Nath Ram Nath & Co.
3. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction, Juta and Company Ltd, 2004.

Program:	M. Tech. (Civil) Construction Management	Semester : I	
Course :	Project Planning and Management in Construction (PPMC)	Code :	MCI1402

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Project Management & Economics, Construction Management

Objectives:

1. To provide knowledge of basic management practices adopted in civil engineering by using various techniques and softwares.
2. To provide knowledge of various aspects relayed to site moblization & workstudy.
3. To provide knowledge of site safety and administration.

Outcomes: After learning the course the students should be able to:

1. Apply knowledge of Construction Management on construction projects.
2. Analyze project scheduling using various techniques.
3. Apply knowledge of work-study on construction site to improve productivity.
4. Evaluate safety norms in construction site and decide incentive scheme.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Basics of Management:** Modern scientific management, Management Functions, Project Management: Basic forms of organization with emphasis on Project and matrix structures; project life cycle, planning for achieving time, cost, quality, Project feasibility reports based on socio-techno-economic-environmental impact analysis.	6
2.	**Procedures in management:** Project clearance procedures and necessary documentation for infrastructure projects, Qualities, role and responsibilities of project Manager, Role of Project Management Consultants. **Project Scheduling:** Construction S ch ed u l i n g, Work break down structure, activity cost and time estimation in CPM, PERT, LOB technique, Mass haul diagrams. Precedence Network Analysis.	6
3.	**Softwares:-**Software in Construction scheduling (MSP, Primavera, Construction manager). **Site mobilization –** demobilization aspects, various Resources management based on funds availability. Co-coordinating, communicating & reporting techniques. Application of MIS to construction.	6
4.	**Work study:-** Definition, Objectives, basic procedure, method study and work measurement, work study applications in Civil Engineering. Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. Work measurement – Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating.	6
5.	**Safety Engineering:** Causes of Accidents on various sites, safety measures and safety policies to be adopted, determination of safety parameters, personal protective equipment's. Workmen Compensation Act.	6
6.	**Administration of Incentive Schemes:** Necessity, Merit rating, job evaluation, installation, modification and maintaining of incentive schemes based on implementation experience.	6
	Total	36

Text Books:

1. Construction Planning & Management By P.S. Gahlot & B M Dhir , New Age International Limited Publishers
2. Construction Project planning & Scheduling By Charles Patrick, Pearson, 2012
3. Construction Project Management Theory & practice --- Kumar Neeraj Jha,Pearson,2012
4. Construction management Fundamantals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill, 2 nd Edition, 201Modern construction management--.Harris, Wiley India.
5. Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication.

Reference Books:

1. Project Management – K Nagrajan – New age International Ltd.
2. Work study – Currie.

3. Professional Construction Management Barrie-Paulson-McGraw Hill Institute Edition.
4. Project Management – Ahuja H.N. – John Wiely, New York.
5. Construction Project Management Planning, Scheduling and Controlling-Chitakara-Tata McGraw Hill, New Delhi
6. Construction Management – Roy, Pilcher
7. Construction Management – O'Brien.
8. Project Management-Planning and Control---Rory Burkey 4 th ed.—Wiley,India.

Program:	M. Tech. (Civil) Construction Management			Semester :	I	
Course :	Construction Technology			Code :	MCI1403	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Building Materials, Building Construction, Concrete Technology, Geo-technical and foundation Engineering, Tunnel engineering

Objectives:

1. To know the various methods and techniques involved in construction of deep foundations.
2. To get familiar with different construction processes with recommended specifications.
3. To provide a coherent development to the students in area of construction technology.

Outcomes: After learning the course the students should be able to:

1. Select the process and technique involved in pile construction.
2. Decide the type of coffer dam /caisson and its techniques of construction
3. Explain the construction techniques involve in tunnel/underground construction.
4. Create an action plan for various activities and processes involved in high rise construction.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Pile construction-**Introduction, uses, selection of piles, Classification of piles based on function, pile driving techniques, grouping of piles, efficiency of group of piles, pile cap and pile shoe, load tests on piles, loads on piles, pulling of piles, causes of failures of piles and precautionary measures, Use of NDT in pile construction.	6
2.	**Coffer Dams:** types, selection, design features of coffer dams and construction of single, double wall, Sheet pile cofferdams, concrete wall movable cofferdam, land cofferdams, soldier construction method. Cofferdam construction by different techniques, diaphragm wall construction, leakage prevention, economic height.	6
3.	**Caissons:** Definition, uses, construction material, types of caissons, loads on caisson, design features of caissons, Construction of pneumatic and precast caissons, floating of caissons, cutting edges, sinking of caisson, tilting of caisson, caisson diseases.	6
4.	**Underground Tunneling** –Tunnel alignment, size and shape of tunnel, tunneling in hard and soft strata, tunnel shaft-sinking and construction, tunnel lining, ventilation and lighting in tunnel, advance techniques for tunnel maintenance, Micro Tunneling.	6
5.	**Under water construction :**Problems encountered in excavation, Underwater drilling, blasting, Grouting methods in soft and hard soil including Jet grouting and Chemical grouting, Dewatering in shallow and deep excavations using different methods, Vacuum Dewatering and Well point system, electro-osmosis, injections with cement and chemical, freezing process, vibro-flotation.	6
6.	**High rise construction techniques:** Prefab construction techniques, types and erection methods of shuttering/form work system for high rise building, formwork for dome, erection of Ready Mix Concrete plant and pumping of concrete for high rise construction, principles, types and advantages of slip form and scaffolds, techniques for maintenance of high rise construction.	6
	Total	**36**

Text Books:

1. S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai &Sons, New Delhi.
2. S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press,New Delhi.
3. B.C. Punamia, Building Construction, Laxmi Publications, New Delhi
4. S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand
5. *Construction Equipment Planning and Applications – Dr. Mahesh Varma*

Reference Books:

1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication
2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
3. Journals such as CE & CR. Construction world, International Construction.
4. Dr. Kumar Niraj Jha, ― Formwork for Concrete Structures, Mc Graw Hill Publication

Program:	M. Tech. (Civil) Construction Management					Semester : I
Course :	Professional Core Lab-I					Code : MCI1404
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
2	2	1	50	--	50	100

Objectives:

Project Planning and Management in Construction (PPMC)

1. To provide knowledge of basic management practices adopted in civil engineering by using various techniques and software's.
2. To provide knowledge of various aspects relayed to site mobilization & work-study.
3. To provide knowledge of site safety and administration.

Construction Technology (CT)

1. To know the various methods and techniques involved in construction of deep foundations.
2. To get familiar with different construction processes with recommended specifications.
3. To provide a coherent development to the students in area of construction technology

Outcomes: After learning the course, the students should be able to:

Project Planning and Management in Construction (PPMC)

1. Apply knowledge of Construction Management on construction projects.
2. Analyze project scheduling using various techniques.
3. Apply knowledge of work-study on construction site to improve productivity.
4. Evaluate safety norms in construction site and decide incentive scheme.

Construction Technology (CT)

1. Select the process and technique involved in pile construction.
2. Decide the type of coffer dam /caisson and its techniques of construction
3. Explain the construction techniques involve in tunnel/underground construction.
4. Create an action plan for various activities and processes involved in high rise construction.

Detailed Syllabus:

Unit	Description	Duration (H)
	Project Planning and Management in Construction (PPMC)	
	1. Assignment on Project clearance procedures and necessary documentation for any one project in detail.	**2**
	2. Assignment on project life cycle	
	3. Assignment on developing a precedence network, calculation of floats and project crashing.	**2**
	4. Assignment on safety measures and safety policies to be adopted on construction site.	**2**
		2
	Construction Technology (CT)	
	1. Assignment on Pile construction.	**2**
	2. Assignment on cofferdam and caisson	**2**
	3. Assignment on high rise construction or under water structure	**2**
	4. Student have to create action plan for any one construction technique from syllabus	**2**
	5. Conduct site visit and prepare a detail site visit report on high rise/ pile/ caisson /cofferdam/ tunneling construction.	**2**

Program:	M. Tech. (Civil) Construction Management		Semester :	I		
Course :	ELECTIVE I- SUSTAINABLE CONSTRUCTION MATERIALS		Code :	MCI1501A		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Basic Civil Engineering, Concrete Technology

Objectives:

1. To examine the properties of common construction materials and their behaviors under different environmental conditions.
2. To explore various sustainable material available in market.
3. To understand material properties, mechanical tests and quality control tests for High performance concrete.
4. To understand concepts of sustainability in the context of building and conventional engineered building materials.

Outcomes: After learning the course, the Engineer should be able to:

1. To decide properties of construction materials to be tested before its procurement.
2. To suggest appropriate material satisfying need of the project.
3. To experiment and innovate for improving performance concrete.
4. To apply concept of sustainability, Green Performance rating for Building Certification.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	Conventional sustainable materials, Necessity and importance of sustainable construction materials. Material composition and properties, production, storage, distribution, testing, acceptance criteria, limitations use, economic consideration, recent development related to of the following materials to be studied.	6
2.	Various construction chemicals/admixtures, Fly ash and its use in concrete, Silica fume concrete, Self compacting concrete, Fiber Reinforced plastics and concrete, Light weight concrete .	6
3.	Use of CD waste in concrete ,Crumb modified bitumen Rubber, Glenium Concrete, Materials used in nuclear-containment structures.	6
4.	High performance concrete, Nano technology in cement concrete, Ferro-cement Technology, Timbercrete.	6
5.	Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts of energy efficiency.	6
6.	Energy codes ECBC requirement, Concepts of OTTV etc, Green Performance rating, requirements of LEED, GRIHA etc.	6
	Total	**36**

Text Books:

1. Engineering Materials –Dr. S.V.Deodhar
2. Building Materials by M L Gambhir, Neha Jamwal, Tata McGraw Hill Publ.
3. Concrete Technology by M.S.Shetty, S.Chand Publ.
4. Concrete Technology by Neville

Reference Books:

1. Construction Materials, Methods & Techniques(3e) by William P Spence, Yesdee Publication 2012, Pvt. Ltd,, Chennai, India
2. Concrete Structure properties & Materials by Mehta P.K & Mantreio P.J.M, Prentice hall.
3. New Building Materials and Construction World magazine.
4. Ferro-cement Construction Mannual - Dr. D. B. Divekar-1030, Shivaji Nagar, Model Colony, Pune.
5. Civil Engineering and Construction Review magazine

Program:	M. Tech. (Civil) Construction Management	Semester :	I
Course :	ELECTIVE I- Disaster Management	Code :	MCI1501-B

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Construction Management

Objectives:

1. To make students aware about various types of natural and manmade disasters and their effects.
2. To make students self-efficient to solve the challenges with the aid of technological aids used in disaster management.
3. To make students aware about various IT aids and Public awareness & their Management.

Outcomes: After learning the course, the engineers should be able to:

1. To Justify effect of various natural and manmade disasters.
2. To explain various aspects of disaster management.
3. To organize emergency management programme.
4. To organize various public awareness programme initiated by government.

Detailed Syllabus:

Unit	Description	Duration (H)
	Disasters – Natures and extent of disasters, natural calamities such as earthquake, floods, drought volcanoes, forest, coasts hazards, landslides etc. Manmade disasters such as chemical and industrial hazards, nuclear hazards, fire hazards etc.	**6**
2.	**Disaster Management –** Financing relief expenditure, legal aspects, rescue operations. Casual management, risk management.	**6**
3.	**Emergency Management program –** Administrative setup and organization. Hazard analysis, training of personnel, information management, emergency facilities and equipment necessary public awareness creation, preparation and execution of the emergency management program.	**6**
4.	**Organizations -**Various organizations registered with Government and NGO's working for disaster relief-Challenges faced by organizations.	**6**
5.	**Methods of assessment -** Methods of assessment of impact of disasters such as photogrammetric methods, media survey, ground data collection.	**6**
6.	**International adopted practices-**International adopted practices for disaster mitigation. Rules and regulations, Monitoring aspects of disaster mitigations programs.	**6**
	Total	**36**

Reference Books:

1. Construction Engineering and Management – Seetharaman
2. Project Management – K Nagarajan (New Age International Ltd.)
3. Different sites on internet on disaster management
4. NICMAR Publications
5. CECR‟s Journals

Program:	M. Tech. (Civil) Construction Management			Semester :	I	
Course :	ELECTIVE I- Material Management			Code :		MCI1501-C
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:

Building Materials, Building Construction, Project Management and Engg. Economics, Construction Management

Objectives:

1. To get familiar with the material management organization and procurement process.
2. To understand the inventory management and material storage systems
3. To know the concept of material quality control and wastage management of materials.

Outcomes: After learning the course the students should be able to:

1. Decide the plan for organizing material and store management.
2. Create purchase order for procuring material.
3. Apply inventory control techniques for material Management.
4. Suggest quality control techniques and remedial measures to control material wastage.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Materials Management importance:** Importance -its role in construction industry- scope, objectives and functions of material management, Integrated approach to materials management, Role of materials manager. Organizing for materials management – basis for forming organizations – conventional and modern approaches to organizing materials management. Materials identification – classification and codification of materials – standardization – simplification and variety reduction of materials	6
2.	**Material Procurement–** Material research, Identification of sources of procurement, Planning and creative Purchasing of Materials – Purchase under different situations - Bulk purchasing -budgeting- Norms of Vendor Rating – vendor analysis- Concept of (MRP)- Supply Management – Sources of Supply – Out Sourcing Material Management- Procurement Organization - Procurement Planning and Methods – Legal Aspects – Insurance of Materials, concept of international purchase	6
3.	**Inventory management:** Inventory Control techniques. Economical Order Quantity (EOQ), Advantages and limitation, ABC analysis-Procedure and its use, concept of (JIT)- Just in time management, Use of (MMS) – Materials Management Systems in materials planning, procurement, inventory, control, cost control etc. Introduction to application of software used for material management.	6
4.	**Stores Management:** Storing of Materials- Management of stores –Receipt and inspection- location -site layout and site organization– different types of stores – methods of storing –store accounts -stock verification- care, safety and security of materials - losses on storage- wastage, stores equipment – materials handling equipment – factors affecting materials handling	6
5.	**Quality Control –** Conventional methods of quality control of Construction materials. Statistical method of quality control, sampling techniques quality control in process. Quality management and its economics. OR techniques in material management	6
6.	**Waste management-** Obsolete, surplus and Scrap Materials Management – reasons for accumulation of surplus obsolete and scrap materials – methods of disposal – regulations and procedures	6
	Total	36

Text Books:

1. P. Gopalakrishnan and Sundaresan, Materials Management An Integrated Approach , Prentice Hall of India
2. Datta .A.K, "Materials Management: Procedures, Text and Cases", PHI Learning
3. Ghose, Materials of Construction' by, Tata- McGraw Hill Publication.
4. B.K. Roy Chowdhury , Management of Materials , S. Chand & Sons

Reference Books:

1. Gopalkrishnan,Handbook of Materials management , Prentice Hall Publication.
2. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
3. Arnold, "Introduction To Materials Management", Pearson Education India,2009
4. Lee and Dobler, Purchasing and Material Management, McGraw Hill Publications
5. K.S. Menon Purchasing and Inventory Control, Wheeler Publishing
6. Magee and Boodman, Production, Planning & Inventory Control
7. Martin K. Starr and Miller, Inventory Management, Prentice Hall of India Pvt. Ltd.

Program:	M. Tech. (Civil) Construction Management			Semester :	I	
Course :	ELECTIVE II: Building Services and Maintenance			Code :	MCI1502-A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
03	03	03	20	30	50	100

Pre-requisite:
Building Construction, Architectural Planning

Objectives: After Completing this course, student will have adequate background to understand and solve the problem involving :

1. To develop concepts of management of building services provisions
2. To learn the synchronization of construction activities with installation of building services
3. To study the suitable electrical and mechanical services, fire protection, acoustic and sound Insulations

Outcomes: After learning the course, the students should be able to:

1. Apply the knowledge for planning building services provisions
2. Execute the construction activities with installation of building services.
3. Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.
4. Design the Fire Protection, Acoustic and Sound Insulations.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Building Services:** Definitions, Objective and uses of services, Applications of services for different types building considering, Classification of building services, Types of services and selection of services, Natural and artificial lighting principles and factors, Arrangement of luminaries, Distribution of illumination, Utilization factors, Necessity of Ventilation Types – Natural and Mechanical Factors to be considered in the design of Ventilation.	6
2.	**Building Maintenance** Role of maintenance in durability and serviceability of buildings: – Necessity of maintenance – Economic aspects of maintenance. Different types of maintenance – Preventive maintenance – Remedial maintenance – Routine maintenance – Pre-monsoon maintenance - Special maintenance – Planning aspects of maintenance Cracks in buildings – Defects in foundation, masonry, plastering, Painting, flooring, doors and windows, concrete (RCC and PCC) and wooden roof - Corrosion of reinforcement and steel structures – structural damage due to fire - Causes – Preventive and remedial measures	6
3.	**Electrical Services &:: E**lectrical services in the building Technical terms and symbols for electrical installations and Accessories of wiring, Systems of wiring like wooden casing, cleat wiring, CTS wiring conduit wiring, Types of insulation, electrical layout for residence, small work shop, show room, school building, etc. **Air Conditioning**-Definition, Purpose, Principles, Temperature Control, Air Velocity Control, Humidity Control, Air Distribution system, Cleaners, Filters, Spray washers, Electric preceptors, Types of Air Conditioners, (Central type, Window Type, Split Unit).	6
4.	**Mechanical Services in Buildings** Introduction of mechanical services, Lift-Definition, Types of Lifts, Design Considerations, Location, Sizes, Component parts- Lift Well Escalators- Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators, Uses of different types of elevators Escalators. Conveyors-Different types of Conveyors, Uses of different types of Conveyors.	6
5.	**Fire Protection, Acoustic and Sound Insulations** **:** Introduction, Causes of fire and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2016, Fire load calculation, Characteristics of Fire resisting materials, Maximum Travel Distance, Fire Fighting Installations for Horizontal Exit, Roof Exit / Fire Lifts, External Stairs,**Acoustics:** Requirement of good Acoustic, Various sound absorbent, Factors to be followed for noise control in residential commercial buildings .	6
6.	**Plumbing, Water supply and Sanitation** Water quality, Purification and treatment- water supply systems-distribution systems in small towns -types of pipes used- laying jointing ,testing-testing for water tightness plumbing	6

	system for building-internal supply in buildings- municipal bye laws and regulations – Rain Water Harvesting - Sanitation in buildings-arrangement of sewerage systems in housing -pipe systems- storm water drainage from buildings -septic and sewage treatment plant – collection, conveyance and disposal of town refuse systems.	
	Total	**36**

Text Books:

1. A text book on Building Services R. Udaykumar Eswar Press, Chennai
2. Building Services S. M. Patil Seema Publication, Mumbai Revised edition
3. National Building Code of India - 2005 Bureau of Indian Standards BIS, New Delhi

Reference Books:

1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd

List of Software/Learning Websites

1. www.academia.edu
2. www.nptel.iitm.ac.in
3. "http://en.wikipedia.org/w/index.php?title=Dumbwaiter_(elevator)&oldid=621761813" Categories: www.bis.org.in/sf/nbc.htm
4. cpwd.gov.in/Units/handbook.pdf
5. http://www.civilengineeringnews.tk/2014/07/methods-of-demolition-of-building.html thecontractor.org

Program:	M. Tech. (Civil) Construction Management	Semester :	I
Course :	ELECTIVE II: Value Engineering and Valuation	Code :	MCI1502B

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:
Project Management & Economics, Construction Management

Objectives:

1. To produce civil engineers with knowledge of value Engineering and analysis used in construction industry.
2. To produce civil engineer with knowledge of analysis carried out for life cycle costing and applications of value engineering.
3. To produce civil engineer with detailed knowledge of valuation for various types of assests.

