



**HINDUSTAN**  
INSTITUTE OF TECHNOLOGY & SCIENCE  
(DEEMED TO BE UNIVERSITY)

**DEPARTMENT OF CIVIL ENGINEERING**

**CURRICULUM AND SYLLABUS**

**M. Tech. Structural Engineering and Construction Management**

**DEPARTMENT OF CIVIL ENGINEERING**

**SCHOOL OF BUILDING SCIENCES**

# **M.TECH STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT**

## **PROGRAM EDUCATIONAL OBJECTIVES**

**PEO 1:**The graduates will demonstrate competence in analysis and design principles and adopt new technologies for solving multi-disciplinary problems.

**PEO 2:**The graduates will practice as professional engineers and project managers, achieving sustainability and economic objectives through ethical practices.

**PEO 3:**The graduates will be socially committed researchers and entrepreneurs with an aptitude for knowledge dissemination and lifelong learning.

**PROGRAMME OUTCOMES (POs)**

**1. Scholarship of Knowledge:**

Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

**2. Critical Thinking**

Analyse complex engineering problems critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

**3. Problem Solving**

Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

**4. Research Skill**

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

**5. Usage of modern tools**

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

**6. Collaborative and Multidisciplinary work**

Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

**7. Project Management and Finance**

Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

**8. Communication**

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

### **9. Life-long Learning**

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

### **10. Ethical Practices and Social Responsibility**

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

### **11. Independent and Reflective Learning**

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

**M.TECH. STRUCTURAL ENGINEERING AND CONSTRUCTION  
MANAGEMENT**

**SEMESTER I**

<b>M.TECH – STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT</b>								
<b>(65 CREDIT STRUCTURE)</b>								
<b>SEMESTER - I</b>								
<b>SL. NO</b>	<b>COURSE CATEGORY</b>	<b>COURSE CODE</b>	<b>NAME OF THE COURSE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>TCH</b>
1.	PC	CEA4701	Construction Project Planning & Scheduling	3	1	0	3	4
2.	PC	CEA4702	Project Formulation and Contract Regulations	3	0	0	3	3
3.	PC	CEA4703	Advanced Structural Analysis	3	1	0	3	4
4.	Ele		Elective - I	3	0	0	3	3
5.	Ele		Elective - II	3	0	0	3	3
6.	MLC	ZZZ4715	Research Methodology & IPR	2	0	0	2	2
7.	PC	CEA4791	Construction Software Laboratory	0	0	4	2	4
8.	MLC	CEA4796	Seminar	0	0	3	2	3
<b>Total</b>				<b>17</b>	<b>0</b>	<b>7</b>	<b>21</b>	<b>26</b>
<b>SEMESTER – II</b>								
<b>SL. NO</b>	<b>COURSE CATEGORY</b>	<b>COURSE CODE</b>	<b>NAME OF THE COURSE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>TCH</b>
1	PC	CEA4704	Structural Dynamics And Aseismic Design	3	1	0	3	4
2	PC	CEA4705	Advanced Design of Structures	3	0	3	3	6
3	PC	CEA4706	Material Management and Quality Control	3	0	0	3	4
4	Ele		Elective - III	3	0	0	3	3
5	Ele		Open Elective	3	0	0	3	3
6	PC	CEA4792	Structural Analysis & Design Studio	0	0	4	2	4
7	PC	CEA4781	Mini Project	0	0	3	2	3
<b>Total</b>				<b>15</b>	<b>1</b>	<b>10</b>	<b>19</b>	<b>26</b>

\*One of the course shall be a MOOC. (Same course to all students)

SEMESTER - III								
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	TCH
1	Ele		Elective-IV	3	0	0	3	3
2	MLC	CEA4897	Internship*	0	0	3	2	3
3	MP	CEA4898	Project Work-Phase-I	0	0	24	8	24
<b>Total</b>				<b>3</b>	<b>0</b>	<b>27</b>	<b>13</b>	<b>30</b>
*Internship to be undergone during vacation between 2 <sup>nd</sup> and 3 <sup>rd</sup> semesters								
SEMESTER - IV								
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	TCH
1	MP	CEA4899	Project Work-Phase-II	0	0	24	12	24
<b>Total</b>				<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>	<b>24</b>

**TOTAL CREDITS: (21+19+13+12) = 65 CREDITS**

## LIST OF ELECTIVES

<b>S.No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>TCH</b>
1.	CEA4721	Maintenance and Rehabilitation of Structures	3	0	0	3	3
2.	CEA4722	Green Buildings & Sustainable Construction	3	0	0	3	3
3.	CEA4723	Sensors and Control Devices for Civil Structures	3	0	0	3	3
4.	CEA4724	Structural Health Monitoring	3	0	0	3	3
5.	CEA4725	Numerical Methods applied to Civil Engineering	3	0	0	3	3
6.	CEA4726	Advanced Design of Steel Structures	3	0	0	3	3
7.	CEA4727	Advanced Concrete Technology	3	0	0	3	3
8.	CEA4728	Smart materials and New technologies	3	0	0	3	3
9.	CEA4729	Energy conservation techniques in Building Construction	3	0	0	3	3
10.	CEA4730	Construction Personnel Management	3	0	0	3	3
11.	CEA4731	Shoring, Scaffolding and Formwork	3	0	0	3	3
12.	CEA4732	Industrial Structures	3	0	0	3	3
13.	CEA4733	Design of Bridges	3	0	0	3	3
14.	CEA4734	Stability of Structures	3	0	0	3	3
15.	CEA4735	Design of Tall Structures	3	0	0	3	3
16.	CEA4736	Optimization in Structural Design	3	0	0	3	3
17.	CEA4737	Off Shore Structures	3	0	0	3	3
18.	CEA4738	Prestressed Concrete Structures	3	0	0	3	3
19.	CEA4739	Disaster Management	3	0	0	3	3
20.	CEA4740	Building Acoustics and Noise Control	3	0	0	3	3
21.	CEA4741	Building Services	3	0	0	3	3
22.	CEA4742	Resource Management and Control in Construction	3	0	0	3	3
23.	CEA4743	Forensic Engineering	3	0	0	3	3
24.	CEA4744	Design of Substructures	3	0	0	3	3
25.	CEA4745	System Integration in Construction	3	0	0	3	3
26.	CEA4746	Design of Plates, Shells and Spatial Structures	3	0	0	3	3
27.	CEA4747	Prefabricated Structures	3	0	0	3	3
28.	CEA4748	Project Economics and Financial Management	3	0	0	3	3
29.	CEA4749	Construction Equipment Management	3	0	0	3	3