Outcomes: After learning the course, the students should be able to:

1. Analyze product using value engineering.
2. Create various steps for the product development.
3. Prepare report using value Engineering applicable to construction project.
4. Prepare valuation report of product by applying Value Engineering..

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Value Engineering:** Definition, Importance to Contractors, Potential. VE Applications Value : basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, economic : identifying reasons or unnecessary costs.	6
2.	**Value Analysis:** 10 Commandments of value analysis; value analysis team; principles of value analysis, elements of a job plan viz. orientation, Information, presentation. Implementation, follow, up action, benefits of value analysis, various applications; assessing effectiveness of value analysis.	6
3.	**Value Engineering Methodology** - Orientation phase, Information phase, Function Analysis phase, Creative Phase, Evaluation Phase, Development Phase, Presentation Phase, implementation Phase.	6
4.	**Life cycle costing –** Forecasting of Capital as well as operating & maintenance costs, time value, present worth analysis, DCF methods, ROR analysis, sensitivity analysis.	6
5.	**Application of Value Engineering to a Construction Project:-** VE during the Planning Phase of a Construction Project , VE during the Design Phase of a Construction Project, VE during the Construction Phase of a Construction Project	6
6.	**Valuation Report:-**Valuation Report, contents, standard formats, Case study of any one Report.	6
	Total	36

Text Books:

1. Value Engineering: Analysis And Methodology By Del Younke
2. Industrial Organization & Engg. Economics, T.R.Banga, S.C.Sharma, Khanna Publ.
3. Estimating and Costing in Civil Engineering: Theory and Practice B.N Dutta Published S. Dutta & Company, Lucknow.

Reference Books:

1.Industrial Engg. & Mgt., O.P.Khanna, Dhanpat Rai Publ.
2.Estimating and Costing By: G.S.Birdie
3.Estimating and Costing By: Rangwala Published By: Charotar Publishing House,
4.Practical Information for Quantity Surveyors, Property valuers, Architects Engineers and Builders,
5.P.T.Joglekar, Pune Vidyarthi Griha Prakashan, 2008 reprint.

Program:	M. Tech. (Civil) Construction Management	Semester :	I
Course :	ELECTIVE II: Human Resources and Management	Code :	MCI1502C

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Construction Management

Objectives:

1. To make aware of various key aspects of Human Resource Development.
2. To make aware of skills & recruitment procedures adopted in Human Resource management in the industry.
3. To make aware of details like training, various types of projects and Career Plan.

Outcomes: After learning the course, the engineers should be able to:

1. Describe skills required for development Human Resource.
2. Evaluate the skills of recruiter required for construction project.
3. Decide a training programme for recruitment.
4. Develop carrier plan.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction:** Need of Human Resource Development in the context of globalization, Organization Policies various HRD parameters viz. Elements of the ICDP i.e. integrated construction development paradigm, key elements of HRD such as basic literacy, functional skills, supervisory skills, entrepreneurship skills.	6
2.	**Need for Development of Human Resource-** flow diagram of human resource development and human resource management. Training, competency development, capacity building of resources required at grass root level and at the managerial level in construction.	6
3.	**HRD Construction Projects -** Selection of contractors region wise & retaining, Upgrading Human Resource Developement for construction MNC/Multi portfolio project handling organization. Formation of joint ventures, privatization and BOT type of systems.	6
4.	**Recruitment process:-**Recruitment policies, Pre requisites skills- Soft and technical skills. Employee testing & selection Personal Management – Concept of Personal Management, Responsibilities & authority and Role Function of Personal Manager, Necessity of Personal Management	6
5.	**Training: –**Training of multi-skilled workforce, quality, productivity and employee relations in construction, contractors & sub-contractors – selection, training & development, performance appraisal, potential appraisal, training rewards and recognition etc.	6
6.	**Career Plan & development** Career development cycle, career need assessment, use of assessment centers by small organization, teams synergy, Participative management	6
	Total	36

Text Books:

1.Human Resource Management by Biswajeet Pattanayak
2. Human Resource Management by Gary Dessler & Biju Varkkey, Pearson publication
3. Managing Human Resources by Bohlander & Snell.

Reference Books:

1.Personnel Management‘ by Monappa A. Tata McGraw Hill,new delhi.1997
2. Harvard Business Review, Appraising Perfoprmance Appraisal, Tata McGraw Hill.
3. Nair,MRR, Excellence through Human Resource D evelopment, Tata McGraw Hill.
4. Rao T, HRD in the New Economic Environment, Tata McGraw Hill.
5. Pareck,HRD in the New Millenium, Tata McGraw Hill.
6. Singh, Selected Reading in HRD Tata McGraw Hill.

Program:	M. Tech. (Civil) Construction Management	Semester : I
Course :	**Professional Elective Lab-I** **Elective-I-** Sustainable Construction Materials, Disaster Management, Material Management, **Elective-II-** Building Services and Maintenance, Value Engineering and Valuation, Human Resources and Management	Code : MCI1503

Teaching Scheme			Evaluation Scheme			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
2	2	1	50	--	50	100

Pre-requisite

Sustainable Construction Materials

1. Basic Civil Engineering 2. Concrete Technology

Disaster Management

1. Construction Management

Material Management,

1. Building Materials, 2. Building Construction, 3. Project Management and Engineering, 4. Economics, Construction Management

Building Services and Maintenance,

1. Building Construction, 2. Architectural Planning

Value Engineering and Valuation,

1. Project Management & Economics, 2. Construction Management

Human Resources and Management

1. Construction Management

Objectives: Elective I

Sustainable Construction Materials

1. To examine the properties of common construction materials and their behaviors under different environmental conditions.
2. To explore various sustainable material available in market.
3. To understand material properties, mechanical tests and quality control tests for High performance concrete.
4. To understand concepts of sustainability in the context of building and conventional engineered building materials.

Disaster Management:

1. To make students aware about various types of natural and manmade disasters and their effects.
2. To make students self-efficient to solve the challenges with the aid of technological aids used in disaster management.
3. To make students aware about various IT aids and Public awareness & their Management.

Material Management:

1. Explain concept of material management, standardization and codification of materials.
2. Explain the material procurement process.
3. Understand inventory management and store management techniques.
4. Suggest the quality control techniques and remedial measures to control material wastage

Elective II

Building Services and Maintenance:

1. To develop concepts of management of building services provisions
2. To learn the synchronization of construction activities with installation of building services
3. To study the suitable electrical and mechanical services, fire protection, acoustic and sound Insulations

Value Engineering and Valuation:

1. To produce civil engineers with knowledge of value Engineering and analysis used in construction industry.
2. To produce civil engineer with knowledge of analysis carried out for life cycle costing and applications of value engineering.
3. To produce civil engineer with detailed knowledge of valuation for various types of assets.

Human Resources and Management:

1. To make aware of various key aspects of Human Resource Development.
2. To make aware of skills & recruitment procedures adopted in Human Resource management in the industry.
3. To make aware of details like training, various types of projects and Career Plan.

Outcomes: Elective I

Sustainable Construction Materials: After learning the course, the Engineer should be able to:

1. To decide properties of construction materials to be tested before its procurement.
2. To suggest appropriate material satisfying need of the project.
3. To experiment and innovate for improving performance concrete.
4. To apply concept of sustainability, Green Performance rating for Building Certification.

Disaster Management: After learning the course, the students should be able to:

1. To Justify effect of various natural and manmade disasters.
2. To explain various aspects of disaster management.
3. To organize emergency management programme.
4. To organize various public awareness programme initiated by government.

Material Management: After learning the course the students should be able to:

1. Decide the plan for organizing material and store management.
2. Create purchase order for procuring material.
3. Apply inventory control techniques for material Management.
4. Suggest quality control techniques and remedial measures to control material wastage.

Elective I

Building Services and Maintenance: After learning the course, the students should be able to:

1.Apply building services provisions

2.Execute the construction activities with installation of building services.

3.Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.

4.Design the Fire Protection, Acoustic and Sound Insulations.

Value Engineering and Valuation: After learning the course, the students should be able to:

1. Analyze product using value engineering.
2. Create various steps for the product development.
3. Prepare report using value Engineering applicable to construction project.
4. Prepare valuation report of product by applying Value Engineering.

Human Resources and Management: After learning the course, the students should be able to:

1. Describe skills required for development Human Resource.
2. Evaluate the skills of recruiter required for construction project.
3. Decide a training programme for recruitment.
4. Develop carrier plan.

Guidelines :

1. Any one subject from Part A and Part B as per students elective choices
2. Total assignment to be conducted are Three from Part A and Three from Part B
3. Total : 6 assignment- 12 hours

Detailed Syllabus:

Part A: Elective 1- Sustainable Construction Materials (ANY Three)

Assignment	Description	Duration (H)
1	Importance of Sustainable Construction Materials.	**2**
2	Reuse and Recycling of waste construction Materials	**2**
3	High performance concrete, Nano technology in cement concrete, Ferro-cement Technology, Timbercrete.	**2**
4	Green Performance rating for Building Certification.	**2**
	Total	**6**

Part A: Elective 1- Disaster Management, (ANY Three)

Assignment	Description	Duration (H)
1	Assignment-1	**2**
2	Assignment-2	**2**

3	Assignment-3	**2**
4	Assignment-4	**2**
	Total	**6**
Part A: Elective 1- Material Management, (ANY Three)		
1	Assignment on Inventory management	**2**
2	Assignment on use of any material management software	**2**
3	Assignment on store management and wastage reduction	**2**
4	Case study Presentation by individual on any topic from above syllabus.	**2**
	Total	**6**

Part B: Elective II- Building Services and Maintenance, (ANY Three)		
Assignment	**Description**	**Duration (H)**
1	Assignment based on Types of services and selection of services.	**2**
2	Assignment based on Electrical services in the building.	**2**
3	Assignment based on Lift/ Elevators and component parts.	**2**
4	Assignment based on Air Conditioning, types, description.	**2**
	Assignment based on Fire Protection, Acoustic and Sound Insulations.	**2**
	Total	**6**
Part B: Elective II- Value Engineering and Valuation, (ANY Three)		
Assignment	**Description**	**Duration (H)**
1	Write report on guest lecture conducted related to value Engineering.	**2**
2	One site visit related to any topic from above syllabus.	**2**
3	Assignment on case study of value engineering.	**2**
4	Assignment on application of value Engineering in Construction Industry.	**2**
	Total	**6**
Part B: Elective II- Human Resources and Management (ANY Three)		
1	Assignment on need of HRD in Construction Industry	**2**
2	Assignment on recruitment process adopted in Construction industry in detail.	**2**
3	Assignment on various types of training program organized by HR department for staff.	**2**
4	Prepare career Plan using guidelines studied in the course.	**2**
	Total	**6**

Program:	M. Tech. (Civil) Construction Management			Semester : I		
Course :	Skill Development Lab - I (Software Skills)			MCI1405		
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
2	2	1	50	--	--	50

Pre-requisite: -

Objectives:

1. To acquire basic software skills competency skill
2. To learn planning ,scheduling using software

Outcomes: After learning the course the students should be able to:

1. learn planning, scheduling, and controlling of small scale projects using software
2. Understand cost and risk minimization
3. Prepare various reports using software

Guidelines :

1. **S**oftware Application Use of construction management software's (**PRIMAVERA or MS-PROJECTS, ERP in Construction Management, Building Information Modeling-BIM or any other etc.)**
2. **Expected hours 24 hrs**

Detailed Syllabus:

Skill Development Lab (ANY Six)

Expt.	Description	Duration (H)
1.	Describing Enterprise and Project-Specific data	**2**
2.	Create a project & navigating in the Projects Window	**2**
3.	Defining & creating the WBS Hierarchy	**2 + 2**
4.	Adding Activities and Creating relationships	**2**
5.	Project scheduling and Constrain assign and formatting of data	**2 + 2**
6.	Define & assign roles and resources	**2 +2**
7.	Optimize the project plan/schedule	**2 +2**
8.	Report Creation	**2**
	Total	**24**

Course Syllabus

Semester-II

Program:	M. Tech. (Civil) Construction Management	Semester :	II
Course :	CONSTRUCTION CONTRACTS ADMINISTRATION AND MANAGEMENT	Code :	MCI2405

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:
Quantity Surveying & Contract Tenders, Construction Management

Objectives:

1. To develop concepts related with Construction contracts & Tendering which involves Planning,
2. management and Execution of the project with economic development & prosperity
3. To learn basic principles of Construction contracts, Tendering & Arbitration in the context of various Construction aspects.
4. To learn various aspects of Arbitration to resolution of disputes in construction projects.

Outcomes: After learning the course, the students should be able to:

1. Adopting the ethical knowledge for preparing construction contracts clauses.
2. Create contractual Tender documents satisfying need of project.
3. Exhibit role and responsibilities of Arbitrator for resolution of disputes in construction projects.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Construction Contracts :** Indian Contract Act (1872) :Definition of the contract as per the ACT. Valid, Voidable,Void contracts, Objectives of the act.(from model 5) Clauses 1 to 75- Contract formation, contract performance, valid excuses for non-performance, Breach of contract, effects of breach-understanding the clauses and applying them to situations/scenarios on construction projects. Importance of the Workmen's Compensation Act on construction projects. Salient features of workmen compensation act.	6
2.	**Contract Formation (Procurement):** Methods of inviting tenders, pre-bid meetings, pre-qualification system, scrutiny of tenders and comparative statement.Contract formation, conditions of contracts, contracts with various stakeholders on a major construction projects, contract pricing by the client, project management consultants and the contractor, contract performance, contract correspondence and contract closure.Contract Strategies (Traditional approach, design & amp; build, BOT, management, partnering, joint ventures).	6
3.	**Project Administration:** Pre-construction Operations – Constructibility Analysis, Issuance of Bidding Documents, Pre-qualification of Bidders, Bonds, Opening Acceptance and Documentation of Bids. Construction Administration, Organizational Structure, Lines of Authority on Construction Projects, Responsibility, Staffing Responsibilities, Design Build Contracts, Responsibility for Coordination of the trades.	6
4.	**Documentation and Risk Identification:** Familiarization with construction documents, Certainty, Risk and Uncertainty, Risk Management, Identification and Nature of Construction Risks, Contractual allocations of Risk, Types of Risks, Minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Control of Quality in Construction.	6
5.	**Dispute Resolution & Arbitarion:** Disputes – Settlement through arbitration – Indian Arbitration Act 1940 – Clauses and advantages of arbitration. Alternate Dispute Resolution methods- mediation, conciliation, arbitration and Dispute Resolution Boards..	6
6.	**Construction Claims:** Construction Claims: Extra items and causes of claims. Types of construction claims, documentation. Settlement of claims Dispute Resolution: Causes of disputes and importance of role of various stakeholders in prevention of disputes.	6
	Total	**36**

Text Books:

1. Civil Engineering Contracts and Estimates - B.S.Patil – Universities Press- 2006 Edition,reprinted in 2009.
2. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
3. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.

Reference Books:

1. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency.
2. Arbitration, Conciliation and Alternative Dispute Resolution Systems- Dr. S.R. Myneni- 2004 Edition, reprinted in 2005- Asia Law House Publishers.
3. The Workmen‘s Compensation Act, 1923 (8 of 1923) Bare Act- 2005- Professional Book Publishers.
4. Standard General Conditions for Domestic Contracts- 2001 Ministry Of Statistics and Program Implementation, Government of India.
5. FIDIC Document (1999).
6. Dispute Resolution Board foundation manual -www.drbf.org. 30 Edition

Program:	M. Tech. (Civil) Construction Management		Semester :	II		
Course :	Project Economics and Financial Management (PEFM)		Code :	MCI2406		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Basics of Finance, Project management

Objectives: After Completing this course, student will have adequate background to:-

1. Analyze of economics to facilitate the process of economic decision making.
2. attain awareness on basic financial management aspects.
3. Develop the skills to analyze financial statements.

Outcomes: After learning the course, the students should be able to:

1. Evaluate the economic theories, cost concepts and pricing policies.
2. monitor accounting systems and analyze financial statements using ratio analysis.
3. Apply the concepts of financial management for project appraisal.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Principles of Economics:** Importance of the economic background to measurement, objectives of business firm. Factors bearing on size of firms. Motives to growth. Obstacles to growth of firms, Study of present economy. **Capital:** Analysis of need for working capital, Estimation of requirements of working capital, Credit Management, Cash Management,. Corpus Fund	**6**
2.	**Economic Analysis:** Cost implication to different forms of construction and maintenance and maintenance and replacement lives of material, Installation and running cost of services, Capital investment in project, Cost analysis by traders and by functional element, Cost planning techniques, Cost control during design and Construction, Various Appraisal Criteria Methods. Break-even analysis, Cash flow analysis, Risk Analysis and Management Practice, Role of Lender‘s Engineer, Cost pricing method	**6**
3.	**Financial Planning:** Need and sources of Finance, Long term finance planning, Stock, Borrowings, Debentures, Loan Capital, Public Deposit, Dividend Policies, Bonus Shares, Market value of shares, Reserves. **Budget:** Budgetary control system. Types of budgets, Procedure for master budgets. Budget manual. Accounting Information System:, Project Commentary, project Running Commentary	**6**
4.	**Corporate Sector:** Corporate tax planning, Public policies on ICRA grading of exchange, World financial market, Role of financing institutes in Construction sector, SEBI regulation., GST, CGST, SGST, Direct Tax Court System	**6**
5.	**Construction Accounts:** Accounting process, preparation of profit and loss account and balance sheet as per the companies Act2013, preparation of contract accounts for each project, methods of recording and reporting site accounts between project office and head office, Ratio Analysis. Escrow Account for PPP Project.	**6**
6.	**Case Studies (Any Two) :** Case studies for 1) PPP projects 2) Dams and Canals 3) Mass Transit System 5) Government Funded Projects with respect to a) Project Appraisal b) Raising of funds c) Cost to complete analysis	**6**
	Total	**36**

Text Books:

1. Construction project scheduling and control ----Mubarak, Wiley India.
2. Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
3. Construction Management and Accounts -- Singh H. Tata McGraw Hill, New Delhi, 1988
4. Construction Management: Planning and finance-- Cormican D. Construction press, London, Feb 2002.
5. Principles of Corporate Finance, Brealey R.A. Tata McGraw Hill, New Delhi, 2003.
6. Engineering Economics—Kumar---Wiley,India.

Reference Books:

1. Engineering Economy, Leland T. Blank. Anthony Tarquin. McGraw Hill, 2008.
2. Engineering Economics, David Bedworth, Sabah Randhawa. McGraw Hill, 1996.
3. Real Estate, Finance and investment, Bruggeman. Fishr, McGraw Hill, 2010.
4. Foundations of Financial Management', Block Hirt. McGraw Hill, 2009.
05. Case studies in finance, Burner, McGraw Hill, 2009.
06. Cases in Finance , DeMello McGraw, 2003.
07. The cost management toolbox ; A Managers guide to controlling costs and boosting profits. Oliver, Lianabel. Tata McGraw Hill, 1999.
08. ―Financial Management‖ – Indian Institute of Banking and Finance – Macmillan Publications.
09. Projects planning, Analysis Selection, Implementation and Review, Prasanna Chandra Tata McGraw Hill, New Delhi, 2005
10. Fundamentals of Engineering Economics—Pravin Kumar, Wiley, India.

Program:	M. Tech. (Civil) Construction Management				Semester :	I
Course :	Professional Core Lab-II				Code :	MCI2407
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
2	2	1	50	--	50	100

Objectives:

CONSTRUCTION CONTRACTS ADMINISTRATION AND MANAGEMENT

1. To develop concepts related with Construction contracts & Tendering which involves Planning, management and Execution of the project with economic development & prosperity
2. To learn basic principles of Construction contracts, Tendering & Arbitration in the context of various construction aspects.
3. To learn various aspects of Arbitration to resolution of disputes in construction projects.

Project Economics and Financial Management

1. Understanding of economics to facilitate the process of economic decision making.
2. attain awareness on basic financial management aspects.
3. Develop the skills to analyze financial statements.

Outcomes: After learning the course, the students should be able to:

CONSTRUCTION CONTRACTS ADMINISTRATION AND MANAGEMENT

1. Adopting the ethical knowledge for preparing construction contracts clauses.
2. Create contractual Tender documents satisfying need of project.
3. Exhibit role and responsibilities of Arbitrator for resolution of disputes in construction projects.

Project Economics and Financial Management

1. Evaluate the economic theories, cost concepts and pricing policies.
2. monitor accounting systems and analyze financial statements using ratio analysis.
3. Apply the concepts of financial management for project appraisal.

Detailed Syllabus:

Unit	Description	Duration
	CONSTRUCTION CONTRACTS ADMINISTRATION AND MANAGEMENT 1. Definition of the contract as per the ACT. Valid, Voidable,Void contracts, Objectives of theICA (1872) 2. Preparation of conditions of Contract related to time of completion , delay , Defects in construction work. 3. Tender form submission and necessary Tender Documents. **4.** Procedure of Bid Opening **PROJECT ECONOMICS AND FINANCIAL MANAGEMENT** 1. Assignment on objectives of business firm / working capital/ cash management. 2. Assignments on cash planning / Depreciation /Various Appraisal Criteria Methods/ Break-even analysis / Cash flow analysis / Risk Analysis. 3. Assignment on Stock, Borrowings/Debentures/ Loan Capital/ Public Deposit/ Dividend Policies/ Budgetary control system. 4. Assignment on World financial market/ Role of financing institutes in Construction sector/ SEBI regulation /GST, CGST,SGST /Direct Tax Court System. 5. Preparation of profit and loss account and balance sheet as per the companies Act2013/ Ratio Analysis.	

Program:	M. Tech. (Civil) Construction Management			Semester :	II	
Course :	Elective III- Retro Fitting (PE III)			Code :	MCI2504-A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:

Building Construction, Concrete Technology, Advanced concrete Technology

Objectives:

1. To impart knowledge about maintenance and Retrofitting of Structures
2. To acquire knowledge about repairs, rehabilitation and damage assessment
3. To enable the students to understand the repair materials and techniques

Outcomes: After learning the course the students should be able to:

1. Evaluate the cause of deterioration of concrete structures.
2. Assess the damage and design the plan to repair
3. Decide the various techniques of retrofitting of structures
4. Recognize good materials for repair and retrofitting technique

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to retrofitting:** Definition for Repair, Retrofitting, Strengthening and rehabilitation. Importance of retrofitting, Physical and Chemical Causes of deterioration of concrete structures. Rehabilitation studies of buildings, underground construction, bridges, highways, sewage treatment plants – masonry work, R.C.C works, steel structures.	6
2.	**Damage Assessment:** Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non-destructive and semi destructive testing systems	6
3.	**Influence on Serviceability and Durability:** Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.	6
4.	**Maintenance and Retrofitting Techniques:** Definitions: Facts of Maintenance and importance of Maintenance, Need for retrofitting, retrofitting of various RC structural members, Study of different retrofitting techniques like Externally bonding technique (ERB), near surface mounted (NSM) technique, External post- tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building, Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack.	6
5.	**Materials for Repair and Retrofitting:** Types of FRP like CFRP, GFRP, AFRP, BFRP, and use of natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Gunite and Shot Crete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Construction chemicals based on nano- technology.	6
6.	**Repair of Earthquake damages buildings and maintenance:** methods of seismic retrofitting, restoration of buildings, effects of earthquakes, response of buildings to earthquake motion, factors related to building damages due to earthquake, Maintenance of rehabilitated structures, Evaluation of structural damages to the concrete structural elements.	6
	Total	36

Text Books:

1. Sidney, M. Johnson, "Deterioration, Maintenance and Repair of Structures"
2. Denison Campbell, Allen & Harold Roper, "Concrete Structures – Materials, Maintenance and Repair"- Longman Scientific and Technical.

3. Technology of Building Repairs, Raikar R N 4. Maintenance & Repairs of Buildings, P. K. Guha *5.Construction, Maintenance & Restoration and Rehabilitation of Highway Bridges, K. S. Rakshit*
Reference Books: 1.R.T.Allen and S.C. Edwards, "Repair of Concrete Structures"-Blakie and Sons 2. Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL). 3. Concrete Structures Protection Repair and Rehabilitation, R. Dodge Woodson, Elsevier Publication 4. Retrofitting of Concrete Structures by Externally Bonded FRP's – CEB – FIP, Technical report. 5. Handbook on repair and rehabilitation of RC structure by -CPWD

Program:	M. Tech. (Civil) Construction Management			Semester :	II
Course :	Elective III- Advanced Construction Technology (PE-III)			Code :	MCI2504-B
Teaching Scheme			Evaluation Scheme		
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:

Construction Technology

Objectives:

1. To acquire knowledge of implementation of advanced construction techniques with recommended specifications.
2. To provide knowledge about equipment, systems required to facilitate the advanced construction techniques.
3. To provide a coherent development to the students in area of advanced construction technology

Outcomes: After learning the course the students should be able to:

1. Select construction equipment and processes involved in bridges and metro, construction.
2. Recommend the method of construction used for port and high rise construction
3. Justify advanced techniques used in special structures and marine construction.
4. Suggest outline for construction of high rise construction.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Construction of Bridges:** Types, Construction methods for sub-structure and super-structure, various launching methods,Steel Bridges, Arch Bridges, Cantilever Bridges Segmental construction & Box Girders. Construction of special type of bridges such as cable stayed bridge, suspension and Pre-stressed bridge.	6
2.	**Construction of Metro and Monorail -** Underground and over ground structures, different methods and techniques of construction. Problems and solutions – during maintenance and up-keep of structures. Fire, Ventilation , De watering and power supply, Subsidence, Vibration etc.	6
3.	**Construction of Ports:** Construction of docks & Jetties, Fender Systems, Container terminals & oil terminals, under water construction, Dredging System, Mechanism, Advantages & Disadvantages of Various Dredging System	6
4.	**Construction of high rise structures:** Steel and concrete composites construction methods, techniques, automation used for construction, Fabrication and erection of heavy structures including prefab construction, Erection of different cranes like mobile, lifting, tower, roof truss. Innovative methods of construction – Jump form, Aluform & Tunnel Form Technology, Dry wall technology**.**	6
5.	**Construction of Special structures:** Features and functions of the special types of civil engineering structures: Silos, Elevated service reservoir, domes and arches, Construction of power generating structures – Atomic Power stations, Thermal power stations. Co generation power plant , Windmills, Transmission towers, Chimneys	6
6.	**Marine and offshore structures** such as- Beacons, Oil drilling Platforms, light houses. Barges- types, Function, utilization & economics of barges.	6
	Total	36

Text Books:

1. S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai &Sons, New Delhi.
2. S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press,New Delhi.
3. B.C. Punamia, Building Construction, Laxmi Publications, New Delhi
4. S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand
5. *Construction Equipment Planning and Applications – Dr. Mahesh Varma*

Reference Books:

1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication

2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
3. Journals such as CE & CR. Construction world, International Construction.
4. Dr. Kumar Niraj Jha, ― Formwork for Concrete Structures, Mc Graw Hill Publication
5. Manuals, brochures, publications from construction companies, firms etc.

Program:	M. Tech. (CM)			Semester :		II
Course :	Elective III - Construction Equipments and Management (CEM)			Code : MCI2504C		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite: Construction management, Basic Mathematics.

Objectives:

1. Importance of Construction Equipment and their maintenance.
2. Application of different equipment in construction industry.
3. Carry effective management of equipment.

Outcomes: After learning the course, the students should be able to:

1. Experience through stud, various applications of equipment and its management.
2. Analyze the operational role of different equipment's in construction industry.
3. Evaluate equipment maintenance and operative cost analysis.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Construction Equipment-I** Construction Equipment's – Understanding basics, Capacity, Function & Efficiency of All Machinery, involving all machinery data, power use, fuel consumption and labour utilization.	**6**
2.	Equipment for **Earthmoving Machinery**, Concreting Equipment, Material Handling Equipment such as cranes, boom, lift and maintenance transportation Equipments. Bitumen Equipments, Compacting Equipments, rollers etc.	**6**
3.	**Construction Equipments – II** a) Pile driving equipments. b) Explosives & blasting equipments. c) Crushers. d) Concreting equipments including plant.	**8**
4.	**Work cycle** time of any machine with corrective factors, depreciation of equipment, operative cost, inventory cost control, higher/rental- a) Average Investment value, b) Annual Ownership Cost.	**6**
5.	**Equipment Managemen**t: Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, interest on capital, Manpower, Spare parts etc, Documentation, Log-Books, History Books, Periodical MIS Report	**6**
6.	**Equipment maintenance** - Planned, unplanned, preventive, breakdown maintenance, merits and demerits of maintenance	**4**
	Total	**36**

Text Books:

1. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
2. Construction Technology: Analysis, and Choice, Bryan, Wiley India
3. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
4. Construction Equipment Planning and Applications – Dr. Mahesh Varma

Reference Books:

1. Journals such as CE & CR. Construction world, International Construction.
2. Document Reports of actual major works executed.
3. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
4. Dr. Kumar Niraj Jha, ―Formwork for Concrete Structures‖, Mc Graw Hill Publication

Program:	M. Tech. (Civil) Construction Management	Semester :	II
Course :	Elective IV- SAFETY PRACTICES IN CONSTRUCTION	Code :	MCI2505A

Teaching Scheme			Evaluation Scheme			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**
3	3	3	20	30	50	100

Pre-requisite: Construction Management

Objectives:

1. To Understand Safety risk and safety practices followed on basic level on job site
2. To get knowledge of effective implementation safety program in a construction company.
3. To be acquainted with knowledge of Laws related to construction Safety.

Outcomes: After learning the course, the students should be able to:

1. Identify safety risks on job sites.
2. Create and manage an effective safety program in a construction company.
3. Explain various laws related to construction safety and Compensation act.
4. Understand safety risk and code of practice on construction site.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	Introduction to Health, Safety and Environment, Introduction to Construction Safety And Safety Technology, historical background and current perspective; Government's policy in industrial safety; safety & health legislation in India, Construction Sites (Safety) Regulations	**6**
2.	Codes of practice; Potential hazards/risks associated with construction sites and high risk activities such as underground construction, use of hoist, Working at height and working in confined space. Safety in typical civil structures –Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring. Safety in Erection and closing operation	**6**
3.	Construction materials –Specifications – suitability – Limitations – Merits and demerits – Steel structures –Concrete structure. Workplace ergonomics including display screen equipment and manual Material Storage handling of hazardous materials.	**6**
4.	Construction Safety Management and Accident Prevention. Accident Prevention: Principles of accident prevention; job safety analysis; fault tree analysis; accident management , Accident count, Hazards of Construction and their Prevention,fire safety, electrical hazards.	**6**
5.	Accidents and First Aid,Safety Policies, Management Systems for Safe Construction & Safety Costs, Personal Protective Equipment (PPE) and Safety Training	**6**
6.	Enforcement of Health and Safety Laws, Safety Reliability and Safety Information, Safety training; safety policy; safety committees; safety inspection; safety audit; reporting accidents and dangerous occurrences	**6**
	Total	**36**

Text Books:

1. John V. Grimaldi. (1996). "Safety Management." AITBS Publishers & Distributors, New Delhi, India.

Reference Books:

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
2. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons,1979.
3. D. Reese and J. V. Eidson, Handbook of OSHA construction safety and health, 2 n d ed., CRC Press, Bocaaton, 2006.
4. S. J. Holt, Principles of construction safety, Blackwell Publishing, Oxford, 2008.

Program:	M. Tech. (Civil) Construction Management			Semester : II		
Course :	Elective IV – Infrastructure Development (ID)			Code : MCI2505B		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Pre-requisite:

Objectives:

1. To know role of Infrastructure in Nations Economy.
2. Co-relating Budget provisions and construction sector for infrastructure development
3. Role of Public Private Partnership in Economic Development

Outcomes: After learning the course, the engineers should be able to:

1. Justify role of Infrastructure in National Economy.
2. Co-relate Indian budget and its relation w,r,to any of the Construction sector.
3. Explain role of Public Private Partnership in Construction project.
4. Identify and apply various provisions made for Infrastructure Development.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Construction Industry:** Nature, characteristics, size and structure. Role of infrastructure development in employment generation and improving of the National economy. Various Agencies associated with infrastructure development in India as regards various sectors.	**7**
2	**Status of Infrastructure in India:** Road sector Port , Railway, communication, water supply and drainage, Power sector, oil and industry, Health and educational services. Infrastructure Development, Indian budget and its relation with Infrastructure development projects in India. Various programs related with Infrastructure development in rural and urban sector.	**6**
3	Public Private Partnership (PPP) in Infrastructure: Concept, definition, benefits; Processes, Modules of PPP, Draft Concession Agreement for PPP projects, Escrow Agreement.	**5**
4	Issues related to infrastructure development – pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing, funding and managing infrastructure projects, role, responsibility of project management consultants. FDI in Infrastructure development, Problem areas and solutions.	**9**
5	Provisions made for Infrastructure Development in the 12 and 13 **five year plans of the planning commission Government of India**. Formation of the Indian Infrastructure Development Corporation. SPV's for Infra projects.	**5**
6	JNNURM - Jawaharlal Nehru National Urban Renewal Mission, PMGSY – Pradhan Mantri Gram Sadak Yojana, RGGVY - Rajiv Gandhi Grameen Vidyutikaran Yojana, Ports Connectivity Projects, Indira Gandhi International Air Port project, Indo – US Nuclear Deal, Nuclear Power Projects in India	**4**
	Total	**36**

Text Books:

1. Construction Engineering & management of Projects(For Infrastructure & Civil Works) by S. C. Sharma, Khanna Publishers, 2 Edition, 2011
2. India Infrastructure Report – Rakesh Mohan.
3. Infrastructure Development in India by Rajarshi Majumder Rawat Publications – 2010

Reference Books:

1. Document of five year plans, published by Govt. of India.
2. Public Private Partnership in Infrastructure by R. N. Joshi Vision Publications – 2010.6.
3. Journal of the Indian Roads' Congress.
4. Infrastructure Today – Magazine.
5. Indian Highways – Journals.

Program:	M. Tech. (Civil) Construction Management	Semester :	I
Course :	Elective IV- International Contracting	Code : MCI 2505C	

Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
3	3	3	20	30	50	100

Objectives:

1. Able to know role of International Contracting
2. Able to understand rules and regulations for international contracting
3. Able to know the roles disputes arising in international contracting and their resolution

Outcomes:

After learning the course, the students should be able to:

1. Explain the impact of international contracting in construction
2. Develop international contract documents
3. Apply disputes resolutions for international contracting

Detailed Syllabus:

Unit	Description	Duration (H)
1	International contracting – meaning, scope, nature, present status of the International construction market, role of Asia- Pacific region countries in the present construction development. Impact of WTO/GATS on the Indian Construction Sector as regards domestic market and export sector. Selection of personnel to suit socio-economic-environmental culture in other countries, suitable organizational structure.	**9**
2	Study and application of various conditions of contract under the FIDIC document. Development of regulatory framework. Project exports from India. International financing : Various institution such as WB, IMF, ADB. African bank etc. and their role, rules – regulations in funding various projects, forming alliance, bilateral and multilateral funding, trade practices etc.	**9**
3	International Projects – Types of BOT systems such as BOT, BOOT, BOO, DBO, BOR, BLT, BRT, BTO & DBFOT, MOOT, ROO, ROT, BOLT – Contractual procedures, special features, methods of handling.	**9**
4	Disputes Resolving – International Courts, formation of DRB's (Dispute resolving boards) functioning and experiences in India and abroad, Advantages of DRB's UNICTRAL Proceedings for International Arbitration. Institutionalized Arbitration, CIDC –SIAC Arbitration.CASE studies of any 2 major project executed/functioning under International contracting.	**9**
	Total	**36**

Text Books:

Reference Books:

1. A Short Course in International Contracts: Drafting the International Sales by By Karla C. Shippe : world trade press
2. FIDIC documents
3. Construction Contracts & Claims – Simon M.S. McGraw Hill, New York
4. Unified Contract Documents by Ministry of Statistics and program implementation, Government of India.
5. Dispute Review Board Manual by Robert Matyas and Mathews.
6. International Construction Contracting – K.N.Vaid-NICMAR Publication

Program:	M. Tech. (Civil) Construction Management			Semester :	I	
Course :	Professional Elective Lab-II			Code :	MCI2506	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
2	2	1	50	--	50	100

Objectives: Elective III

Retro Fitting

1. To impart knowledge about maintenance and Retrofitting of Structures
2. To acquire knowledge about repairs, rehabilitation and damage assessment
3. To enable the students to understand the repair materials and techniques

Advanced Construction Technology

1. To acquire knowledge of implementation of advanced construction techniques with recommended specifications.
2. To provide knowledge about equipment, systems required to facilitate the advanced construction techniques.
3. To provide a coherent development to the students in area of advanced construction technology

Construction Equipments and Management

1. Importance of Construction Equipment and their maintenance.
2. Application of different equipment in construction industry.
3. Carry effective management of equipment.