COURSE TITLE		CONSTRUCTION PROJECT PLANNING AND SCHEDULING		CREDITS	3
COURSE CODE	CEA4701	COURSE CATEGORY	PC	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 3				
CO	COURSE OUTCOMES			PO	
<b>Students will be able to</b>					
1.	Identify the framework of construction industry, project life cycle and parties involved in construction project.			1, 2, 3, 7, 9	
2.	Plan and conduct a feasibility study of site and apply the concepts of planning for the activities of construction projects			1, 2, 3, 7, 9	
3.	Prepare detailed estimates, resource requirements and project cost			1, 2, 3, 7, 9, 10	
4.	Use network techniques like CPM and PERT for planning and scheduling projects.			2, 3, 5, 7, 9	
5.	Apply the concept of Earned Value Analysis and use BIM for monitoring and control of projects			2, 3, 5, 7, 9, 10	
<b>Prerequisites : Nil</b>					
<b>MODULE 1 : CONSTRUCTION PROJECT</b>					<b>(9)</b>
Introduction-Construction industry segments- general building construction, engineering construction, construction industry characteristics – overview of construction project life cycle - different phases –pre project phase- selection of project delivery system, traditional design-tender-build, design-build, the parties and their roles, project manager.					
<b>MODULE 2 : CONSTRUCTION PLANNING</b>					<b>(9)</b>
Introduction – consultant selection, site investigation & selection, land acquisition, preliminary cost estimate, basic concepts in the development of construction plans – Cost and Benefit of Planning – Types of Plan – Planning for Construction – The Planning Process in the project Cycle – The Context of Construction Project Planning - Defining Work Tasks -Defining Precedence relationships among activities - Estimating Activity Durations.					
<b>MODULE 3: COST ESTIMATING</b>					<b>(9)</b>
Estimating process – types of estimates – preparation of detailed estimates for buildings and roads - Cost estimation for item of work – method of structuring project cost - elements of net project cost – labor, material, equipment requirement, sub contract work, provisional and prime cost allowances, site overheads, company overheads.					
<b>MODULE 4 : PROJECT SCHEDULING</b>					<b>(9)</b>
Program planning and scheduling – work breakdown structure, bar chart, network schedules, general concept, computer application, relevance of construction schedules-the critical path method- Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows – concept of PERT.					
<b>MODULE 5: PROJECT MONITORING AND CONTROL</b>					<b>(9)</b>
Monitoring and control- schedule updating-cost control-definition of earned value – importance of earned value analysis – schedule variance, cost variance, scheduled performance index, cost performance index methods of determining earned value. Building Information Modeling – definitions, advantages, levels of information management, development of 4D CADD.					
<i>On completion of the course, the students have to submit a term project report.</i>					

<b>TEXT BOOKS</b>	
1	Chitkara, K.K. "Construction Project Management Planning ", Scheduling and Control, Tata McGraw Hill Publishing Co., New Delhi, 4th edition, 2019.
2	Andrew Baldwin, David Bordoli , "Handbook for Construction Planning and Scheduling", John Wiley & Sons, 2014
3	B.C. Punmia, K.K. Khandelwal (I.A.S.), "Project Planning and Control with PERT and CPM", Laxmi Publications Private Limited, Fourth edition, 2016
<b>REFERENCES BOOKS</b>	
1	Chris Hendrickson and Tung Au, "Project Management for Construction - Fundamentals Concepts for Owners ", Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2	Hira N. Ahuja, S. P. Dozzi, Simaan M. AbouRizk, Project Management- Techniques in Planning and Controlling Construction Projects, 2nd Edition-Wiley, 1994
3	Willis., E.M., " Scheduling Construction projects ", John Wiley and Sons 1986.

COURSE TITLE		PROJECT FORMULATION AND CONTRACT REGULATIONS		CREDITS	3
COURSE CODE	CEA4702	COURSE CATEGORY	PC	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 3, 4, 5				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Identify project financing and costing and apply the principles of cash flow, time value of money and cost of capital in project			1, 2, 3, 7, 9	
2.	Identify the different aspects of project appraisal and examine the various methods of investment appraisal.			1, 2, 3, 7, 9	
3.	Distinguish the different elements and procedures in the preparation of contracts and NCB document.			1, 2, 3, 7, 9, 10	
4.	Explain the various taxes, legal requirement, exercise and customs duties, property laws and statutory regulations.			2, 3, 5, 7, 9	
5.	Compare the characteristics of various infrastructure projects, models and regulatory bodies.			2, 3, 5, 7, 9, 10	
<b>Prerequisites : Nil</b>					
<b>MODULE 1 : PROJECT FORMULATION AND COSTING</b>					<b>(9)</b>
Generation and Screening of Project Ideas-Project Identification-Preliminary Analysis, Market, Technical, Financial, Economic and Ecological-Pre-Feasibility Report, various local approvals and clearances for land and building - Statutory Regulations for town and country planning, development control rules - Detailed Project report. Means of Finance -Key Financial Indicators, Project cash flows- components, basic principles of cash flow estimation, concept of time value of money.					
<b>MODULE 2 : PROJECT APPRAISAL</b>					<b>(9)</b>
Market, Technical, and Environment appraisal, Financial, Economic appraisal - Cost of Capital-cost of production, working capital requirement - Net Present Value-Benefit Cost Ratio-Internal Rate of Return-Accounting Rate of Return- Urgency-payback period-Assessment of Various Methods-Indian and international Practice of Investment Appraisals.					
<b>MODULE 3: CONTRACT LAW AND BIDDING PROCESS</b>					<b>(9)</b>
Introduction to construction law - civil and common law-common delivery methods- Comparison of Actions and Laws- Law Governing Contracts, - Indian contract act - Elements of Contracts- World bank procedure and guideline, National competitive bidding (NCB) document – various clauses, Prequalification-Bidding-Accepting-Evaluation of Tender from Technical, Contractual and commercial points of view – International standard contract document - FIDIC –Other standard forms of construction contracts.					
<b>MODULE 4 : DISPUTE, CLAIM AND ARBITRATION</b>					<b>(9)</b>

Contract and Related Issues-Consequences of Breach of Contract- Potential contractual problems, variations, claims, claim management, construction dispute boards Law of damages and extension of Time-Construction claims and Disputes-Mechanism of dispute Resolution-Agreements, subject Matter-Violations. Arbitration: Laws Related to Construction Arbitration in India-Present Status, opportunities and Challenges-Institutional Arbitration-Promotion of Arbitration-International Arbitration-Training of Arbitrators on Ethics-Appointment of Arbitrators- Conditions of Arbitrations-Powers and duties of Arbitrator-Rules of Evidence-Enforcement of Award Costs-Arbitration and conciliation(Amendment) Act - Insurance and Bonds.

**MODULE 5: CONCEPT OF INFRASTRUCTURE PROJECTS (9)**

Types of project – EPC, Design/Build contracts- Infrastructure development potential as per five year plans, central level and state level development, definition and characteristics of infrastructure projects and project stakeholders, Public Private Partnership – BOT models, model concession agreement, benefits -Technology Transfer and Foreign Collaboration-Scope of Technology Transfer.  
Case studies on Design-Build project contracting.