Elective IV

SAFETY PRACTICES IN CONSTRUCTION

1. To Understand Safety risk and safety practices followed on basic level on job site
2. To get knowledge of effective implementation safety program in a construction company.
3. To be acquainted with knowledge of Laws related to construction Safety.

Infrastructure Development

1. To know role of Infrastructure in Nations Economy.
2. Co-relating Budget provisions and construction sector for infrastructure development
3. Role of Public Private Partnership in Economic Development

International Contracting

1. Able to know role of International Contracting
2. Able to understand rules and regulations for international contracting
3. Able to know the roles disputes arising in international contracting and their resolution

Outcomes: Elective III

After learning the course, the students should be able to:

Retro Fitting

1. Evaluate the cause of deterioration of concrete structures.
2. Assess the damage and design the plan to repair
3. Decide the various techniques of retrofitting of structures
4. Recognize good materials for repair and retrofitting technique

Advanced Construction Technology

1. Select construction equipment and processes involved in bridges and metro, construction.
2. Recommend the method of construction used for port and high rise construction
3. Justify advanced techniques used in special structures and marine construction.
4. Suggest outline for construction of high rise construction.

Construction Equipment's and Management

1. Experience through stud, various applications of equipment and its management.
2. Analyze the operational role of different equipment's in construction industry.
3. Evaluate equipment maintenance and operative cost analysis.

Elective IV

SAFETY PRACTICES IN CONSTRUCTION

1. Identify safety risks on job sites.
2. Create and manage an effective safety program in a construction company.
3. Explain various laws related to construction safety and Compensation act.
4. Understand safety risk and code of practice on construction site.

Infrastructure Development

1. Justify role of Infrastructure in National Economy.
2. Co-relate Indian budget and its relation w,r,to any of the Construction sector.
3. Explain role of Public Private Partnership in Construction project.
4. Identify and apply various provisions made for Infrastructure Development.

International Contracting

1. Explain the impact of international contracting in construction
2. Develop international contract documents
3. Apply disputes resolutions for international contracting

Detailed Syllabus:

Unit	Description for List of Experiments / Assignments	Duration
	Elective III **Retro Fitting** 1. Assignment on damage assessment 2. Assignment on maintenance and retrofitting Techniques 3. Collection and comparative study of retrofitting materials 4. Case study Presentation by individual on any topic from above syllabus. **Advanced Construction Technology** 1. Students have to write case study on bridges/metro including advance technology used and safety adopted 2. Students have to write case study based assignment on ports/high rise construction including technology and safety adopted 3. Assignment on Special structures/marine construction Individual presentation on any advance construction technology based on Syllabus **Construction Equipments and Management** 1. One Site Visit for Each Unit and submission of a report for the same. 2. Cost Comparison of Various Construction Equipments for any Construction activity / Cost effective analysis of equipment used for a construction activity. 3. Determination of work cycle time for any Equipment for its use. 4. Analysis of maintenance cost for any equipment for its use. **Elective IV** **SAFETY PRACTICES IN CONSTRUCTION** 1. Report on Safety Codes available. 2. Accident Prevention measures. 3. Laws related to construction safety and Compensation act. **4.** Report on Safety Audits. **Infrastructure Development** 1. Presentation on Any one on: JNNURM, PMGSY, RGGVY and its New forms. 2. Case study of any Public Private Partnership scheme. 3. Presentation on Infrastructural activities and its effect on GDP in India. 4. Detailed study of (last) FIVE year plan and its provisions for development of Infrastructure. **International Contracting** 1. Role of Asia- Pacific region countries in the present construction development. 2. Impact of WTO/GATS on the Indian Construction Sector 3. Study and application of various conditions of contract under the FIDIC document **4.** CASE studies of any 2 major project executed/functioning under International contracting	

Program:	M. Tech. (Civil) Construction Management	Semester : II
Course :	Skill Development Lab - II (Soft Skills and English Aptitude)	Code:MCI2101

Teaching Scheme			Evaluation Scheme			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
2	2	1	50	--	--	50

Pre-requisite: -

Objectives:

1. To facilitate holistic growth
2. To make the students aware about the significance of Soft Skills and English Aptitude
3. To develop the ability of effective communication through individual and group activities
4. To expose students to right attitude and behavioral aspects and build the same through various activities

Outcomes: After learning the course the students should be able to:

1. Express effectively through verbal/oral communication skills
2. Prepare for group discussions/meetings/interviews and presentations
3. Operate effectively in multi disciplinary and heterogeneous teams through the knowledge of team work, inter personal relationships, conflict management and leadership activities.

Guidelines :

1. Total experiments to be conducted are Six **out of eight**
2. **Total : 6 experiments 12 hours**

Detailed Syllabus:

Skill Development Lab (ANY Six)

Expt.	Description	Duration (H)
1	**Group Discussion:** Make students aware of proper and globally accepted ethical way to handle work, colleagues and clients. Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven analytical arguments making them contributors in any team.	2
2	**Public Speaking:** Any one of the following activities may be conducted : **1. Prepared speech** (Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) **2. Extempore speech** (Students deliver speeches spontaneously for 5 minutes each on a given topic)	2
3	**Writing An Article On Any Social Issue:** Build writing skills, improve language and gain knowledge about how to write an article/ report	2
4	**Reading and Listening skills:** The batch can be divided into pairs. Each pair will be given a article by the facilitator. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students would be asked questions and needful corrections in the article. The facilitator can evaluate the students for reading and listening skills.	2
5	**Debate On Current Affairs/ Social Relevance Topics:** Cultivate the habit to present forceful arguments while respecting the opponents perspective and enhance verbal skills.	2
6	**Telephonic etiquettes:** To teach students the skills to communicate effectively over the phone. Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call.	2
7	**Email etiquettes:** To provide students with an in-depth understanding of writing formal emails.	2
8	**Mock interviews:** Guide students and conduct mock interviews	2
	Total	12

Text Books: 1. Barun Mitra, Personality Development and Soft Skills 2. Stephen Lucas,The Art of Public Speaking
Reference Books: 1. Marcia Weaver,Empowering Employees Through Basic Skills 2. Gerald Ratigan, Aced: Superior Interview Skills to Gain an Unfair Advantage to Land Your DREAM JOB!

Program: M. Tech. (Civil) Construction Management					Semester II:	
Course : Integrated Mini-Project					Code : MCI2701	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
6	6	3	50	--	50	100

Pre-requisite:

1. Basics of Fluid mechanics, Heat Transfer and thermodynamics
2. Basics of MATLAB and ANSYS

ectives:

1. To understand the ―Product Development Process‟ including budgeting through Mini Project.
2. To plan for various activities of the project and channelize the work.
3. To build, design and implement real time application using available platforms

comes:

r learning the course the students should be able to:

1. Understand, plan and execute a Mini Project.
2. Design real time application
3. Prepare a technical report based on the Mini project.
4. Deliver technical seminar based on the Mini Project work carried out.
5. Understand publication and copyright process of research

delines: Total: 24 h (contact) + 48 h(non-contact/implementation)

1. Individual student needs to design and demonstrate Mini-project under the guidance of allocated guide.
2. Students can choose the project considering their future implementation in Major Project in second year
3. The hardware implementation and software simulation is compulsory.
4. Mini-Project Report should be submitted as a compliance of term work associated with subject.
5. Paper publication associated with mini-project as research outcome is appreciable.
6. Mini-project work preferably should be completed in laboratory.

iled Syllabus:

Integrated Mini-Project

Sr. No.	ivity	Duration (H)
1.	Week 1 &2 : Mini-project guide allotment, finalization of topic and platform, Planning of the work	4
2.	Week 3&4: Literature review and specification and Methodology Finalization, Review 1 for finalization of topic and specification.	4
3.	Week 5&6 : Simulation of Idea on appropriate software tools and finalization of hardware platform	4
4.	Week 7 & 8 : understanding platform implementation and related software flow and execute block level design , Review 2 to understand the progress of the project	4
5.	Week 9 & 10: Mini Project Report writing and publication or copyright planning and execution.	4
6.	Week 11&12: Demonstration of Project work and Final Review for submission and term work compliances.	4
	Total	**24**

Annexure I

Semester-I & II

Audit Courses

Program:	M. Tech. Civil (Construction Management)				Semester:	I and II
Course :	Audit Courses (Semester I and II)				Code:	M_1961 M_2962
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
1	1	--	--	--	--	--

Guidelines:

1. The audit courses are common to all M. Tech programs
2. Students can select any audit course from list of audit courses for Semester I and II
3. These are non-credit courses but mandatory to comply the submission of the semester.

Program:	M. Tech. (Civil) Construction Management			Semester :	I	
Course :	Constitutions of India **(AC I)**			Code :	M1961A	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**
1	1	--	--	--	--	--

Objectives:

1. To understand the constitution and the centre-state relations and functioning
2. To understand the rules and regulations under which public and private sector work
3. To understand E-governance through computers and knowledge of cyber laws

Outcomes: After learning the course, the students should be able to:

1. Understand the functions of the Indian government and identify and explore the basic features, modalities about Indian constitution and assessment of the Parliamentary System in India.
2. Differentiate the functioning of Indian Political system at Central and State level and comprehend the fundamental rights and abide the rules of the Indian constitution.

Detailed Syllabus:

Unit	Description	Duration (H)
1	Introduction to Constitution & System of Government Meaning of the constitution law and constitutionalism, making of constitution, Salient features and characteristics of the Constitution of India, Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties and it's legal status, Citizenship. Structure and Function of Central Government, President, Vice President, Prime Minister, Cabinet, Parliament, Supreme Court of India, Judicial Review, Federal structure and distribution of legislative and financial powers between the Union and the States, local self-government	**6**
2	Judiciary and Constitution Functions: Governor, Chief Minister, Cabinet, State Legislature Judicial System in States, High Courts and other Subordinate Courts, Parliamentary Form of Government in India. Constitution Functions: Indian Federal System and it's characteristics, Center& State Relations, President's Rule, Constitutional Amendments and powers, Constitutional Functionaries, Emergency Provisions, Assessment of working of the Parliamentary System in India.	**6**
	Total	**12**

Text Books:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi, 24th Edition, 2020, ISBN-109388548868
2. Clarendon Press, Subhash C, Kashyap, "Our Constitution: An Introduction to India's Constitution and constitutional Law", NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1.Dr J N Pandey : Constitutional Law of India 2. https://www.meity.gov.in/divisions/national-e-governance-plan
2. https://www.meity.gov.in/DeitY_e-book/e-gov_policy/download/Policy%20Document.pdf
3. http://www.iibf.org.in/documents/cyber-laws-chapter-in-legal-aspects-book.pdf
4. Maciver and Page, "Society: An Introduction Analysis ", Laxmi Publications, 4th edition, 2007, ISBN-100333916166
5. PM Bhakshi, "The constitution of India", Universal Law Publishing - An imprint of Lexis Nexis, 14th edition, 2017, ISBN-108131262375

Program:	**M. Tech. (Civil) Construction Management**					**Semester :**	**I**
Course :	Value Education **(AC-I)**					**Code :**	**M1961B**
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**	
1	1	--	--	--	--	--	

Objectives:

1. To identify and develop Attitude and Core Faith values
2. To expose students to Family Relations
3. To enable student to understand Creative Thinking and Problem solving
4. To enable students to understand Humanistic Education

Outcomes: After learning the course the students should be able to:

1. Change in awareness levels, knowledge and understanding of student
2. Change in attitudes / behavior of students with regards to their education improved teamwork,
3. institutional leadership and other life skills
4. Improvement in social health and attitude.

Detailed Syllabus:

Unit	**Description**	**Duration (H)**
1.	Why Human Relations are so important? Understanding Behavior, Human Relations, and Performance, Personality, Stress, Learning, and Perception, Attitudes, Self-Concept, Natural acceptance of human values, and Ethics, Dealing with Conflict, Leading and Trust	**6**
2.	Justice in Humankind, Nurturing and Exploitation, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics	**6**
	Total	**12**

Text Books:

1. "A Foundation Course in Human Values and Professional Ethics" R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi and Teacher's Manual, R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi

Reference Books:

1. "Human Relations in Organizations Applications and Skill Building" Robart Lussier, eighth edition, McGraw-Hill (2014).
2. Atkinson and Hilgard's, "Introduction to psychology" Nolen-Hoeksema, S., Fredrickson, B. L., Loftus, G. R., & Lutz, C., Cengage Learning EME.

Program:	M. Tech. (Civil) Construction Management					Semester :	I
Course :	Stress Management **(AC-I)**					Code :	M1961C
Teaching Scheme			**Evaluation Scheme**				
Lecture	**Hours**	**Credit**	**IE1**	**IE2**		**ETE**	**Total**
1	1	--	--	--		--	--

Objectives:

1. To overcome stress
2. To achieve overall health of body and mind
3. To learn to achieve the highest goal happily
4. To become a person with stable mind, pleasing personality and determination

Outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Detailed Syllabus:

Unit	Description	Duration (H)
1.	Definitions of Eight parts of Yog. (Ashtanga) Yam and Niyam. Do`s and Don't's in life.	**6**
2.	Pranayam Regularization of breathing techniques and its effects- Types of pranayama, Approach to day to day work and duties, wisdom	**6**
	Total	**12**

Text Books:

1.'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

Reference Books:

1."Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

2.A Handbook of Practical Wisdom Leadership, Organization and Integral Business Practice By Wendelin Küpers, David J. Pauleen · 2016

3. A Foundation Course in Human Values and Professional Ethics Presenting a Universal Approach to Value Education - Through Self-exploration

M. Tech. (Civil) Construction Management					Semester:	II
Course: Team Building & Leadership **(AC-II)**					**Code: M2962A**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**
1	1	--	-	-	-	-

Objectives:

1. Develop and strengthen interpersonal skills
2. Become familiar with and discuss different leadership models.
3. Familiarize students with the characteristics of team building.

Outcomes: After learning the course, the students should be able to:

1. Use leadership and teamwork knowledge to develop projects.
2. To develop the capacity to work collaboratively in a team

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Leadership:** Will and motivation, Personal leadership, self-knowledge, and self-control, using power responsibly and respectfully: the leader as a team-builder, Ability to plan future actions and transmit that vision to others. Taking the initiative and stimulate others. What the word "leader" means, Types of leadership, Traditional, legal, and legitimate leader. Categories: autocratic, democratic, charismatic, paternalistic, authentic, spiritual, dictatorial, etc	**6**
2.	**Team work** Why is teamwork important? The evolution from group to team: development stages. Advantages and disadvantages of teamwork. How to determine roles in a team. Traditional vs. virtuoso teams, forming effective and balanced teams, Strengthening teams within the organization. Creating a friendly and collaborative environment. Strategies to develop the team's mission, vision, values, and objectives. Shared objectives vs. personal motivation. Distinguishing purpose and tasks in the team. Encouraging participation. Creating team identity, creating high-performing teams.	**6**
	Total	**12**

Text Books

1. Stephen Covey, The Seven Habits of Highly Effective People, Free Press, 1989.
2. Ronald A. Heifetz, Leadership without Easy Answers, Belknap Press, 1994.
3. Michael E. Porter, Competitive Strategy, Free Press, 1980.

Reference Books:

1. John Kotter, Leading Change: Why Transformation Efforts Fail,
2. Ikujiro Nonaka, The Knowledge-Creating Company
3. Michael West, The Secrets of Successful Team Management, Chap. 2, "Self-Management," pgs. 32-61

Program:	**M. Tech. (Civil) Construction Management**				**Semester :**	**II**
Course :	English For Research Paper Writing **(AC-II)**				**Code :**	**M2962C**
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**
1	1	--	--	--	--	--

Objectives:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Outcomes: After learning the course the students should be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Detailed Syllabus:

Unit	**Description**	**Duration (H)**
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness, Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**6**
2.	key skills are needed when writing a Title, Abstract, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**6**
	Total	**12**

Text Books:

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
3. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Program:	M. Tech. (Civil) Construction Management			Semester :	II	
Course :	Disaster Management **(AC-II)**			Code :	MCI2962C	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE1**	**IE2**	**ETE**	**Total**
1	1	--	--	--	--	--

Objectives:

1. To orient engineers about various natural and manmade disasters.
2. To teach the concept of Disaster management and measures to be taken at different stages of disaster management.
3. To provide insight about global, national and regional level scenario of disaster management.

Outcomes: After learning the course the engineers should be able to:

1. Explain different disasters and measures to reduce the risk due to these disasters.
2. Justify institutional frame work for disaster management at national as well as global level.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction** – Hazard and Disaster. Concepts of Hazard, Vulnerability, Risks. Different Types of Disaster : A) Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc B) Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc. Slow Disasters (famine, draught, epidemics) and Rapid Onset Disasters(Air Crash, tidal waves, Tsunami) Causes, effects and practical examples for all disasters.	**6**
2.	**Natural disasters**- Earthquakes, Tsunami, Floods, Drought, Landslides, Cyclones and Volcanic eruptions. Their case studies. Coastal disasters. Coastal regulation Zone. **Disaster Prevention and Mitigation**. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters. **Disaster Management** : Role of Government, International and NGO Bodies. Role of IT in Disaster Preparedness Role of Engineers on Disaster Management.	**6**
	Total	**12**

Reference Books:

1. Pandey, M., 2014. Disaster Management, Wiley India Pvt. Ltd., 240p.
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd
3. Jagbir Singh, Disaster, Management: Future Challenges and Opportunities, K W Publishers Pvt. Ltd.
4. J.P. Singhal, Disaster Management, Laxmi Publications
5. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication
6. Shailesh Shukla, Shamna Hussain, Biodiversity, Environment and Disaster Management, Unique Publications

Text Books:

1. Disaster Administration and Management, Text & Case studies- SL Goel-Deep and Deep Publications
2. Disaster Management- G.K Ghosh-A.P.H. Publishing Corporation
3. Disaster management – S.K.Singh, S.C. Kundu, Shobha Singh A – 119, William Publications, New Delhi.
4. Disaster Management – Vinod K Sharma- IIPA, New Delhi,1995
5. Encyclopedia of Disaster Management- Goel S.L. - Deep and Deep Publications, New Delhi, 2006.

Annexure II

Semester-I & II

Open Elective

Program:	M. Tech. Mechanical (Heat Power Engineering)				Semester :I	
Course :	Electronic Cooling				Code : MMH1601A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20		30	50

Pre-requisite:
hermodynamics, Fluid Mechanics, Heat Transfer

Objectives:

1. To establish fundamental understanding of heat transfer in electronic equipment.
2. To select a suitable cooling process for electronic components and systems.
3. To increase the capabilities in design and analysis of cooling of electronic packages.
4. To analysis the thermal failure for electronic components and define the solution.

Outcomes: After learning the course, the students should be able to

1. Understand Heat transfer processes involved in electronics cooling.
2. Analyze thermal failure for electronic components and define the solution.
3. Assign the best cooling method for each individual application.
4. Design cooling system for any electronic device and select Best packaging approach for any design.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction to Electronics Cooling** Introduction, Packaging Trends and Thermal Management, Basics of Heat Transfer, Conduction Heat Transfer, Multi-Dimensional Conduction, Transient Conduction, Natural Convection in Electronic Devices, Forced Convection Heat Transfer, Radiation Heat Transfer, contact and spreading resistances.	06
2.	**Electronics Cooling Methods in Industry** Thermal interface and phase change materials, passive and novel air-cooling approaches, Heat Sinks, Heat Pipes in Electronics Cooling, Thermoelectric Cooling, Liquid Immersion Cooling (Single and Two-phase), Cooling Techniques for High Density Electronics	06
3.	**Packaging of Electronic Equipments** Components of Electronic Systems, Packaging of Electronic Equipment, Conduction Cooling for Chassis and Circuit Boards, Chip/circuit material for augmenting heat transfer.	06
4.	**Control Parameters Measurement and simulation** Temperature & humidity requirement, CFD analysis for Airflow & temperature evaluation, thermography etc	06
	Total	24

Text Books:

1. Dave S. Steinberg," Cooling Techniques for Electronic Equipment ", Second Edition, John Wiley & Sons, 1991.
2. Frank P. Incropera, "Introduction to Heat Transfer ", Fourth Edition, John Wiley, 2002.
3. Sung Jin Kim and Sang Woo Lee, "Air cooling Technology for Electronic Equipment", CRC press, London, 1996.
4. Frank P. Incropera, "Liquid Cooling of Electronic Devices by Single-Phase Convection", John Wiley& sons, inc, 1999.

Reference Books:

1. Joel L. Sloan, "Design and Packaging of Electronic Equipment", Van Nostrand Reinhold Company, 1985.
2. Belady C., "Standardizing Heat Sink Performance for Forced Convection, Electronics Cooling", Vol. 3, No. 3, September, 1997.
3. Biber C., Wakefield Engineering, Wakefield, Massachusetts, "Characterization of the Performance of Heat Sinks,", Personal Communication, October 1997.
4. A. B.-Cohen, "Encyclopedia of Thermal Packaging volume 1 to 6", February 2013, World Scientific Publication

Program:	M. Tech. Mechanical (Heat Power Engineering)			Semester: II		
Course:	Green Buildings Open			Code: MMH1601B		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2		2	20	-	30	50

Pre -requisite:

Basics of air conditioning

Basics of building construction

Objectives:

1. To develop a multidisciplinary approach to the energy supply and use in new and existing buildings
2. To develop knowledge and understanding of system solutions that provide optimal indoor environment in buildings in an environmentally and cost-effective way
3. To create awareness of different building rating tools

Outcomes: After learning the course, the students should be able to:

1. Should be able to identify features of an energy efficient building system
2. Learner should be able to apply simulation programs of buildings to perform energy calculations, evaluate the relationship between energy use, indoor comfort
3. Learner should be able to evaluate and justify energy-saving measures in existing building on the basis of engineering and economic feasibility
4. Learner should be able to apply the principles of energy management to obtain buildings that can be certified

Detailed Syllabus:

Unit	Description	Duration, h
1	**Overview and comparison of green building rating systems** What is green building, conventional building practices versus integrated design process, comparison of USGBC LEED, IGBC, GRIHA, EDGE and other green building rating systems, Conducting feasibility studies, reference standards, key definitions, synergies between various credit categories, understanding building forms, site level features, microclimate features	**06**
2.	**Resource Efficiency** Energy efficiency in buildings, Water efficiency – indoor water use, rainwater harvesting, irrigation water use, wastewater systems, strategies for reducing water consumption Waste management – source reduction, reduce – recycle – reuse, strategies for waste management, construction waste management plan	**06**
3	**Health and Wellness** Introduction to indoor air quality, ASHRAE 62.1 overview and requirements, ventilation rate procedure method, key parameters affecting indoor environment, IAQ management plan Daylight and views, strategies to enhance daylight availability, Overview of WELL standard for buildings, impact of VOCs and hazardous chemicals on human health	**04**
4	**Site features** Erosion and sedimentation control, water efficient landscaping and irrigation practices, microclimate, heat island effect, exterior lighting pollution, Location and transportation, transportation management strategies and planning	**02**
5	**Materials and resources** Low-embodied energy materials, environmental product declarations (EPDs), overview of material categories of IGBC, LEED & GRIHA, life cycle analysis and its application, overview of software tools for LCA,	**05**
6	**Government schemes and incentive programs** Funding and Incentives for green building rating programs, requirements of NBC 2016 related to sustainability, local byelaws, model building code	**01**
	Total	**24**

Text Books:

1. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
2. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
3. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison "Green Building Handbook" Volume I, Spon Press, 2001.
4.

Reference Books:

1. Mili Majumdar, "Energy-efficient buildings in India" Tata Energy Research Institute, 2002.
2. TERI "Sustainable Building Design Manual- Volume I & II" Tata Energy Research Institute, 2009
3. Reference manuals of green building rating programs (LEED, WELL, IGBC, GRIHA)
4. ASHRAE Standard 62.1, Standard 55, Standard 90.1, and other standards referred by green building programs
5. EDGE App user manual
6. National Building Code of India – 2016
7. ECBC 2017

Program:	M. Tech. Mechanical (Heat Power Engineering)			Semester :	I	
Course :	System Modelling and Simulation			Code :	MMH1601C	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20		30	50

Pre-requisite:

Objectives:

1. Students able to model any physical system for realtime applications
2. Students able to simulate any physical system for realtime applications

Outcomes:

After learning the course, the students should be able to:

1. Develop mathematical model for practical problem
2. Develop Bond Graph model for system
3. Apply transfer function and State space model techniques
4. Simulate the system using suitable software and Estimate parameters by optimization

Detailed Syllabus:

Unit	Description	Duration
1.	Introduction to Modelling and Simulation, Basic systems, Introduction and Types of Mathematical modelling, Basic building blocks Mechanical, Electrical, Thermal systems.	6
2.	Bond Graph Modelling of Dynamic Systems: Representation,Elements, Single,Two and multiports Causality, Application to basic Mechanical,Electrical and Electromechanical system	6
3.	Dynamic Response and System Transfer Function: Poles, Stability Block diagram/Signal flow diagram/State Space formulation and Frequency response	6
4.	Simulation and Simulation application Parameter Estimation, System Identification and Optimization	6
	Total	24

Reference Books:

1. Brown, Forbes T. Engineering System Dynamics. New York, NY: CRC, 2001. ISBN: 9780824706166.

Program: M. Tech. (Heat Power Engineering)					Semester: II		
Course: Waste Management for Smart Cities					Code: MMH2602A		
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credits	IE 1	IE 2	ETE	Total
2	-	-	2	20	30	50	100

Course Objective:

1. To provides an in-depth understanding of Municipal waste characteristics and management.
2. To make aware about regulations in the area municipal waste management.
3. To equip with the methods of environment risk assessment of waste.
4. To provide an in-depth understanding of Physiochemical and biological treatment of Municipal waste.
5. To be able to design the land-fields for the smart cities.

Course Outcomes: The learners will be

1. Identify and evaluate the sources; composition; generation rates, methods of separation and collection methods of municipal waste treatment.
2. Evaluate and analysis the risk and methods of handling the hazardous and radioactive waste based on health effects.
3. Evaluate the Physiochemical and biological waste for its treatment and disposal
4. Design the land field for solid and hazardous wastes collection and removal.

Detailed Syllabus

Unit	Description	Duration, h
1.	**Municipal Solid Waste Management** Fundamentals Sources; composition, generation rates, collection of waste, separation, transfer and transport of waste, treatment and disposal options. Municipal waste management and handling rules for solid waste, hazardous waste, biomedical waste, fly ash, recycled plastics usage and batteries	6
2.	Hazardous and Radioactive Waste Management Fundamentals Characterization of waste, fate and transport of chemicals, health effects, Fundamentals sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.	6
3.	Physiochemical Treatment of Solid waste Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapour extraction, air stripping, chemical oxidation); ground water contamination and remediation.	6
4.	Biological Treatment of Solid waste and landfill design Biological Treatment of Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor. Landfill design Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration	6

Total	**24**

References:

1. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994.
3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 1997.
4. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L.Shah 1999, Prentice Hall.
5. Solid And Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.

Program: M. Tech. Mechanical (Heat Power Engineering)				Semester : II		
Course : Battery management for Electric Vehicles				Code : MMH2602B		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Basics of Electrical Engineering,

Objectives:

1. To understand the various battery performance parameters and types of batteries used for EV applications
2. To understand the requirements of battery management system
3. To make the learners conversant with Equivalent Circuit Cell Modeling of Battery
4. To make the learners conversant with SOC estimation
5. To make the learners conversant with Battery Pack Balancing and Power Estimation
6. To make the learners aware of thermal issues of Lithium ion battery and thermal management system

Outcomes: After learning the course,

1. the learners will be able to select battery for EV application and design battery pack
2. the learners will be able to estimate available energy and power of battery pack
3. The learners will be able to simulate charge discharge characteristics of a battery using equivalent circuit model
4. the learners will be able to estimate SOC and SOH of battery
5. the learners will be able to understand various methods of battery pack balancing
6. the learners will be able to estimate heat generation inside battery and propose cooling strategy for the battery pack.

Detailed Syllabus

Unit	Description	Duration, h
1.	**Introduction to battery-management systems** Battery terminology and performance parameters, Types of electrochemical cells , Lithium Ion Cells components, primary functions and components of BMS **BMS design requirements** Primary functions of BMS, sensing voltage, current and temperature of cell and battery pack, estimation of cell SOC and battery pack SOC, Estimation of available energy and power of cell and battery pack	6
2.	**Equivalent Circuit Cell Model (ECM)** Modeling OCV and SOC, Modeling voltage polarization, Warburg impedance, Estimation of Model parameter values: OCV, Columbic Efficiency, total capacity, temperature dependence of OCV, modeling hysteresis, using the ECM to simulate constant voltage/ power charge/ discharge characteristics	5
3.	**State-of-Charge (SOC) Estimation and Battery Pack Balancing** Different approaches to estimating battery cell SOC, Kalman-filter method of SOC estimation: linear Kalman filter , extended Kalman filter Reasons of battery pack unbalancing, criteria for specifying a balancing set point and when to balance a battery pack ,Passive balancing methods for battery packs, Active balancing methods for battery packs: capacitor-based circuits, transformer-based circuits, Estimation of available battery power using a simplified cell model	7

4.	**Battery Thermal Management** Heat Generation inside battery , Thermal issues of Lithium Ion Battery, Operating temperature range, Energy analysis and Thermal modeling of LIB, Cooling strategies in thermal management : Air cooling, liquid cooling, PCM based cooling , effect of parameters like cell arrangement, spacing, fluid velocity etc.	**6**
	Total	**24**

Reference Books:

1. Gregory L. Plett, Battery Management Systems, Volume I: Battery Modeling, Artech House, London
2. Gregory L. Plett, Battery Management Systems Volume II, Equivalent-Circuit Methods, Artech House, London
3. Gianfranco Pistoia, Boryann Liaw (eds.), Behaviour of Lithium-Ion Batteries in Electric Vehicles_ Battery Health, Performance, Safety, and Cost, Springer International Publication
4. Reiner_Korthauer, Li-I Batteries Basics and Applications, Springer International Publication

Program: M. Tech. Mechanical (Heat Power Engineering)				Semester: II		
Course: Renewable Energy Sources				Code: MMH2602C		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Thermodynamics; Fluid Mechanics; Heat Transfer; Elements of Electrical Engineering;

Objectives: Following concepts to be taught to the students,

1. -Demonstrate significance of analysis solar and Wind Resources Sources and design technologies of their utilization
2. Expose them to conceptualize and design renewable energy appliances and equipment
3. Enable them to independently analyze, implement and asses the real-life systems
4. Develop a research insight about renewable technologies so as to motivate all concerned for their enhanced deployment.

Course Outcomes:

1) To be able to determine the fundamental performance of characteristics of solar thermal, photovoltaic and wind energy systems
2) Enable the students to estimate the potential of solar and wind resources
3) To be able to understand the fundamentals of energy conversion from biomass, geothermal, tidal and ocean thermal energy conversion systems
4) To be able to determine the economic feasibility of renewable energy technologies.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Solar energy** Potential of Renewable energy sources (Flow & not stocks), Current scenario of worldwide installed capacity Solar- Earth Geometry for assessment of available solar radiation, Solar radiation estimation, instruments for measurement **Solar thermal collectors** – General description and characteristics: Flat plate collectors – Heat transfer processes – Short term and long-term collector performance. Solar concentrators – Aspects of Design, and performance evaluation. **Solar Photovoltaic Systems**– Working, Constructional details & Performance Assessment for Technmo-economic evaluation / feasibility	6
2.	**Wind energy -** Principles of wind energy conversion – Site selection considerations, Wind resource / energy potential measurement, wind electric generator components, Wind power plant design – *Aerodynamics and performance*, vertical vs. Horizontal axis design, and energy wheeling and banking concepts. Types of wind power conversion systems – Operation, maintenance and economics	6
3.	**Energy from biomass -** Sources of biomass – Different species, Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion, Properties of biomass Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas. Biogas / Producer Gas Technology, Engines - Constructional, Operational & Performance aspects	5
4	**Geothermal, Tidal and Wave Energy Conversion** Geothermal energy: hot springs and steam ejection site selection, power plants, and economics. Environmental impacts, Economic and social considerations, Availability, system development and limitations, Wave and tidal energy –Scope and economics, Introduction to integrated energy systems.	7

	Other plants**:** Fuel cell-based power plants, tidal and wave energy plant design	
	Total	**24**
	Text Books 1. S.P. Sukhatme, Solar Energy – Principles of thermal collection and storage, II edition, Tata McGraw Hill, New Delhi, 1996. 2. Garg H.P., Prakash J., Solar energy Fundamentals and Applications, Tata Mc Graw Hill Publishing Company, New-Delhi, Latest Edition 3. V.V. N. Kishore, Editor, Renewable Energy Engineering and Technology, A knowledge Compendium, The Energy and Resources Institute, New Delhi, 2008	
	Reference Books: **1.** J.A.Duffie and W.A.Beckman, Solar engineering of Thermal processes, II edition, **2.** John Wiley, New York, 1991. **3.** D.Y.Goswami, F.Kreith and J.F.Kreider, Principles of Solar Engineering, Taylor and **4.** Francis, Philadelphia, 2000. **5.** D.D.Hall and R.P.Grover, Biomass Regenerable Energy, John Wiley, New York,1987. **6.** Mukund R Patel, Wind and Solar Power Systems, CRC Press, 1999. **7.** J F Manwell, J.G.McGowan, A.L.Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley and Sons, May 2002. **8.** R D Begamudre, Energy Conversion Systems, New Age International (P) Ltd., Publishers, New Delhi ,2000. **9.** Bureau of Energy Efficiency – Volume 1	

Program:	M. Tech. Mechanical (Design Engineering)				Semester : I	
Course :	Advanced Materials				Code: MMD1601A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:

Chemistry, Physics, Material Science, Metallurgy

Objectives:

1. To introduce advanced and exotic materials.
2. To familiarize students with structure and properties of materials.
3. To establish significance of material selection in engineering design.
4. To explore new design opportunities.

Outcomes: After learning the course, the students should be able to:

1. Student will be able to analyze of different materials in advanced engineering application.
2. Student will be able to relate structure and properties of new materials in engineering applications
3. Student will be able to evaluate and select materials for advanced engineering applications.

Detailed Syllabus:

Unit	Description	Duration, h
1	Advanced and exotic materials – ceramics and Plastics, Biomaterials, Aerogels, Superconductors, Carbon nano tubes	8
2	Mechanical, electrical, optical and magnetic properties of materials.	8
3	Smart materials, Piezoelectricity, Magnetostriction, smart polymers, Shape memory alloys	6
4	Introduction to nano, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterizations of nanomaterials.	6
	Total	24

Text Books:

1. W.D. Callister Material Science and Engineering: An Introduction, Wiley publication.

Reference Books:

1. Malsch, N.H., "Biomedical Nanotechnology", CRC Press. (2005).
2. L.F. Pease, R.M. Rose and J. Wulff, Electronic Properties (Volume IV: Structure and Properties of Materials)

Program:	M. Tech. Mechanical (Design Engineering)				Semester : I	
Course :	Optimization Methods				Code: MMD1601B	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Engineering Mathematics

Objectives:

1. To introduce students to the modeling of constrained decision-making problems and optimization.
2. Provide students with the basic mathematical concepts of optimization.
3. Provide students with the modelling skills necessary to describe and formulate optimization problems.
4. Provide students with the skills necessary to solve and interpret optimization problems in engineering.