*On completion of the course, the students have to submit a term project report.*

**TEXT BOOKS**

1	Prasanna Chandra, "Projects-Planning Analysis Selection Implementation & Review 6th Edition", Tata Mc Graw Hill Publishing Co., Ltd., New Delhi., 2006.
2	Jimmie Hinze, "Construction Contracts", 2nd Edition, McGraw Hill, 2001.
3	Gransberg, D.D., Koch, J.A., Molenaar, K.R. "Preparing for design-build projects", ASCE Press, 2006

**REFERENCES BOOKS**

1	Joy.P.K., "Total Project Management - The Indian Context (Chapters 3- 7) ", New Delhi, Macmillan India Ltd., 2006.
2	Lukas Klee, "International Construction Contract Law", Wiley & Sons, 2015 ISBN: 978-1-118-71790-5
3	Arbitration and Conciliation Code, 1996.
4	Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects ", 6th Edition, McGraw Hill, 2000.

<b>COURSE TITLE</b>	<b>ADVANCED STRUCTURAL ANALYSIS</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CEA4703</b>	<b>COURSE CATEGORY</b>	<b>PC</b>	<b>L-T-P</b>	<b>3 -0- 0</b>
<b>CIA</b>	<b>50%</b>			<b>ESE</b>	<b>50%</b>
<b>LEARNING LEVEL</b>	<b>BTL 4, 5</b>				
<b>CO</b>	<b>COURSE OUTCOMES</b>				<b>PO</b>
The Students will be able to					
1	Analyse the structural elements using displacement method.				1,2,3,5,9,10,11
2	Analyse beam and plane frames using MATLAB				1,2,3,9,10,11
3	Analyse Beam and Truss Elements using FEM method.				1,2,3,9,10,11
4	Derive shape functions for various 2-D and 3-D elements				1,2,3,5,9,10,11
5	Derive shape functions for higher order elements.				1,2,3,5,9,10,11
<b>Prerequisites: B.Tech.</b>					
<b>MODULE 1: ANALYSIS OF STRUCTURAL ELEMENTS USING STIFFNESS METHOD</b>					<b>9</b>
Introduction to Matrix Methods - Determinate- Indeterminate Structures-displacement formulation - analysis of continuous beams. Transformation of System Displacement to Element Displacement-Element Stiffness to System Stiffness-Transformation of Forces and Displacements -analysis of rigid plane frames.-3D rigid frames					
<b>MODULE 2: ANALYSIS OF STRUCTURES USING MATLAB</b>					<b>9</b>
Programming techniques – Analysis of Beams and plane frames using MAT LAB and evaluate with classical methods.					
<b>MODULE 3 : MATHEMATICAL FOUNDATIONS OF FINITE ELEMENT METHOD</b>					<b>9</b>
Historical background - Influence of Computer Development on Computational Mechanics – Approximate Solution - Discretization of Continuum Structures - Characterization of 1D, 2D and 3D problems based on Aspect ratio - Strain - displacement, Stress-strain and equilibrium equations - Constitutive Matrix - Concept of a finite element - Shape Function - Derivation of element stiffness equation - Illustration through application to bar, beam and truss problems - Temperature effects - p and h mesh refinement - Adaptive refinement.					
<b>MODULE 4: TWO AND THREE DIMENSIONAL SIMPLEX ELEMENTS</b>					<b>9</b>
Plane Stress, Plane Strain and Axi-symmetric Problems - CST element - Derivation of Shape Function - Various loading conditions like body force, surface force and temperature change - Tetrahedron element - Introduction to Plate and Shell elements.					
<b>MODULE 5: HIGHER ORDER ELEMENTS AND ISOPARAMETRIC MAPPING</b>					<b>9</b>
Need for higher order elements - Generation of shape functions - Lagrange interpolation - QUAD4, QUAD8 and QUAD9 elements for 2D problems - BRICK8 element for 3D problems - Isoperimetric Mapping - Gauss quadrature.					
<i>On completion of the course, the students have to submit a term project report.</i>					
<b>TEXT BOOKS</b>					
1	Devdas Menon., “Advanced Structural Analysis”, Narosa Publishing House, New Delhi,2009				
2	Pandit G.S. and Gupta S.P., “Structural Analysis-A Matrix Approach”, Tata McGraw-Hill Publishing Company Limited, New Delhi				

4	Chandraputla T.R. and Belegundu A.D., Introduction to Finite Element Analysis in Engineering. Pearson Education 2012 , 4th Edition.
5	Reddy J.N. An Introduction to Finite Element Method. McGraw Hill International student Edition (2006).
<b>REFERENCES BOOKS</b>	
1	Madhujit Mukhopadhyay, Abdul Hamied Sheikh, Matrix and Finite Element Analyses of Structures, Anne Books, First Edition, 2004
2	Damodar Maity, Computer Analysis of framed Structures, I.K. International Publishing house Pvt. Ltd, 2007.
3	Matrix Analysis of Framed Structures - Jr. William Weaver & James M. Gere, CBS Publishers and Distributors, Delhi.
4	O.C. Zienkiewicz and R.L. Taylor. The Finite Element Method. Vol.I. Butterworth Heinemann, 5th Edition, 2000.
5	Robert D. Cook, David S. Malkus and Michael E. Plesha. Concepts and Application of Finite Element Analysis. 4th edition, Wiley, 2007.

COURSE TITLE		RESEARCH METHODOLOGY & IPR		CREDITS	2	
COURSE CODE		ZZZ4715	COURSE CATEGORY	MLC	L-T-P	2-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES			PO		
<b>Students will be able to</b>						
1.	Identify research problems and formulate the methodology.			1,2,3,4,6		
2.	Prepare effective research report based on literature.			1,2,3,4,6,7		
3.	Adopt suitable sampling techniques to analyse data and interpretation of results.			1,2,3,4,6,9		
4.	Utilize the knowledge gained on IPR and apply for innovative ideas and products.			1,2,3,4,9,10, 11		
5.	Utilize the knowledge gained on patent rights for licencing and transfer of technology with new developments in IPR			1,2,3,4,5		
<b>Prerequisites : Nil</b>						
<b>MODULE 1 : RESEARCH PROBLEM FORMULATION</b>					<b>(6)</b>	
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations						
<b>MODULE 2 : RESEARCH PROPOSAL AND ETHICS</b>					<b>(6)</b>	
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.						
<b>MODULE 3 : DATA ANALYSIS AND INTERPRETATION</b>					<b>(6)</b>	
Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.						
<b>MODULE 4 : NATURE OF INTELLECTUAL PROPERTY</b>					<b>(6)</b>	
Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.						
<b>MODULE 5 : PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR</b>					<b>(6)</b>	
Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.						
<b>REFERENCES BOOKS</b>						
1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", 1996.					
2	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", 2004.					
3	Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners", SAGE, 2005.					
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.					
5	Mayall , "Industrial Design", McGraw Hill, 1992.					

6	Niebel , “Product Design”, McGraw Hill, 1974.
7	Asimov, “Introduction to Design”, Prentice Hall, 1962.
8	Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9	T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008
10	C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International, 2004.
11	International publishers, Third Edition. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005
12	Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition, 2006
13	Creswell, John W. Research design: Qualitative, quantitative, and mixed methods, approaches. Sage publications, 2013

COURSE TITLE		CONSTRUCTION SOFTWARE LABORATORY		CREDITS	3	
COURSE CODE		CEA4791	COURSE CATEGORY	PC	L-T-P	0-0-3
CIA		60%		ESE	40%	
LEARNING LEVEL		BTL-3				
CO	COURSE OUTCOMES			PO		
Students will be able to						
1.	Students will be aware of estimation of budgeted cost for multistoried building			1, 2, 3, 7, 9		
2	Students will be able to apply principles of valuation and rent calculation of a building.			1, 2, 3, 7, 9		
3	Students will be able to evaluate bids and use MS Excel to prepare supporting documents for the execution of project			1, 2, 3, 7, 9, 10		
4.	Students will learn about Primavera and apply methods of scheduling using network techniques for civil engineering projects.			2, 3, 5, 7, 9		
5.	Students can apply knowledge of resource allocation and calculation of Budgeted Cost in construction projects.			2, 3, 5, 7, 9, 10		
<b>Prerequisites : Nil</b>						
LIST OF EXPERIMENTS						
1.	Preliminary Cost Estimation of Multistoried building					
2.	Detailed Cost Estimation, Material and labour requirement for multistoried building using MS Excel					
3.	Valuation and Rent calculation of Building					
4.	Preparation of Bill of quantities, comparative statement and completion report using MS Excel.					
5.	Evaluation of Bid and report preparation for construction works					
6.	Learn about Primavera					
7.	Scheduling-Network Diagram					
8.	Resource allocation-Calculation of budgeted cost					
9.	Estimation of Budgeted cost for Multistoried building					
10.	Building Information Modelling (BIM) software in project management					
SOFTWARE REQUIRED						
1	MS Excel					
2	Primavera Software					
3	Bentley BIM software					

COURSE TITLE		SEMINAR		CREDITS	2
COURSE CODE	CEA4796	COURSE CATEGORY	MLC	L-T-P	0-0-3
CIA	-			ESE	100%
LEARNING LEVEL	BTL4				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Independently study and investigate current research areas and share ideas while actively participating in presentation			4, 6,7,8	
2.	Develop writing skills and prepare reports			4, 6,7,8	
3.	Present and defend their research at seminars and conferences			4, 6,7,8	
<b>Prerequisites : Nil</b>					
<p>This work should consist of soft bound report on any technical topic of interest associated with the post graduate course and should be submitted in a standard format having the following contents.</p> <ul style="list-style-type: none"> <li>(i) Introduction</li> <li>(ii) Literature survey</li> <li>(iii) Theoretical contents</li> <li>(iv) Field applications, case studies</li> <li>(v) Relevance to the present national and global scenario of construction industry</li> <li>(vi) Strength and weaknesses of the particular area of seminar</li> <li>(vii) R &amp; D in the particular area</li> <li>(viii) Benefit cost studies – feasibility studies</li> <li>(ix) Vendors associated</li> <li>(x) Conclusions</li> <li>(xi) References</li> </ul> <p>Students should prepare a power point presentation to be delivered in fifteen minutes and should be able to answer questions asked in remaining five minutes. Where ever possible, the topic for the seminar may be decided on the mini project or the main project work to be done in semester II, III. The students will be evaluated through an end semester examination by a team of internal staff.</p>					

## SEMESTER II

COURSE TITLE		STRUCTURAL DYNAMICS AND ASEISMIC DESIGN		CREDITS	3	
COURSE CODE		CEA4704	COURSE CATEGORY	PC	L-T-P	3 -1- 0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 4, 5, 6				
C O	COURSE OUTCOMES			PO		
The Students will be able to						
1	Distinguish between the behaviour of static and dynamic analysis and Analyse SDOF systems			1,2,3,4,5,9		
2	Analyse MDOF systems			1,2,3,4,5,9		
3	Describe the response of structures subjected to Earthquake.			1,2,3,4,5,9		
4	Design reinforced concrete structures using the codal provisions.			1,2,3,4,5,9		
5	Design earthquake resistant structures, masonry structures, bridges and dams for earthquake and adopt appropriate vibration control techniques.			1,2,3,4,5,9		
<b>Prerequisites: Nil</b>						
<b>MODULE 1: INTRODUCTION TO DYNAMICS</b>					<b>(9L+3P)</b>	
Structural dynamics – free vibration – forced vibration – SDOF – Response of SDOF systems – Response to general dynamic loading – Duhamel’s Integral – Response to earthquake loading – Response spectrum.						
<b>MODULE 2: FREE AND FORCED VIBRATION OF MULTIPLE DEGREES OF FREEDOM SYSTEM</b>					<b>9</b>	
MDOF s/m – free vibration – forced vibration – earthquake response - Nonlinear method of analysis - Wilson- $\theta$ Method - Newmark-beta method - Response of MDF systems to support motion						
<b>MODULE 3: RESPONSE OF STRUCTURES TO EARTHQUAKE</b>					<b>9</b>	
Building Systems - Rigid Frames, Braced Frames, Shear Walls - Behaviour of RC, steel and prestressed concrete elements under cyclic loading - Soil performance						
<b>MODULE 4: EARTHQUAKE RESISTANT DESIGN &amp; CODE PROVISIONS</b>					<b>9</b>	
Concept of Earthquake Resistant Design - Provisions of Seismic Code IS 1893 (Part I) - 2002 - Response Spectrum - Design Spectrum - Structural Configuration - 3 D computer analysis of building (Theory) - Design and Detailing of Frames, Shear Walls and Framed Walls - Provisions of IS-13920.						
<b>MODULE 5: DESIGN PROVISIONS AND VIBRATION CONTROL</b>					<b>9</b>	
Design of Non-Engineered construction - strengthening of buildings - Design Provisions for Bridges and Dams. Modern Concepts - Base Isolation - Adoptive systems - Case studies.						
<i>On completion of the course, the students have to submit a term project report.</i>						
<b>TEXT BOOKS</b>						
1	Madhujit Mukhopadhyay, Structural Dynamics - Vibrations & Systems, Ane Books India.					
2	Mario Paz, William Leigh, " Structural Dynamics Theory and Computation", Springer - 2004.					