Outcomes:

After learning the course, the students should be able to:

1. Formulate mathematical programs in various practical systems
2. Understand basic optimization techniques
3. interpret the results of a model and present the insights (sensitivity, duality)
4. Know the limitations of different solution methodology
5. Use software to solve problems

Detailed Syllabus:

Unit	Description	Duration, h
1.	**Classical Optimization Techniques** Introduction to Mathematical Modeling, Single variable optimization and multi variable optimization, with constraints and without constraints	6
2.	**Linear and non-Linear Programming** Simplex Methods, Elimination and iterative methods for one-dimensional minimization .	6
3.	**Simulation Modeling** Introduction, definition and types, limitations, various phases of modeling, Monte Carlo method, applications, advantages and limitations of simulation	6
4.	**Modern Methods of Optimization** Genetic algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, etc.	6
	Total	24

Text Books:

1. Engineering Optimization: Theory and Practice, Singiresu S. Rao, John Wiley & Sons
2. Practical Optimization Methods with Mathematical Applications, M. Asghar Bhatti, Springer
3. Optimization for engineering design, K. Deb, PHI

Reference Books:

1. Topology Optimization – Theory, Methods and Applications, M. P. Bendse, Q. Sigmund
2. Evolutionary Topology Optimization of Continuum Structures, Methods and Applications, X. Huang, Y.M. Xie, Wiley
3. Structural Optimization, Raphael T. Haftka and Zafer Gurdal, Kluwer Academic Publishers
4. Mathematical Modelling, J N Kapur, New age international publication
5. Optimization concepts and applications in engineering, Belegundu, Chandrupatla, Pearson Education

Program:	M. Tech. Mechanical (Design Engineering)				Semester : I	
Course :	Modeling and Simulation of Dynamic systems				Code: MMD1601C	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Engineering Mathematics

Objectives:

1. Students able to model any physical system for realtime applications
2. Students able to simulate any physical system for realtime applications

Outcomes: After learning the course, the students should be able to:

1. Develop mathematical model for practical problem
2. Develop Bond Graph model for system
3. Apply transfer function and State space model techniques
4. Simulate the system using suitable software and Estimate parameters by optimization

Detailed Syllabus:

Unit	Description	Duration h
5.	Introduction to Modelling and Simulation, Basic systems, Introduction and Types of Mathematical modelling, Basic building blocks Mechanical, Electrical, Thermal systems.	6
6.	Bond Graph Modelling of Dynamic Systems: Representation,Elements, Single,Two and multiports Causality, Application to basic Mechanical,Electrical and Electromechanical system	6
7.	Dynamic Response and System Transfer Function: Poles, Stability Block diagram/Signal flow diagram/State Space formulation and Frequency response	6
8.	Simulation and Simulation application Parameter Estimation, System Identification and Optimization	6
	Total	**24**

Reference Books:

1. Brown, Forbes T. Engineering System Dynamics. New York, NY: CRC, 2001. ISBN: 9780824706166.

Program:	M. Tech. Mechanical (Design Engineering)				Semester : II	
Course :	Room Acoustics				Code : MMD2602A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Engineering Mathematics, Physics,

Objectives:

The course includes sound fields in rooms with wave theoretical methods, geometrical acoustics methods Acoustical measurement techniques, sound absorption for evaluation of room acoustic quality

Outcomes:

After learning the course, the students should be able to:

Understand Basic principals in acoustics, measurement of sound Power and apply to analyze effectiveness in compliance to noise regulations.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Basics of acoustics –** Terminologies speed of sound, wavelength, frequency, and wave number, acoustic pressure, acoustic intensity and acoustic energy density, spherical wave, **Acoustic measurement** Directivity factor and directivity index, levels and the decibel, combination of sound sources, octave bands, weighted sound levels. Sound power measurement	6.
2.	**Transmission of Sound:** changes in media with normal incidence, changes in media with oblique incidence, sound transmission through a wall, transmission loss for walls - stiffness-controlled region- mass-controlled region - damping-controlled region,	6
3.	**Sound Absorption:** General description of acoustical materials - acoustical tiles, fiberboard, resonator absorption unit absorber, carpets, acoustical plaster, resilient packing composite materials, etc. Their use, selection criteria and construction.	6
4.	**Room acoustics -** surface absorption coefficients, steady-state sound level in a room, Behaviour of sound in an enclosed space. Concept of reverberation and reverberation time effect of energy absorption in the air, noise from an adjacent room, acoustic enclosures, acoustic barriers.	6
	Total	24

Text Books:

Industrial Noise Control, Randell Barron, Marcel Dekker, Inc.

Reference Books:

Mechanical Vibrations & Noise Engineering, A.G.Ambekar, Prentice Hall of India, New-Delhi.

Program:	M. Tech. Mechanical (Design Engineering)				Semester : II	
Course :	Design Thinking				Code: MMD2602B	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:
Any Engineering Graduate

Objectives:
1. To acquaint with concepts of Design Thinking.
2. To apply design thinking tools in every field of Engineering.

Outcomes:
After learning the course, the students should be able to:
1. Use Design Thinking tools.
2. Create simple Products using design thinking tools

Detailed Syllabus:

Unit	Description	Duration h
1.	Introduction to Design thinking and its importance. Steps in Design Thinking	04
2.	Empathize Phase	04
3.	Define Phase	04
4.	Ideate Phase	04
5.	Prototype Phase	04
6.	Test Phase. One simple Product development using Design thinking tools	04
	Total	24

Reference Books:

1. Design Thinking methodology book by Emrah Yayici , Publisher Emrah Yayici, 2016
2. Designing for Growth: A design thinking toolkit for managers, Tim Ogilvie ,Columbia Business School Publishing

Program:	M. Tech. Mechanical (Design Engineering)				Semester : II	
Course :	Reliability Engineering				Code: MMD2602C	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Engineering Mathematics

Objectives:

1. To perform reliability engineering analysis.
2. To compute reliability engineering parameters and estimates for applications in mechanical devices and manufacturing environments.

Outcomes:

After learning the course, the students should be able to:

1. Identify the possible faults in systems and their impacts to the overall system reliability.
2. Develop fault trees for a sub-system and apply various reliability models on fault analysis.
3. Evaluate maintenance schedules and assess the corresponding risk with appropriate techniques and tools.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Fundamental concepts - I** Failure density, failure rate, hazard rate, MTTF, MTBF, pdf, cdf, modes of failure, Areas of reliability, Quality and reliability assurance rules, product liability, probability distributions binomial, normal, Poisson.	6
2.	Sy**stem reliability** Series, parallel, mixed configuration, k- out of n structure, complex systems- enumeration method, conditional probability method, cut set and tie set method,	6
3.	**Redundancy** Element redundancy, unit redundancy, standby redundancy- types of stand by redundancy, parallel components single redundancy, multiple redundancy. Markov analysis.	6
4.	**System reliability Analysis** Reliability apportionment, Reliability apportionment techniques – equal apportionment, AGREE, ARINC, feasibility of objectives apportionment.	6
	Total	**24**

Text Books:

1. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-Wast Press (P) Ltd., 1985.
2. E. Balagurusmy, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1984.

Reference Books:

1. A.K. Govil, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1983.
2. B.S. Dhillion, C. Singh, Engineering Reliability, John Wiley & Sons, 1980.
3. M.L. Shooman, Probabilistic, Reliability, McGraw-Hill Book Co., 1968.
4. P.D.T. Conor, Practical Reliability Engg., John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, Reliability in Engineering Design, John Wiley & Sons, 1977.
6. A. Birolini , Reliability Engineering, Theory and Practice, Third Edition, Springer, 1999

Program:	M. Tech (E&TC)-VLSI and Embedded Systems				Semester:	I
Course:	Automotive Electronics and its Applications				Code:	MET1601A
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
2	2	2	20	--	30	50

Prior Knowledge of Electronics & electrical, instrumentation, control systems, and IC engine operation, **is essential.**

Objectives:

1. To explain the various application of electronics systems and ECU in automotive.
2. To deliver knowledge about principles and applications of sensors and actuators in automotive electronics systems.
3. To explore various control systems in automotive

Outcomes: After learning the course, the students should be able to:

1. Acquire an overview of automotive components, subsystems, and basics of electronic control in today's automotive industry.
2. Understand the available automotive sensors and actuators in various electronic control systems.
3. Understand components of engine control system in automotive design.
4. Analyze the safety systems in automotive application

Detailed Syllabus:

Unit	Description	Duration h
1.	**Automotive Systems Overview:** Automotive vehicle technology, Present trends in automobiles with emphasis on increasing role of electronics and software, Overview of typical automotive subsystems and components, Body, Chassis, and Powertrain Electronics	**6**
2.	**Sensors and Actuators:** Basic sensor arrangement, Types of sensors such as oxygen sensors, Crank angle position sensors, Fuel metering/ vehicle speed sensors, Flow sensor, Temperature, EGO, Air mass flow sensors, Throttle position sensor, Solenoids, Stepper Motors, Relays, etc.,	**6**
3.	**Engine Control System:** Algorithms for engine control including open loop and closed loop control system, Electronic ignition, EGR for exhaust emission control. Look-up tables and maps, Need of maps, Procedure to generate maps, Engine calibration, Torque table, Dynamometer testing	**6**
4.	**Active and passive safety systems:** Body electronics including lighting control, Remote keyless entry, Immobilizers etc., Electronic instrument clusters and dashboard electronics, Antilock braking system, Electronic stability program, Air bags, Computer vision based ADAS	**6**
	Total	**24**

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", 7th edition, Butterworth-Heinemann Publications, 2017.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill, 1999

Reference Books:

1. Robert Bosch, "Automotive Hand Book", 10th edition, Wiley Publications, 2018
2. Kiencke, Uwe, Nielsen & Lars, "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication, 2005.
3. Tom H. Denton , "Automobile Electrical and Electronic Systems", 3rd Edition, Elsevier, 2004
4. John F. Kershaw, James D. Halderman, "Automotive Electrical and Electronic Systems", 5th Edition, Pearson Prentice Hall, 2007

Program:	M.Tech (E&TC)-VLSI and Embedded Systems			Semester:	I	
Course:	Industrial Drives			Code:	MET1601B	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:
Electrical Drives, Dynamics of Electrical drives, Control Systems

Objectives:

1. To define electric drive, its parts, advantages and explain choice of electric drive.
2. To explain dynamics and modes of operation of electric drives.
3. To explain selection of motor power ratings and control of dc motor using rectifiers.
4. To explain the control of induction motor, synchronous motor and stepper motor drives.
5. To discuss typical applications electrical drives in the industry

Outcomes: After learning the course, the students should be able to:

1. Analyze the performance of induction motor drives under different conditions.
2. Control induction motor, synchronous motor and stepper motor drives.
3. Suggest a suitable electrical drive for specific application in the industry
4. To analyze the performance of induction motor drives under different conditions.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Selection of Motor Power Ratings:** Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating. **Direct Current Motor Drives:** Controlled Rectifier Fed dc Drives, Single and three Phase Half and Fully Controlled Rectifier Control of dc Separately Excited Motor, Rectifier Control of dc Series Motor, Supply Harmonics, Power Factor and Ripple in Motor Current, Chopper Control of Separately Excited dc Motor, Chopper Control of Series Motor.	6
2.	**Induction Motor Drives:** Analysis and Performance of Three Phase Induction Motors, Analysis of Induction Motor Fed from Non-Sinusoidal Voltage Supply, Starting, Braking, Transient Analysis. Speed Control Techniques-Stator Voltage Control, Variable Voltage Frequency Control from Voltage Sources.	6
3.	Voltage Source Inverter (VSI) Control, Cyclo-converter Control, Closed Loop Speed Control and Converter Rating for VSI and Cyclo-converter Induction Motor Drives, Variable Frequency Control from a Current Source, Current Source (CSI) Control, current regulated voltage source inverter control, speed control of single phase induction motors.	6
4.	**Synchronous Motor Drives:** Operation from fixed frequency supply-starting, synchronous motor. Self-controlled synchronous motor drive employing load commutated thruster inverter, Permanent Magnet ac (PMAC) Motor Drives, Sinusoidal PMAC Motor Drives, Brushless dc Motor Drives. **Stepper Motor Drives:** Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping Rate Characteristics, Drive Circuits for Stepper Motor. **Industrial Drives:** Textile Mills, Steel Rolling Mills, Cranes and Hoists, Machine Tools.	6
	Total	**24**

Text Books:

1. Gopal K Dubey , Fundamentals of the electrical drives Narosa publication
2. N. Mohan T.M. udeland & W.P.Robbins , Power Electronics converter application J.Wiley & sons
3. Vedam Suryavanshi**,** Electrical Drives Concept and application
4. B.K. Bose, Advanced power Electronics & A.C. Drives
5. S.K.Pillar, Analysis of thyristor power conditioned motors

Reference Books:

1. N.K De,P.K. Sen , Electric Drives PHI Learning 1 st Edition, 2009
2. Gobal K.Dubey, Fundamentals of Electrical Drives- Alpha Science Int. Ltd.,
3. Shepherd Hullay & Liag, Power Electronics & Motor Control -, Cambridge Univ. Press
4. Gopal K Dubey, Power Semiconductor controlled Drives, - Prentice Hall pub.
5. R. Krishnan, Electric Motor Drives–Modelling, Analysis and Control, - Pearson Education, 2003
6. P.C. Sen , Thyristorised DC Drives -, Krieger pub.
7. S.B.Dewan, G.R.Slemon & A.Stranghan; Power Semi conductor controlled Drives - John-Willey pub.

Program:	M.Tech (E&TC)-VLSI and Embedded Systems				Semester :	I
Course :	Basic of FPGA and CPLD				Code :	MET1601C
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Fundamentals of digital electronics, Knowledge of one hardware description language

Objectives:

1. To make students familiar with programmable logic devices and its architectures.
2. To understand the architecture and features of FPGA and CPLD .
3. To make the students familiar with the design process and how the design is mapped to the existing hardware in FPGA and CPLD.

Outcomes:

After learning the course the students should be able to:

1. To understand the depth of CPLD and FPGA architectures.
2. To design a system using FPGAs.
3. To demonstrate an understanding of interfacing of different external devices with FPGA/CPLD.
4. To apply the complete design flow of FPGA and CPLD for the specific application.

Detailed Syllabus:

Unit	Description	Duration H
1.	**Introduction:** Introduction to Hardware Description language, Need of Programmable logic devices, PLA PAL, CPLD, FPGA: General Architecture, features CPLD Architecture: overview, specification and applications, Features of XC9500 series of CPLD family.	**6**
2.	**FPGA Architecture:** Xilinx Logic Cell Array, Configurable Logic Block, I/O Block, Programmable Interconnects, Programming methods, Advanced features of Xilinx 4000 series Technology Trends: Device capacity, Utilization and Gate Density, Programming methods, General Design Flow, General Design Guidelines.	**6**
3.	**Interfacing with FPGA/CPLD:** The purpose of interfacing, interfacing of external devices such as WiFi Module, Bluetooth Module, GPS Module, Zigbee Module, Different types of display devices with FPGA/CPLD	**6**
4.	**Case Studies-FPGA/CPLD:** Xilinx Virtex-6, Spartan-6, Z-board Advanced features in FPGA based on Case studies. **Logical Design by FPGA/CPLD:** Complete design of any combinational circuit by gates, Boolean Algebra, Design of sequential circuits	**6**
	Total	**24**

Text Books:

1. P.K.Chan& S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall (Pte), 1994
2. Ronald Sass and Andrew G. Schmidt, "Embedded systems design with platform FPGAs: Principles and practices", Morgan Kaufmann, 2010.
3. Design manuals of Altera, Xilinx and Actel.

Reference Books:

1. S. Trimberger, Edr. Field Programmable Gate Array Technology, Kluwer Academic Publications, 1994.
2. Ronald J Tocci, Neal S. Widmer, Gregory L. Moss, "Digital Systems: Principles & Applications", 10th Edition, Pearson, 2009
3. J. Old Field, R. Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork, Reprint 2008.
4. S. Brown, R. Francis, J. Rose, Z. Vransic, Field Programmable Gate Array, BSP, 2007.
5. S. Brown and J. Rose, "Architecture of FPGAs and CPLDs: A Tutorial", IEEE Design & Test of Computers, Vol. 13, No. 2, pp. 42-57, 1996.
6. Stephen Brown Zvonko Vranesic – Fundamentals of Digital Logic with VHDL design, McGraw Hill – 2000

Program:	M.Tech (E&TC)-VLSI and Embedded Systems				Semester :	I
Course :	Robotics				Code :	MET1601D
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Prior Knowledge of

1. Sensors and actuators
2. Programming language 'C', MATLAB **is essential.**

Objectives: To impart knowledge on

1. Electromechanical elements of robots
2. Control system for robot automation
3. Existing robots designed for various applications

Outcomes: After learning the course the students should be able to:

1. Understand kinematics, statistics and dynamic of robots
2. Apply concepts of industrial automation and communication for selection of robots
3. Select sensing and actuating elements for designing robots as per applications requirements
4. Integrate and design control system and information system for various applications.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction to robotics:** Evolution of Robotics, Elements of robots; Kinematics of serial and parallel robots; Velocity and static analysis of robots; Dynamics of robots; Motion planning and control; Flexible manipulators; Wheeled mobile robots, classification of Robots	5
2.	**Advanced concepts in robotics:** Introduction to Cloud and Fog robotics; Basic concepts of industrial automation and communication protocols for PLC, DCS, SCADA systems; Introduction to Internet of Things, Protocols and real time applications.	5
3.	Sensing Elements **for robots:** Classification of Sensors, Encoders and Dead Reckoning Infrared Sensors, Ground-based RF Systems, Active Beacons, Ultrasonic Transponder Trilateration, Accelerometers, Gyroscopes, Laser Range Finder, Vision-based Sensors, Color-tracking Sensors, safety and motion sensors, Force/ Torque Sensors , Tactile Sensors, DC Motors, Controlling a DC Motor, Pulse Width Modulation, Stepper Motors, Servo Motor.	7
4.	Control System of Robots: Automatic-Feedback Control System, Control Elements, Control System Design, A Robot's System Dynamics, Sensory Feedback, Control Algorithms and Performances, Space Control, Introduction to Information System of Robots.	7
	Total	24

Text Books:

1. John J C, Introduction to Robotics: Mechanics and Control , Addison-Wesley (1989).
2. Appin Knowledge Solutions, Robotics (2007)
3. Ming Xie, Fundamentals of Robotics - Linking Perception to Action (2003)

Reference Books:

1. Thomas Bräunl, Embedded Robotics - Thomas Braunl (2006)
2. Bruno S and Sciavicco L, Robotics: Modelling, Planning and Control, Springer (2009).
3. Fu K S, Ralph G and Lee C S G, Robotics: Control Sensing. Vision, and Intelligence , Tata McGraw-Hill (1987).
4. Mukhopadhyay S, Sen S and Deb A K, Industrial Instrumentation, Control and Automation, Jaico (1999).
5. Rajkumar B and Dastjerdi A V, Internet of Things: Principles and Paradigms , Morgan Kaufmann (2016).

Program:	M.Tech (E&TC)-VLSI and Embedded Systems				Semester:	II
Course:	Drone Programming for Beginners				Code:	MET2602A
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Basic understanding of physics (Force, Velocity, Acceleration, etc), Understanding of sensors and actuators, Control systems, Modelling Basics –MATLB & SIMULINK, Programming in python

Objectives:

1. To understand the physics behind drones
2. To create the mathematical model of quadcopter drone from simple mathematics & Experimental data
3. To implement model into Simulink & check it against real life performance

Outcomes:

After learning the course, the students should be able to:

1. Identify & select different accessories of Drones as per applications
2. Establish the mathematical model & the Physics behind Quadcopter drone
3. Design Simulink model simulating the complete dynamics of quadcopter drone.

Detailed Syllabus:

Unit	Description	Duration H
1.	**Introduction to drones:** Unmanned Aerial Systems (UAS), Basics of drones, Introduction to Drones programming and Development Tools, Current rules and regulations governing owning and operating a UAS, concerns surrounding UAS safety, security and privacy issues	6
2.	**Drone accessories and Applications:** Sensors, Motors, Propellers, Battery, Concept of propulsion, Forces working on a Flight, Principal axes and rotation of aerial systems, Stable, unstable and neutral systems, Control drone (roll, pitch and yaw), Application of drones.	6
3.	**Drone control system development in Simulink:** Control system architecture, Quadcopter with actuator & propellers functionality block, Sensing & estimation functionality block, controller functionality block, Motor mixing algorithm (RPYT) functionality block	6
4.	**Modelling, Simulation & Flight control design:** Dynamic quadcopter system Model, flight control design, 3D visualization, testing & Tuning the model, Flight operations, Applicable software for data collection, processing, and analysis	6
	Total	24

Text books:

1. John Baichtal ,Building your own drones, a beginner's guide to drones, UAVS, and ROVs
2. Muhammad Usman , Quadcopter modelling and control with Matlab/Simulink implementation
3. Ryan Gordon , Model based design of a quadcopter
4. K.S.Fu, R.C.Gonzalez, C.G.Lee , Robotics control, sensing, vision and intelligence

Reference Books:

1. - R.K.Mittal , I.J.Nagrath,Robotics and control
2. Ben Rupert , Drones (The ultimate guide), , CreateSpace Independent Publishing Platform
3. Agam Kumar Tyagi Matlab and Simulink for engineers, , Oxford University Press, 2012

Program:	M. Tech (E&TC)-VLSI and Embedded Systems				Semester:	II
Course :	Instrumentation and Measurements				Code:	MET2602B
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE1	IE2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Basics of sensors and Actuators, Basic of Electronics, Analog and Digital Systems

Objectives:

To impart knowledge on the following Topics -

1. Basic functional elements of instrumentation
2. Fundamentals of electrical and electronic instruments
3. Comparison between various measurement techniques
4. Various storage and display devices
5. Various transducers and the data acquisition systems

Outcomes:

After learning the course, the students should be able to:

1. Analyse different measuring parameters of any electronics/mechatronics system
2. Design and evaluate characteristics of different types of mechatronics/ electrical/ electronic system
3. Understand different types of wave/spectrum analyzer.
4. Interface various system components and analyse its data using data acquisition system.

Detailed Syllabus:

Unit	Description	Duration h
1.	Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement. Bridge Measurement: DC bridges- wheatstone bridge, AC bridges – Kelvin, Hay, Maxwell, Schering and Wien bridges, Wagner ground Connection. Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter.	6
2.	Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope. Signal Generators: Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Pulse and square wave generators. Function Generators.	6
3.	Signal Analysis: Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters Transducers: Types, Strain Gages, Displacement Transducers	6
4.	Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus	6
	Total	24

Text Books:

1. Albert D.Helstrick and William D.Cooper, Pearson Education , Modern Electronics Instrumentation & Measurement Techniques, . Selected portion from Ch.1, 5-13.
2. by Joshph J.Carr ,Elements of Electronics Instrumentation and Measurement-3rd Edition.Pearson Education. Selected portion from Ch.1,2,4,7,8,9,13,14,18,23 and 25.

Reference Books:

1. Electronics Instruments and Instrumentation Technology – Anand, PHI
2. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

M.Tech (E&TC)-VLSI and Embedded Systems					Semester :	II
Course : Microcontrollers and Microprocessors applications					**Code :**	**MET2602C**
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE 1**	**IE 2**	**ETE**	**Total**
2	**2**	**2**	**20**	**--**	**30**	**50**

Prior Knowledge of Digital Electronics **is essential.**

Objectives:

1. To understand architecture and features of typical Microcontroller.
2. To understand need of microcontrollers in real life applications.
3. To learn interfacing of real-world peripheral devices
4. To study various hardware and software tools for developing applications.
5. To learn the architecture and programmer's model of advanced processor and microcontroller
6. To acquaint the learner with application instruction set and logic to build assembly language programs.

Outcomes: After learning the course the students should be able to:

1. Learn importance of microcontroller and microprocessor in designing embedded application
2. To apply the programming skills to develop real-life embedded application.
3. Learn use of hardware and software tools.
4. Develop interfacing to real world devices

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction to single chip Microcontrollers:** Intel MCS-51 family features, 8051/8031-architecture, 8051 assembly language programming, addressing modes, Programming interrupts, timers and serial communication	6
2.	**Microcontrollers and system design:** Assembly vs High-Level language programming, System Development Environment: assembler, compiler and integrated development environment, Debugging and Simulation, system design with 8051.	6
3.	**System level interfacing design;** Advanced Microprocessor Architectures- 286, 486, Pentium; Introduction to RISC processors; ARM microcontrollers; Embedded system design methodologies, embedded controller design for communication, digital control.	6
4.	**Microcontroller & Processors Applications:** Interfacing with display devices, Sensors, actuators, and memory devices. Case Study on real time embedded system.	6
	Total	24

Text Books:

1. Barry B Brey, The intel microprocessor: architecture, programming and interfacing, Prentice hall of India, New Delhi, 2003.ISBN-0138027455, 4th Edition
2. Mohammad Ali Mazidi and Janice Gillispie Maszidi "The 8051 Microcontroller and Embedded Systems" Pearson education, 2003, ISBN- 9788131710265, 2nd Edition

Reference Books:

1. Chris H. Pappas, William H. Murray, ―80386 Microprocessor Handbooks‖, McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
3. Walter A. Triebel, ―The 80386Dx Microprocessor: Hardware‖, Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
4. Mohammad Rafiquzzaman, ―Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN: -10:0966498011, 13:978:0966498011.
5. K. Bhurchandi, A. Ray, ―Advanced Microprocessors and Peripherals, McGraw Hill Education, Third Edition, ISBN: 978-1-25-900613-5

Program:	**M. Tech(VLSI & Embedded Systems)**				**Semester: II**	
Course:	**Electronics Implementation Platform**				**Code: MET2602D**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**IE 1**	**IE 2**	**ETE**	**Total**
2	**2**	**2**	**20**	**--**	**30**	**50**

Pre-requisite: Knowledge of C language, Python, electronic circuits.

Objectives:

1. Explain about the Arduino, Raspberry Pi, PLDs and all other associated platforms
2. Understand of the importance of micro controllers and computers in science and technology.
3. Discuss basic programming and structures required for basic operation of the platform,
4. Describe how to recognize functions, operations and syntax of Python, C and C++

Outcomes: After learning the course, the students should be able to:

1. Apply logical thinking and problem-solving skills with Arduino platform.
2. Acquire knowledge about Raspberry pi for implementation of applications
3. Understand Digital Signal processing implantation basics
4. Understanding rapid prototyping using PLDs.

Detailed Syllabus:

Unit	Description	Duration H
1.	Arduino: A open-sourceHardware, Working, Interfacing, Coding basics and small applications and Debugging.	**6**
2.	Raspberry pi : Working, Interfacing, Coding basics and small applications and Debugging.	**6**
3.	DSP processor for Real time Video and Inage Processing. : Working, Interfacing, Coding basics and small applications and Debugging.	**6**
4.	Programmable Logic devices: FPGA: Working, Interfacing, Coding basics and small applications and Debugging.	**6**
	Total	**24**

Text Books:

1. Ryan Turner,Arduino Programming: The Ultimate Beginner's & Intermediate Guide to Learn Arduino Programming Step by Step, 2019
2. Derek Molloy Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition,2006
3. Avtar Singh , Digital Signal Processing Implementations : Using DSP Microprocessors (with examples from TMS320C54XX),2003
4. Roger Woods, John McAllister, Ying Yi, Gaye Lightbody, FPGA-based Implementation of Signal Processing Systems, Second Edition, 2017

Reference Books:

1. Mark TorvaldsARDUINO - ARDUINO PROGRAMMING - ARDUINO FOR BEGINNERS, Second Edition June 7, 2018
2. Eben Upton Raspberry Pi User Guide 4th Edition 2019
3. Sen M. Kuo ,Real-Time Digital Signal Processing, : Implementations, Application and Experiments with the TMS320C55X, 2001
4. Cem Unsalan, Bora Tar ,Digital System Design with FPGA: Implementation Using Verilog andx VHDL , 2017

Program:	M.Tech (Computer Engineering)				Semester : I	
Course :	Programming with Python				Code : MCE1601A	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: . Basics of Programming

Objectives:

1.To acquire knowledge in Python and R programming

2.To develop Python programs with conditionals and loops and data structures

3.Acquire skills to apply data analysis methods to a problem

Outcomes:

After learning the course the students should be able to:

1.Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python

2.Interpret Object oriented programming in Python

3.Apply a solution clearly and accurately in a program using Python.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction to Python Programming:** Python Introduction, Installing and setting Python environment in Windows and Linux, basics of Python interpreter, Execution of python program, Editor for Python code, syntax, variable, Data types. Flow control if if else, for, while, range() function, continue, pass, break. Strings: Sequence operations, String Methods.	6
2.	**Lists:** Basic Operations, List slices,list methods,list and strings **Dictionaries:** looping and dictionaries, dictionaries & lists. **Tuples and Files :** reading and writing Functions: Definition, Call, Arguments ,Input output file handling.	6
3.	**Object Oriented Programming** features in Python: Classes, Objects, Inheritance,Errors and Exceptions: try, except and else statements, Exception Objects, Regular expressions.	6
4.	**Numpy and Matplotlib** :Array operations, Numpy Side Effects, 2D Numpy Arrays , Numpy Basic Statistics. Matplotlib: Introduction, Simple plots, Line API, Legend API, Figures, Subplots. **Pandas:** Look Ups, Selections and Indexing, Filling Methods, Series operation, Handling NaN values, Mapping, Data Frames, Reading Files, Plotting, Joins, Correlation, Histograms, Rolling calculation.	6
	Total	24

Text Books:

1. Allen B Downey, ―Think PYTHON‖, O'Rielly, ISBN: 13:978-93-5023-863-9, 4th Indian Reprint 2015

2. Peng, Roger D and Elizabeth Matsui, ―The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162

Reference Books:

1. Zed A. Shaw,Learn Python the Hard Way

Program:	M.Tech (Computer Engineering)				Semester : I	
Course :	Software Engineering Basics				Code : MCE1601B	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:- None

Objectives:

1. To learn and understand the principles of Software Engineering
2. To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
3. To apply Design and Testing principles to S/W project development.
4. To understand project management through life cycle of the project.
5. To understand software quality attributes.

Outcomes:

After learning the course the students should be able to:

1. Decide on a process model for a developing a software project
2. Classify software applications and Identify unique features of various domains
3. Design test cases of a software system.
4. Understand basics of IT Project management.
5. Plan, schedule and execute a project considering the risk management.
6. Apply quality attributes in software development life cycle.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction to Software Engineering and Software Process Models:** Software Engineering Fundamentals: Nature of Software, Software Engineering Principles, The Software Process, Software Myths. Process Models :A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process(RAD), Evolutionary Process, Unified Process, Concurrent. Advanced Process Models & Tools: Agile software development: Agile methods, Plan-driven and agile development.	6
2.	**Software Requirements Engineering and Analysis:** Requirements Engineering: User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. Software Requirements Specification (SRS): The software requirements Specification document, The structure of SRS, Ways of writing a SRS, Requirements elicitation & Analysis: Process, Requirements validation, Requirements management.	6
3.	**Design Engineering:** Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation	6
4.	**Project Risk Management:** Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, The RMMM plan for case study project	6
	Total	24

Text Books:

1. Roger Pressman, ―Software Engineering: A Practitioner ‘s Approach‖, McGraw Hill, ISBN 0–07–337597

2. Ian Sommerville, ― Software Engineering‖, Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Carlo Ghezzi, ―Fundamentals of Software Engineering", Prentice Hall India, ISBN-10: 0133056996
2. Rajib Mall, ―Fundamentals of Software Engineering‖, Prentice Hall India, ISBN-13: 978- 8120348981
3. Pankaj Jalote, ―An Integrated Approach to Software Engineering‖, Springer, ISBN 13: 9788173192715.
4. S K Chang, ―Handbook of Software Engineering and Knowledge Engineering‖, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, ―Handbook of Software Engineering‖, Clanye International, ISBN10: 1632402939
6.Christine Bresnahan, Richard Blum –Linux command line and Shell Scripting Bible -Weilly , ISBN-978-0-470-25128-7

Program:	M.Tech (Computer Engineering)			Semester : I		
Course :	Basics of Machine Learning			Code : MCE1601C		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:

1.Linear Algebra, Statistics, Probability and Calculus

2. Basic Programming Skills

Objectives:

1. To master the concepts of supervised and unsupervised learning, recommendation engine, and time series modeling
2. To gain practical knowledge over principles, algorithms, and applications of Machine Learning through a hands-on approach and to validate Machine Learning models and decode various accuracy metrics. Improve the final models using another set of optimization algorithms, which include Boosting & Bagging techniques
3. To acquire thorough knowledge of the statistical and heuristic aspects of Machine Learning and To comprehend the theoretical concepts and how they relate to the practical aspects of Machine Learning.
4. 4.To implement models such as support vector machines, kernel SVM, naive Bayes, decision tree classifier, random forest classifier, logistic regression, K-means clustering

Outcomes:

After learning the course the students should be able to:

1. Understand machine learning techniques and computing environment that are suitable for the applications under consideration.
2. Solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
3. Develop scaling up machine learning techniques and associated computing techniques and technologies for various applications.
4. Implement various ways of selecting suitable model parameters for different machine learning techniques.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Foundations for Machine Learning [ML]:** ML Techniques overview: Supervised; Unsupervised, Reinforcement Learning,Validation Techniques (Cross-Validations)**;**Feature Reduction/Dimensionality reduction;Principal components analysis (Eigen values, Eigen vectors, Orthogonality)	6
2.	**Clustering:** Distance measures;Different clustering methods (Distance, Density, Hierarchical); Iterative distance-based clustering; Dealing with continuous, categorical values in K-Means; Constructing a hierarchical cluster; K-Medoids, k-Mode and density-based clustering; Measures of quality of clustering	6
3.	**Classification: Naïve Bayes Classifier** Model Assumptions; Probability estimation; Required data processing; M-estimates;, Feature selection: Mutual information;Classifier **K-Nearest Neighbors:** K-Nearest Neighbor algorithm; Aspects to consider while designing K-Nearest Neighbor Support Vector Machines;SVM for classification and regression problems.	6
4.	**Association Rule mining:** The applications of Association Rule Mining: Market Basket, Recommendation Engines, etc. ; A mathematical model for association analysis; Large item sets; Association Rules; Apriori: Constructs large item sets with mini sup by iterations; Interestingness of discovered association rules; Application examples; Association analysis vs. classification ; FP-trees	6

	Research Aspects: Application of ML in various domains-Research Paper Publication in Quality Indexed International Journals/ Conferences;Practical Implementation of Industry Projects/Applications**;** IPR	
	Total	**24**

Text Books:

1. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
2. Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning

Program:	M.Tech (Computer Engineering)			Semester : II		
Course :	Image Processing with MATLAB			Code : MCE2602A		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite: Programming Basics

Objectives:

1. Develop an overview of the field of image processing.
2. Cover the basic theory and algorithms that are widely used in digital image processing.
3. Develop hands-on experience in using computers to process images.
4. Familiarize with MATLAB Image Processing Toolbox Course

Outcomes: After learning the course the students should be able to:

1: Understand the need for image transforms different types of image transforms and their properties.

2: Learn different techniques employed for the enhancement of images.

3: Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.

4: Learn different feature extraction techniques for image analysis and recognition.

5: Develop any image processing application.