3	Pankaj Agarwal, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2006
4	S.R.Damodarasamy, S.Kavitha "Basics of Structural dynamics and Aseismic Design", PHT Learning Private Limited., 2009
<b>REFERENCE BOOKS</b>	
1	S.R.Damodarasamy, S.Kavitha "Basics of Structural dynamics and Aseismic Design", PHI Learning Private Limited., 2009.
2	Clough R.W. and Penzien, J., Dynamics of Structures, McGraw-Hill, 1993
3	Anil K.Chopra, "Dynamics of Structures Theory and Applications to Earthquake Engineering" Pearson Education., 2009.
4	Anil K Chopra, "Dynamics of structures - Theory and applications to Earthquake Engineering", Prentice Hall Inc., 2001.
5	Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw-Hill Book Company, New York, 1986.
6	Muhammad Hadi (Author), Mehmet Eren Uz (Author) Earthquake Resistant Design of Buildings, Taylor and Francis, 2017.

COURSE TITLE		ADVANCED DESIGN OF STRUCTURES		CREDITS	3	
COURSE CODE		CEA4705	COURSE CATEGORY	PC	L:T:P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 3, 4,5,6				
CO	COURSE OUTCOMES				PO	
<b>The Students will be able to</b>						
1	Identify the philosophy involved in the limit state design of steel concrete composite structures.				1,2,3,4,9,10	
2	Design the steel concrete composite beams with deck slabs				1,2,3,4,9,10	
3	Design the steel concrete composite columns and trusses				1,2,3,4,9,10	
4	Assess the behaviour of composite box girders.				1,2,3,4,9,10	
5	Assess the seismic behavior of composite structures.				,2,3,4,9,10	
<b>Prerequisites :</b>						
<b>MODULE 1: INTRODUCTION</b>					<b>9</b>	
Review of Limit State Design of steel columns and beams - Introduction to steel concrete composite structures - concepts and Theory – Typical shear connectors and interaction with concrete - Tests for strength of shear connections. Limit state design of steel concrete composite construction. Comparison of EC4 and IS Codes.						
<b>MODULE 2 :DESIGN OF COMPOSITE BEAMS</b>					<b>9</b>	
Behaviour of simply supported and continuous steel - concrete composite beams with solid deck slabs and profiled deck slabs.						
<b>MODULE 3: DESIGN OF COMPOSITE TRUSSES AND COLUMNS</b>					<b>9</b>	
Behaviour and design of steel concrete composite Trusses - Shear connection details – Design of Steel concrete columns.-Encased columns, Concrete filled steel tubes.						
<b>MODULE 4 : COMPOSITE BOX GIRDER BRIDGES</b>					<b>9</b>	
Introduction to box girder bridges - behaviour of box girder bridges subjected to shear torsion and distortion-Design concepts. Case Studies						
<b>MODULE 5: GENERAL</b>					<b>9</b>	
Introduction to steel concrete sandwich construction – Case Studies Seismic behavior of composite structures – case studies on steel-concrete composite construction in buildings.						
<i>On completion of the course, the students have to submit a term project report.</i>						
<b>TEXT BOOKS</b>						
1	Johnson R.P., Composite Structures of Steel and Concrete, Blackwell Scientific Publications (Second Edition), UK, 1994.					
<b>REFERENCE BOOKS</b>						
1	"Teaching Resources for Structural Steel Design - Vol. I & II", INSDAG, Kolkatta.					
2	Appropriate IS, British and Euro Codes.					

COURSE TITLE		MATERIAL MANAGEMENT AND QUALITY CONTROL		CREDITS	3
COURSE CODE	CEA4706	COURSE CATEGORY	PC	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 3				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Identify methods of materials classification and norms of selection and purchasing methods.			1, 2, 3, 7, 9	
2.	Describe principles of material procurement, management and disposal			1, 2, 3, 7, 9	
3.	Implement quality systems and standards in the preparation of documents and be aware of the different aspects of cost of quality.			1, 2, 3, 7, 9, 10	
4.	Apply relevant codes and standards, codes of quality, quality policy, methods in construction industry to attain customer satisfaction in projects			2, 3, 5, 7, 9	
5.	Identify and solve problems relating to quality improvement on the way and able to take early decisions to achieve the ultimate aim of the organization.			2, 3, 5, 7, 9, 10	
<b>Prerequisites : Nil</b>					
<b>MODULE 1 : MATERIAL CLASSIFICATION AND PROCUREMENT</b>					<b>(9)</b>
Material Classification –conventional and modern approaches to organizing materials management, Materials identification – classifying of materials – codification of materials – standardization – simplification and variety reduction of materials. Material Purchasing– Norms Of Vendor Rating – CEI Methodology – Material Selection And Development – Purchasing Procedures And Methods – Insurance Of Materials.					
<b>MODULE 2 : MATERIAL STORAGE AND SUPPLY</b>					<b>(9)</b>
Storing of Materials – methods of storing – safety and security of materials – store equipment – materials handling equipment – factors affecting materials handling. Supply Management – Sources of Supply – Out Sourcing Material Management - Procurement Planning - Functions of Material Management - Inventory Control. Management of surplus, obsolete and scrap materials – reasons for accumulation – methods of disposal – regulations and procedures.					
<b>MODULE 3: QUALITY MANAGEMENT &amp; SYSTEMS</b>					<b>(9)</b>
Definition of quality - Quality system standard- ISO family of standards and structure Requirement- Preparing quality systems Documents- Quality related training - Quality circles and Improvement Teams- Construction Team- Owner, engineers, Architect, Contractors. Inspection procedures for construction processes and products - Total QA/QC Programme- Cost of Quality - Implementing Quality system- Third party certification. Quality Policy, Objectives and methods in construction Industry - Factors influencing construction Quality -					
<b>MODULE 4: QUALITY ASSURANCE AND CONTROL</b>					<b>(9)</b>
Definitions and Objectives - Techniques and needs of QA/QC- Regulatory agent, Contract and Construction oriented objectives and methods- Technical Control and Financial Control - Different aspects of quality – Appraisals – organizing for quality and safety, Quality control by statistical methods, statistical quality control with sampling by attributes and variables – Quality control register, Quality control for concrete durability – Prescriptive specification.					

<b>MODULE 5: QUALITY IMPROVEMENT (9)</b>	
Selection of Construction materials -Influence of drawings, detailing, work and material specifications – IS codes, Standardization-Bid preparation-Construction activity-Environmental safety, Social and Environmental factors -Natural causes and speed of construction- Life cycle costing- Value Engineering and value analysis.	
<i>On completion of the course, the students have to submit a term project report.</i>	
<b>TEXT BOOKS</b>	
1	Datta .A.K, “Materials Management: Procedures, Text and Cases”, PHI Learning Pvt. Ltd., 2004.
2	Arnold, “Introduction To Materials Management”, Pearson Education India,2009
3	James, J.O Brian, "Construction Inspection Handbook - Quality Assurance and Quality Control", Van Nostrand, New York, 1989.
<b>REFERENCES BOOKS</b>	
1	Gopalakrishnan .P, “Handbook of Materials Management”, PHI Learning Pvt. Ltd. 2004
2	Clarkson H. Oglesby, "Productivity Improvement in Construction ", McGraw Hill, digitized on 2007.
3	Abdul Razzak Rumane, “Quality Management in Construction project”, CRC Press, 2011
4	ISO 9000: 2015

COURSE TITLE		STRUCTURAL ANALYSIS & DESIGN STUDIO		CREDITS	2
COURSE CODE	CEA4792	COURSE CATEGORY	PC	L-T-P	0 -0- 4
CIA	80%			ESE	20%
LEARNING LEVEL	BTL 3, 4, 5				
CO	COURSE OUTCOMES			PO	
The students will be able to					
1	Develop computer programmes to solve typical problems in Structural engineering			1,2,3,4,9,10	
2	Use and Compare latest analysis and design tools and software for analysis of structures.			1,2,3,4,5,9, 10,12	
3	Carry out practical design of a typical RC single and multi-storeyed building, overhead water tanks, and ribbed floor systems, and shear walled buildings.			1,2,3,4,5, 9,10	
4	Perform practical design of steel industrial building, steel bridges, and steel towers.			1,2,3,4,5, 9,10	
5	Experiment the structural configuration to optimise the solutions.			1,2,3,4,5, 10,12	
<b>Prerequisites: Nil</b>					
<ol style="list-style-type: none"> <li>1. Introduction to Engineering Software - Introduction to O/S–storage and time optimization - General purpose packages in Civil Engineering – Program Implementation.</li> <li>2. Concrete Structures: <ul style="list-style-type: none"> <li>• Analysis, design and detailing of solid slabs for a residential building</li> <li>• Analysis, design and detailing of beams in a typical intermediate floor of a multi-storey building.</li> <li>• Analysis, design and detailing of circular ring beam supporting an overhead water tank.</li> <li>• Generation of interaction curves for RC rectangular columns.</li> <li>• Design of slender columns subject to biaxial bending.</li> <li>• Analysis, design and detailing of shear walls- considering shear wall-frame interaction in a tall RC structure subject to wind loading.</li> </ul> </li> <li>3. Metal Structures: Design of Steel Industrial Building - Design of Steel Multi-storey – Building. Design of storage structures -Design of towers.</li> </ol>					
<b>REFERENCE BOOKS</b>					
1	Arthur. H. Nilson, David Darwin and Charles W Dolan, Design of Concrete Structures, Tata McGraw Hill, 2004.				
2	Park,R and Paulay T, Reinforced Concrete Structures, John Wiley & Sons, New York, 1975.				
3	Macleod, I.A, Shear Wall Frame Interaction. A design aid with commentary - Portland Cement Association, 1971.				
4	IS 456 :2000, Indian Standard for Plain and Reinforced Concrete- Code of Practice, BIS, New Delhi				

COURSE TITLE		MINI PROJECT		CREDITS	2
COURSE CODE	CEA4781	COURSE CATEGORY	PC	L-T-P	0-0-3
CIA	60%			ESE	40%
LEARNING LEVEL	BTL5				
CO	COURSE OUTCOMES:				PO
The students will be able to:					
1	Identify and work for the real life needs of the society				1,2,3,4,5,6,7,8,9,10,11
2	Provide practical solutions to the societal problem				1,2,3,4,5,6,7,8,9,10,11
3	Realize the importance of Engineering concepts and its relevant application				1,2,3,4,5,6,7,8,9,10,11
Prerequisites: Knowledge on Basic Core courses					
<ul style="list-style-type: none"> <li>Students are expected to design and develop practical solutions to real life problems related to Industry and Research. Modern Software shall be used during the development and for simulation. The theoretical knowledge gained from the subject shall be applied to develop effective solutions.</li> <li>Students shall design experiments for testing of structural components.</li> <li>At the end of the course the student should submit a complete report of the work carried out.</li> </ul>					

COURSE TITLE		INTERNSHIP		CREDITS	2
COURSE CODE	CEA4897	COURSE CATEGORY	MLC	L-T-P	0-0-3
CIA	-			ESE	100%
LEARNING LEVEL	BTL5				
CO	COURSE OUTCOMES				PO
Students will be able to					
1.	Apply knowledge gained from the field work.				1,2,3,4,6,7,8, 9,10,11
2.	Utilise the experience gained from the field for professionalism in business sphere.				1,2,3,4,6,7,8, 9,10,11
3.	Apply the skills gained in solving practical societal problems.				1,2,3,4,6,7,8, 9,10,11
<b>Prerequisites:</b> Nil					
<p>A student has to compulsorily attend Summer internship between second and third semester for a minimum period of two month preferably in an industry. In lieu of Summer internship, the student is permitted to register for project work under a faculty of the Institute and carry out the project for minimum period of two month. This can be a part of the major project. In both the cases, the internship report in the prescribed format duly certified by the faculty in-charge shall be submitted to the HOD. The evaluation will be done through presentation and viva. The course will have a weightage of one or two credits as defined in the respective curriculum.</p>					

COURSE TITLE		PROJECT WORK PHASE-I		CREDITS	8
COURSE CODE	CEA489 8	COURSE CATEGORY	MP	L-T-P	0-0-24
CIA	60%		ESE	40%	
LEARNING LEVEL	BTL 6				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Describe a process that has previously been unexplained, difficult or poorly/partially understood and to conduct an active, systematic process of inquiry			1,2,3,4,5,6,7,8,9, 10,11	
2.	Demonstrate ability to analyse and investigate new or advanced areas of research.			1,2,3,4,5,6,7	
3.	Develop understanding of research philosophies, design terminologies as well as personal transferable skills.			1,2,3,4,5,6,7,8,9,10,11	
4.	Prepare professional documentation of research work carried out.			8	
<b>Prerequisites:</b> Nil					
<p>The primary objective of the course 'Project' is to introduce the students to various sub-fields in Structural Engineering. It is aimed at exposing the students to current development and research activities in the above mentioned fields. The students are also trained to gather in-depth information on specified areas or topics. The students are made proficient to make proper technical documentation on the selected topic. Moreover, the course would also provide training to students to make effective technical presentations</p>					

COURSE TITLE		PROJECT WORK PHASE-II		CREDITS	12
COURSE CODE	CEA4899	COURSE CATEGORY	MP	L-T-P	0-0-24
CIA	70%			ESE	30%
LEARNING LEVEL	BTL 6				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Describe a process that has previously been unexplained, difficult or poorly/ partially understood and to conduct an active, systematic process of inquiry			1,2,3,4,5,6,7,8,9,10,11	
2.	Demonstrate ability to analyse and investigate new or advanced areas of research.			1,2,3,4,5,6,7	
3.	Develop the essential personal, organisational, management, theoretical and research skills to become independent researchers.			6,7,8,9,10,11	
4.	Prepare professional documentation of research work carried out.			8	
<b>Prerequisites : PROJECT PHASE I</b>					
<p>This course is a continuation of the work initiated in third semester and the student is expected to present two reports at intermediate stages, as well as prepare and submit a consolidated report of the work undertaken in the third and fourth semester. The student has to defend the thesis on his research work at the end of the fourth semester.</p>					