Detailed Syllabus:

Unit	Description	Duration h
2.	**Introduction:** What is image processing?, What are the fundamental issues? , What is the role of perception? Image sampling and quantization, Basic relationship between pixels, MATLAB orientations. **Image Transformations** Discrete Fourier transform, Properties of 2D DFT, FFT, Convolution, Correlation, Discrete cosine transform, Discrete Wavelet transform.	6
2.	**Image Enhancement Techniques** Spatial Domain Techniques: Basic gray level transformations, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing filters, Sharpening filters. Frequency Domain Techniques: Frequency domain filtering, Image smoothing and Image sharpening using frequency domain filters.	6
3.	**Color image processing:** Color fundamentals, Color models, Color transformation, Smoothing and Sharpening **Image Compression:** Fundamentals, Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Huffman coding, Arithmetic coding, Golomb coding, LZW coding, Block transform coding, Run-length coding, JPEG Lossless predictive coding, Lossy predictive coding, Wavelet coding.	6
4.	**Morphological Image processing:** Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Hole filling, Connected components, Convex hull, Thinning, Thickening, Skeletons, Pruning. **Image Segmentation and Representation:** Point, Line and Edge detection, Edge linking and Boundary detection, Thresholding, Basic global tresholding, Otsu's method, Region based segmentation, Use of motion in segmentation	6
	Total	24

Text Books:

1. R. C.Gonzalez, R.E.Woods," Digital Image processing", Pearson edition, Inc3/e,2008.
2. A.K.Jain," Fundamentals of Digital Image Processing", PHI,1995

Reference Books:

1. J.C. Russ," The Image Processing Handbook", (5/e), CRC, 2006
2. R.C.Gonzalez & R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003
3.W. K. Pratt, *Digital Image Processing,* John Wiley & Sons, 2006.
4.S. Ahmed, *Image Processing,* McGraw -Hill, 1994.
5.S. J. Solari, *Digital Video and Audio Compression,* McGraw-Hill, 1997

Program: M.Tech (Computer Engineering)					Semester : II	
Course : Linux Essentials					Code: MCE2602B	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:

Objectives:

1.To acquire knowledge of basic Linux OS, commands, and terminologies

2.To develop programs using Shell scripting

3. To acquire skills related to Linux file system

Outcomes: After learning the course the students should be able to:

1. Use common and simple Linux commands
2. Demonstrate programming ability using Unix Shell
3. Develop collaboratively using GIT and write research-papers using LaTex
4. Apply a solution clearly and accurately in Linux environment

Detailed Syllabus:

Unit	Description	Duration h
3.	**Introduction to Linux:**Linux introduction; Understanding philosophy of Linux; Understanding Software Licensing and Linux Distributions; Architecture of Linux OS; Installation of Linux OS (direct and using virtual machine); Using common Linux programs: Linux desktop environment, working with different productivity software; Understanding and managing hardware: CPU, Disk issues, Device drivers, Display etc.;	6
2.	**Basic Commands and Shell Scripting:** Introduction to Linux commands, concept of shell, shell variables,getcwd() and pwd; Introduction to shell programming features: Variables declaration & scope,test, return value of a program, if-else and useful examples, for and while loop, switch case; Shell functions, pipe and redirection, wildcards, escape characters; Awk script: Environment andworkflow, syntax, variables, operators, regular expressions, arrays, control flows, loops,functions, output redirections	6
3.	**Linux File System and Networking:** File System - Manipulating Files: creating, deleting, copying, moving, renamingetc; Using absolute and relative path; Manipulating Directories: Creating, Deleting and Managing; Basic File and Directory commands; Understanding Linux file system; Networking - Understanding network features; Configuring a network connection; Testing a network connection;	6
4.	**Essential System Administration** **Users and Group Management:** Users and Group management: Creation, Updating, Deletion of user and group; Commands –shadow, useradd, usermod, userdel, groupadd, groupmod, groupdeletc; Managing ownership and permission. **Process and PackageManagement:** Understanding package management,package management commands like rpm, yum, apt; Understanding Process hierarchy and identifying running processes; Log files. **Or** **Introduction to GIT and LaTEX:** LaTEX:Basic syntax, compiling and creating documents; Document structure including sections and paragraphs; Adding Images, Table ofcontents, Source code, graphs; Adding references, and Bibliography; Installation and Hands-on of LaTEX. GIT: Creating a project using GIT locally, add, commit; Branch and Merge; Cloning a remote repo, working with a remote repo; Working on a project in a distributed fashion; Hands-on of GIT.	6
	Total	24

Text Books: 1. Christine Bresnahan, Richard Blum ―Linux Essentials, Sybex, ISBN 9781119092063 2. Sumitava Das, Unix Concepts and Applications, Tata-McGraw Hill, ISBN 0-07-063546-3
Reference Books: 1.Christine Bresnahan, Richard Blum –Linux command line and Shell Scripting Bible -Weilly , ISBN-978-0-470-25128-7

Program:	M.Tech (Computer Engineering)				Semester : II	
Course :	Design with UML				Code : MCE2602C	
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	--	30	50

Pre-requisite:
.Basic understanding of computer programming and related programming paradigms.

Objectives:

1. To introduce the concept of Object-oriented design
2. To understand and differentiate Unified Process from other approaches
3. To design static and dynamic UML diagrams

Outcomes:
After learning the course the students should be able to:

1. Understand Basic features and elements of the object-oriented approach
2. Identify, analyze, and model structural and behavioral concepts of the system.
3. Apply the concepts of architectural design for deploying the code for software.

Detailed Syllabus:

Unit	Description	Duration h
1.	Introduction to UML: Importance of modeling, principles of modeling, object-oriented modeling, conceptual model of the UML, Architecture, Software Development Life Cycle	6
2.	Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. Class & Object Diagrams	6
3.	Basic and Advanced Behavioral Modeling: Interactions, Interaction diagrams. Use cases, Use case Diagrams, Activity Diagrams. Advanced Behavioral Modeling Events and signals, state machines, processes and Threads, time and space, state chart diagrams.	6
4.	Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams. Common modeling techniques	6
	Total	**24**

Text Books:

1. Grady Booch, - The unified modeling language user guide. Pearson Education India, ISBN: 0-201-57168
2. James Rumbaugh. Micheal Blaha- Object-Oriented Modeling and Design with UML: Pearson Education India, ISBN-13: 978-0130159205

Reference Books:

2. Charles Ritcher - Designing Flexible Object-Oriented systems with UML. New Riders Publishing.
3. Jackson, Burd Thomson - Object Oriented Analysis & Design. Thomson Course Technology.
4. Mike O'Docherty - Object-Oriented Analysis and Design: using UML. Wiley Publication
5. Joseph Schmuilers - Teach Yourself UML in 24 Hours. Sams publishing.

Program:	M. Tech. (Information Technology)			Semester : I			
Course :	Business Analytics			Code : MEIT1601A			
Teaching Scheme			Evaluation Scheme				
Lecture	Hours	Credit	IE 1	IE 2		ETE	Total
2	2	2	20	-		30	50

Pre-requisite: 1. Machine Learning; 2. Data Science

Objectives:

1. Understand the different basic concept / fundamentals of business statistics
2. Understand the concept of Probability and its usage in various business applications.
3. Understand the practical application of Descriptive and Inferential Statistics concepts and their uses for Business Analytics.
4. Evaluate different data analytics tools.

Outcomes:

After learning the course, the students should be able to:

1. Gaining Knowledge of basic concept / fundamentals of business analytics.
2. Evaluating basic concepts of probability and perform probability theoretical distributions.
3. To perform practical application by taking managerial decision and evaluating the Concept of Business Analytics.
4. Evaluate different tools.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction** What is business analytics?, Business Analytics process: problem framing, Data modeling, model building, Deployment, Different types of business analytics, application of business analytics, current trends, roles within data analytics team.	**6**
2.	**Analytics Techniques** Optimization techniques: Linear Programming, Goal Programming, Integer Programming, Non –linear programming, Predictive modeling :- regression, multiple linear regression for predictive analysis, logistic regression, linear discriminant analysis, Data Mining: Introduction to supervised and unsupervised learning, clustering	**6**
3.	**Probability Theory & Distribution** Probability: Theory of Probability, Addition and Multiplication Law, Baye's Theorem Probability Theoretical Distributions: Concept and application of Binomial; Poisson and Normal distributions. Concept of Business Analytics- Meaning types and application of Business Analytics, Use of Spread Sheet to analyze data-Descriptive analytics and Predictive analytics	**6**
4.	**Data analytics tools** Data Visualization using Tableau/Python/R/SQL. Case study.	**6**
	Total	**24**

Text Books:

1. R.N. Prasad ,Seema Acharya, "Fundamentals of business analytics", Wiley

Reference Books:

1. James Evans, Business Analytics, 2nd Edition, Pearson

Program:	M. Tech. (Information Technology)			Semester : I		
Course :	R Programming			Code : MEIT1601B		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	-	30	50

Pre-requisite:
1. Knowledge of Statistics in Mathematics
2. Prior Knowledge of any programming

Objectives:
1. To use R and R Studio Environment
2. To understand different data types and control structures in R
3. To interface R with other languages.
4. To understand the use of R for Big Data analytics.

Outcomes:
After learning the course, the students should be able to:
1. Understand the basics in R programming in terms of constructs, control statements, string functions.
2. Apply the use of R for Big Data analytics.
3. Learn to apply R programming for Text processing.
4. Able to appreciate and apply the R programming from a statistical perspective.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Getting Started with R Programming** Introduction to the R-Studio, user-interface, Basic commands, Data Structures in R, Reading data into R, Subsetting	6
2.	**Matrices, Arrays And Lists** Creating matrices ,Matrix operations ,Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, Vector/Matrix Distinction, Avoiding Dimension Reduction, Higher Dimensional arrays, Lists, Creating lists, General list operations,– Accessing list components and values, Applying functions to lists, Recursive lists	6
3.	**Data Frames** Creating Data Frames, Matrix-like operations in frames, Merging Data Frames, Applying functions to Data frames, Factors and Tables: factors and levels, Common functions used with factors, Working with tables, Other factors and table related functions, Control statements: Arithmetic and Boolean operators and values, Default values for arguments, Returning Boolean values, Environment and Scope issues: Writing Upstairs - Recursion ,Replacement functions, Tools for composing function code, Math and Simulations in R	6
4.	**Interfacing** Interfacing R to other languages, Parallel R, Basic Statistics, Linear Model, Generalized Linear models, Non-linear models, Time Series and Auto-correlation – Clustering	6
	Total	24

Text Books:
1. Mark Gardener, Beginning R – The Statistical Programming Language, Wiley, 2013
2. Norman Matloff , The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, 2011

Reference Books:
1. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Addison-Wesley Data & Analytics Series, 2013
2. Robert Knell, Introductory R: A Beginner's Guide to Data Visualization, Statistical Analysis and Programming in R, Amazon Digital South Asia Services Inc, 2013.

Program:	M. Tech. (Information Technology)			Semester : I		
Course :	Cost Management of Engineering Project			Code : MEIT1601C		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	-	30	50

Pre-requisite:
1. Software Engineering, 2. Project Management

Objectives:
1. To provide the parties concerned with a most favorable financial outcome to the project.
2. Identifying "best value" project option selection and developing realistic budgets.

Outcomes:
After learning the course, the students should be able to:
1. Prepare favorable financial outcome to the project.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Introduction and Purpose of Project Cost Management** Client, Engineering consultant supporting Client in Development Phase, Engineering (Managing) Contractor carrying out EPCM role for project implementation, Consultant acting as PMC for Client, Material Suppliers, Construction / Service Contractors, External Finance Provider	**6**
2.	**Core Project Cost Management Issues** Project Concept & Feasibility, Project Development & Definition, Project Implementation, Project Commissioning & Financial Close out	**6**
3.	**Estimating and Project Financing** Estimate Categories, Estimate Quality, Project Schedule influence on estimated cost, Estimate Scope, Study / Development Estimates, Estimates for provision of advanced funding, Estimate quality required for project authorization, Estimating techniques, Location factors, Escalation ,Currency fluctuations, Contingency, Cash flow Project Financing: Internal financing, Financing of project development works, External financing, Banks & Venture Funds, Government grants and loans, Contractors, Suppliers, Customers	**6**
4.	**Vulnerable Projects** Mega-projects (Projects with value >€2Bn), Retrofit projects (Modifications and extensions to existing facilities), New Technology projects, Sub-surface works, Projects in emerging markets (e.g. E Europe, Asia), Projects in remote locations, Projects requiring significant regulatory validation (e.g. Pharmaceutical, Nuclear), Contaminated Demolition, Fast Track Projects	**6**
	Total	**24**

Text Books:
1. Kenneth K. Humphreys, Lloyd M. English, "Project and cost engineer's handbook", third edition, Ace International, Marcel Dekkar Inc., New York Basel.

Reference Books:
1. Kenneth K. Humphreys, Lloyd M. English, "Project and cost engineer's handbook", third edition, Ace International, Marcel Dekkar Inc., New York Basel.

Program:	M. Tech. (Information Technology)			Semester : II		
Course :	Cryptography			Code : MEIT2602A		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	-	30	50

Pre-requisite:
1. Basic Mathematics
2. Basic Computer Network.

1. To understand computer, network and information security.
2. To study operating system security and malwares.
3. To study security issues in internet protocols.
4. To study network defense tools.

Outcomes:
After learning the course, the students should be able to:
1. Understand modern concepts related to cryptography and cryptanalysis
2. Analyze and use methods for cryptography and reflect about limits and applicability of these methods
3. Learn details and design philosophy of modern symmetric and public key systems
4. Learn uses and limitations of the various categories of cryptographic algorithms

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction:** Computer Security Concepts, Terminology, OSI Security Architecture, Elements Of Information Security, Security Policy, Types of Security attacks , Security Goals and services, Modular Arithmetic, GCD, Euclidean Algorithm, Fermat's Little Theorem, Euler Totient Function, Extended Euclidean Algorithm, Chinese Remainder Theorem.	6
2.	**Classical Encryption Techniques:** Symmetric Cipher Model, Encryption Methods, Classical Encryption Techniques, Substitution Ciphers, Transposition Ciphers, one-time pad, Cryptanalysis, Block Ciphers, Stream Ciphers	6
3.	**Private-key Encryption:** Block Cipher Principles, Data Encryption Standard (DES), Triple DES, Advanced Encryption Standard (AES), RC5, International Data Encryption Algorithm (IDEA), Differential and Linear cryptanalysis	6
4.	**Public-key cryptosystems:** Public-Key Cryptography, Key Management, Key Distribution, RSA, Timing Attack, Diffie Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography [ECC]	6
	Total	24

Text Books:
1. William Stallings, Computer Security: Principles and Practices, Pearson 6th Ed, ISBN: 978-0-13-335469-0
2. V. K. Pachghare, "Cryptography and Information Security", PHI Learning 3rd edition
3. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography", CRC press

Reference Books:
1. Oded Goldreich, Foundations of Cryptography Basic Tools, Cambridge University Press.
2. Nina Godbole, Information Systems Security, Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6

Program:	M. Tech. (Information Technology)			Semester : II		
Course :	Cloud Computing and Security			Code : MEIT2602B		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	-	30	50

Pre-requisite:
1. Operating Systems
2. Fundamentals of Computer Networks.

Objectives:
1. To become familiar with Cloud Computing and its ecosystem.
2. To learn basics of virtualization and its importance.
3. To give technical overview of Cloud Programming and Services.
4. To understand security issues in cloud computing.

Outcomes:
After learning the course, the students should be able to:
1. To understand the need of Cloud based solutions.
2. To understand Security Mechanisms and issues in various Cloud Applications
3. To explore effective techniques to program Cloud Systems.
4. To understand current challenges and trade-offs in Cloud Computing..

Detailed Syllabus:

Unit	Description	Duration h
1.	**Fundamentals of cloud computing:** Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Intercloud, Types of Clouds. Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology.	6
2.	**Virtualization and common standards in cloud computing:** Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security	6
3.	**Cloud programming, environments and applications: :** Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Understanding Core OpenStack Ecosystem. Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications (Social Networking, E-mail, Office Services, Google Apps, Customer Relationship Management).	6
4.	**Cloud security and issues:** Basic Terms and Concepts, Threat Agents, Cloud Security Threats and Attacks, Additional Considerations, Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Hardened Virtual Server Images. Cloud Issues: Stability, Partner Quality, Longevity, Business Continuity, Service-Level Agreements, Agreeing on the Service of Clouds, Solving Problems, Quality of Service, Regulatory Issues and Accountability.	6
	Total	24

Text Books:

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
2. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition.

Reference Books:

1.Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
2. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
3.Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security, and More, Jones and Bartlett, ISBN :9789380853772.
4. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.
5. Karl Matthias, Sean P. Kane, Docker: Up and Running, OReilly, ISBN:9781491917572, 1491917571.

Program:	M. Tech. (Information Technology)			Semester : II		
Course :	Bitcoin : Fundamentals of Crypto Currencies			Code : MEIT2602C		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
2	2	2	20	-	30	50

Pre-requisite:
1. Basic of Cryptography
2. Basic of Information and Cyber security.

Objectives:
1. To understand the basic concepts behind Cryptography and Crypto currency.
2. To understand the different Consensus approaches for Bit coin.
3. To understand the concepts of blockchain technology.
4. To understand the Mechanics of bit coin.

Outcomes:
After learning the course, the students should be able to:
1. Apply Cryptography concepts to Currency (real time) problem solving.
2. Learn and apply different consensus mechanisms for real time projects based on digital currency.
3. Analyze block chain model come from a different case studies.

Detailed Syllabus:

Unit	Description	Duration h
1.	**Basics** Fundamentals of Crypto currencies : Nodes, Transaction , Wallets, Coin Mining ,Basics of Trading Exchanges ,Market Tradability Crypto Trading Strategies, Blockchain: Nodes, P2P , Ledger ,Consensus Methods Genesis Block	**6**
2.	**How to Store and Use Bit coins** How to Store and Use Bit coins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Market	**6**
3.	**Cryptography:** Cryptographic Hash Functions: Hashing and SHA 256, Digital Signatures, Public Keys , Private Keys, A Simple Crypto currency	**6**
4.	**Mechanics of Bit coin** Bit coin Transactions, Bit coin Scripts, Applications of Bit coin Scripts, Bit coin Blocks, The Bit coin Network, How Bit coin Achieves Decentralization, Centralization vs. Decentralization, Distributed Consensus : Consensus without Identity, The Block chain Incentives, Miners and Mining :Proof of Work ,Limitations & Improvements.	**6**
	Total	**24**

Text Books:
1. Martin Quest, "Block chain Dynamics: A Quick Beginner's Guide on Understanding the Foundations of Bit coin and Other Crypto currencies", Create Space Independent Publishing Platform, 15-May-2018
2. Daniel Drescher, "Block chain Basics", A Non -Technical Introduction in 25 Steps.

Reference Books:
1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Block chain A Beginner's Guide to Building Block chain Solutions", 2018
2. 2**.** Chris Dannen , "Introducing Ethereum and Solidity", Foundations of Crypto currency and Block chain Programming for Beginners

VISION AND MISSION OF CIVIL ENGINEERING DEPARTMENT

Vision

To be recognized as one of the leading department in respect of professional education and innovation in the western region.

Mission

To develop a multidisciplinary approach to relate civil engineering challenges to social and human context through team spirit, right attitude, moral and higher education.

Programme Outcomes

1. An ability to independently carry out research /investigation and development work to solve practical problems in construction.

2. An ability to write and present a substantial technical report/document

3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Programme Specific Outcomes

1. The engineers will be able to apply construction technology and management skills to identify and resolve real time, organizational and technological problems in construction project.
2. The engineers will be able to demonstrate project management skills required for Civil Engineering entrepreneur.
3. The engineer will be able to utilize and develop innovative tools for construction management discipline.

Higher Study Scope: PhD. Research Centre at PCCOE.

Computer Engineering

E&TC Engineering

Mechanical Engineering

Features of PhD Research Centers

- Experienced Research Guides
- Separate Research Laboratories, Library, licensed software, recent hardware and other Facilities
- Good support for Publications.
- Justified and clear evaluation systems
- Defined rules and regulations for evaluation and submission.
- Effective Course work conductions