## LIST OF ELECTIVES

COURSE TITLE		MAINTENANCE AND REHABILITATION OF STRUCTURES		CREDITS	3	
COURSE CODE		CEA4721	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES			PO		
Students will be able to						
1.	Analyze the influence of different environmental elements, fire and pollution on buildings.			1,2,4,7		
2.	Describe various phases of maintenance and be able to evaluate damaged structures			1,2,3,4		
3.	Identify and describe material used in repair work			1,2,4,9		
4.	Describe various procedures and techniques in repair and rehabilitation			1,2,3,5,9		
5.	Explain strengthening measures and demolition techniques for existing buildings			1,2,3,5,9		
<b>Prerequisites : Nil</b>						
<b>MODULE1:DURABILITY</b>					<b>9</b>	
Life Expectancy of Different Types of Buildings –Influence of Environmental Elements Such as Heat, Moisture, Precipitation and Frost on Buildings- Design and Construction Errors, Corrosion Mechanism- Effect of Biological Agents like fungus, moss, plants, trees, algae, - Termite Control and Prevention - Chemical Attack on Building Materials and Components- Aspects of Fire and Fire Prevention on Buildings- Impact of Pollution on Buildings.						
<b>MODULE 2: PHASES OF MAINTENANCE</b>					<b>9</b>	
Energy and resource Conservation-Design of green Buildings-Evaluation tools for building energy-Embodied and operating energy-Peak demand-Comfort and indoor air quality-Visual and acoustical quality-Land, water and materials-Airborne emissions and Waste management.						
<b>MODULE 3: TECHNIQUES FOR REPAIR</b>					<b>9</b>	
Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.						
<b>MODULE 4: TECHNIQUES FOR REPAIR</b>					<b>9</b>	
Techniques for Repair- Surface repair – material selection – surface preparation - rust eliminators and polymers coating for rebars during repair – repair of cracks in concrete and masonry-methods of repair - mortar repair for cracks -waterproofing of concrete roofs. Guniting and Shotcrete, Epoxy injection, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure.						

Strengthening Measures- Flexural Strengthening, Beam Shear Capacity Strengthening, Column Strengthening, Shoring, Under Pinning and Jacketing Demolition Of Buildings– Introduction – Planning, Precautions And Protective Measures In Demolition Work-Sequence Of Operations- Demolition Of Structural Elements. Engineered Demolition techniques for dilapidated structures - Case studies.

**TEXT BOOKS**

- |    |   |
|----|---|
| 1. | Denison Campbell, Allen and Harold Roper, "Concrete Structures", Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991 |
| 2. | R.T.Allen and S.C.Edwards, "Repair of Concrete Structures", Taylor & Francis, 1993  |

**REFERENCES BOOKS**

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|----|---|
| 1. | M.S. Shetty, "Concrete Technology - Theory and Practice ", S. Chand and Company, New Delhi, 6th Edition, 2005.                                  |
| 2. | Santhakumar, A.R., "Training Course notes on Damage Assessment and repair in Low Cost Housing ", "RHDC-NBO "Anna University, July, 1992.        |
| 3. | Raikar, R.N., "Learning from failures - Deficiencies in Design ", Construction and Service - R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987. |
| 4. | N.Palaniappan, "Estate Management, Anna Institute of Management ", Chennai, 1992.   |
| 5. | Lakshmiathy, Metal Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 - 30th October 1999.                             |

COURSE TITLE		GREEN BUILDINGS & SUSTAINABLE CONSTRUCTION		CREDITS	3
COURSE CODE	CEA4722	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES				PO
Students will be able to					
1.	Assess the environmental and socio-economic impacts of various mega projects.				1,2,3,5,9,10
2.	Describe the laws governing energy, conservation and climate change.				1,4,9
3.	Explain principles of sustainability, energy audits and water conservation				1,3,5,7,9
4.	Identify green building materials and their building codes.				1,3,4,7,9,
5.	Identify Energy efficient projects and be aware of the various methods financing them.				1,7,9
<b>Prerequisites: Nil</b>					
<b>MODULE 1: ENVIRONMENT AND ITS IMPACT</b>					<b>(9)</b>
Concept of environmental and environmental impact factors- area of consideration for mega projects such as airports, highways, power projects, water related projects, 3E's Environmental economics, ethics and ecology of sustainable development. Natural/physical environmental impacts-social impacts, economic impacts – concept of significance effect, commitments of resources. Physical, social, aesthetic and economic environment, type, outline of basic steps in performing the socio economic assessment, fiscal impacts analysis.					
<b>MODULE 2: POLLUTION AND CLIMATE CONTROL</b>					<b>(9)</b>
Rules and regulations & Laws governing Energy, Conservation in India & developed Nations – Energy Conservation Act 2001, Revisions and present state of implementation standardization & Labeling, Electricity Act 2003, Revisions and present status of implementation. United Nations Framework Convention on Climate change(UNFCCC), Protocol, Conference of Parties(COP), Clean Development Mechanism(CDM), Prototype Carbon Funds(PEF), Carbon credits and its trading, Benefits to developing countries.					
<b>MODULE 3: PRINCIPLES OF SUSTAINABILITY AND CONSERVATION OF RESOURCES</b>					<b>(9)</b>
Introduction to Sustainability, Major Environmental Challenges, Global Warming, Sustainable Urban Development. Building energy system strategies, Energy Conservation in Buildings, HVAC Systems, Energy and Atmosphere - LEED Credits, eQuest Energy Simulations, Conducting an Energy Audit, Fossil Fuels vs. Renewable Energy. Water Conservation in Buildings, Storm Water Harvesting and Management, Water cycle strategies.					
<b>MODULE 4: GREEN MATERIAL AND GREEN BUILDING CODES</b>					<b>(9)</b>
Introduction to Green Buildings; LEED, Green Construction Materials, Materials and Resources, Building Deconstruction, C&D Recycling, Indoor Environmental Quality – Basic, IEQ - LEED Credits, Building Commissioning, Materials selection strategies, Green building codes and standards, International Green Construction Code, Carbon accounting, Green Building Specifications.					
<b>MODULE 5: FINANCING OF ENERGY EFFICIENCY PROJECTS</b>					<b>(9)</b>
Energy efficient Projects, Evaluation of energy efficient projects, Various ways of financing Energy efficient projects, Role of Financial Institutions and corporate banks, Deferred Payment					

Financing. Types of energy Performance Contracts, Energy Services Companies (ESCOs), and their role, Emphasis on ESCOs.

#### TEXT BOOKS

1. C.J. Kibert (2008) "Sustainable Construction: Green Building Design and Delivery", 3rd Ed., John Wiley, Hoboken, New Jersey
2. Environmental Monitoring and Characterization by Artiola CBS Publishers 2006.
3. Environmental and Pollution Laws in India by Justice T. S. Doabia, I. P. S. Doabia and M. S, S. Doabia, Second Edition 2010
4. H. Robinson, B. Symonds, B. Ilozor, "Design Economics for the Built Environment – Impact of sustainability on project evaluation", Wiley Blackwell, 2015.  
ISBN: 9780470659090

#### REFERENCES BOOKS

1. G.T. Miller Jr. (2004) "Living in the Environment: Principles, Connections, and Solutions", 14th Ed., Brooks Cole, Pacific Grove, California
2. Environmental Engineering, 4 E by Weiner CBS Publishers 2010.
3. Socioeconomic and Environmental Impacts of Biofuels, by Alexandros Gasparatos and per Stromberg, October 2012.
4. Energy Conservation Building Code (ECBC)
5. Environmental Impact Assessment and Audit by Larry W. Canter Environmental, Tata McGraw Hill.
6. Environmental Pollution and Control, 4th Edition, J. Jeffrey Peirce, P Aarne Vesilind And Ruth Weiner, Nov 1997
7. Financing Energy Efficiency: Forging the link between financing and project implementation-Report prepared by the Joint Research Centre of the European Commission
8. Between Financing And Project Implementation, By Silvia Rezessy And Paolo Bertoldi, Institute Of Energy European Commission, May 2010
9. Public Procurement Of Energy Efficiency Services Lessons From International Experience by Jas Singh, Dilip R. Limaye, Brian Henderson, And Xiaoyu Shi
10. Energy Management Handbook By Steve Doty And Wayne C. Turner, 8th Edition
11. Energy Conservation Act 2001, Electricity Act 2003.

<b>COURSE TITLE</b>	<b>SENSORS AND CONTROL DEVICES FOR CIVIL STRUCTURES</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CEA4723</b>	<b>COURSE CATEGORY</b>	<b>ELE</b>	<b>L-T-P</b>	<b>3 -0- 0</b>
<b>CIA</b>	<b>50%</b>			<b>ESE</b>	<b>50%</b>
<b>LEARNING LEVEL</b>	<b>BTL 3</b>				
<b>CO</b>	<b>COURSE OUTCOMES</b>				<b>PO</b>
The Students will be able to					
1	Demonstrate various types of Sensors and Control Devices.				4,5,10
2	Demonstrate the control devices and its performance.				4,5,10
3	Demonstrate various health monitoring systems.				4,5,10
4	Apply the suitable sensor placement methods.				1,2,3,5,10,11
5	Apply the suitable control device placement methods.				1,2,3,5,10,11
<b>Prerequisites: Nil</b>					
<b>MODULE 1: SENSORS AND SENSORY SYSTEMS</b>					<b>(9)</b>
Wind sensors, Seismic sensors, Load cells, Strain gauges, Displacement sensors, Accelerometers, Fibre-optic sensors, Non-contact sensors, Sensor Performance and sensory systems					
<b>MODULE 2: CONTROL DEVICES AND CONTROL SYSTEMS</b>					<b>(9)</b>
Base isolation devices, Passive energy dissipation devices, Active control devices, Semi-active control devices, Hybrid control devices, Configuration of control systems and control performance.					
<b>MODULE 3: PROCESSORS AND PROCESSING SYSTEMS</b>					<b>(9)</b>
Configuration of health monitoring system, Configuration of a structural vibration control system, Configuration of an integrated health monitoring and vibration control system, Data management system, Structural health evaluation systems.					
<b>MODULE 4: MULTI-TYPE SENSOR PLACEMENT</b>					<b>(9)</b>
Sensor placement methods, Dual-type sensor placement method, Experimental validation, Multi-type sensor placement method.					
<b>MODULE 5: CONTROL DEVICE PLACEMENT</b>					<b>(9)</b>
Control device placement methods, Collective Placement methods for sensors and control devices, Case studies, Determination of configuration of control systems. Structural vibration control.					
<b>TEXT BOOKS</b>					
1	Xu and He, "Smart Civil Structures", CRC Press, Taylor and Francis group, London;2017.				
<b>REFERENCE BOOKS</b>					
1	Ang and Tang, "Probability concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, Second Edition; 2007.				

<b>COURSE TITLE</b>	<b>STRUCTURAL HEALTH MONITORING</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CEA4724</b>	<b>COURSE CATEGORY</b>	<b>ELE</b>	<b>L-T-P</b>	<b>3 -0- 0</b>
<b>CIA</b>	<b>50%</b>			<b>ESE</b>	<b>50%</b>
<b>LEARNING LEVEL</b>	<b>BTL 3</b>				
<b>CO</b>	<b>COURSE OUTCOMES</b>				<b>PO</b>
The Students will be able to					
1	Choose the appropriate damage detection techniques for structures .				1,2,3,10,11
2	Apply frequency domain approach to control vibration in structures.				1,2,3,4,10,11
3	Apply time domain approach to control vibration in structures				1,2,3,4,10,11
4	Interpret structural self-repairing technologies available in current industry.				1,2,3,4,10,11
5	Explain concepts of SHM based life-cycle management of civil structures.				1,2,3,4,10,11
<b>Prerequisites: Nil</b>					
<b>MODULE 1: STRUCTURAL DAMAGE</b>					<b>(9)</b>
Introduction to structural damage detection, Non-destructive testing methods, Dynamic characteristics-based damage detection methods, Dynamic response-based damage detection methods, Damage detection method considering uncertainties.					
<b>MODULE 2: STRUCTURAL HEALTH MONITORING AND VIBRATION CONTROL IN FREQUENCY DOMAIN</b>					<b>(9)</b>
SHM in frequency domain, Integrated procedure using semi active friction dampers, System identification, Vibration control using semi-active friction dampers, Numerical Investigation, Experimental Investigation.					
<b>MODULE 3: STRUCTURAL HEALTH MONITORING AND VIBRATION CONTROL IN TIME DOMAIN</b>					<b>(9)</b>
Formulation of integrated system with time – invariant parameters, Numerical and experimental investigation – time invariant – integrated system. Formulation of integrated system with time – varying parameters, Numerical and experimental investigation – time-varying – integrated system.					
<b>MODULE 4: STRUCTURAL SELF REPAIRING AND HEALTH MONITORING</b>					<b>(9)</b>
Concept of structural health rehabilitation, Self-repairing concrete, Self-repairing concrete beams, Self-repairing steel joints, self-diagnosis and self-repairing active tensegrity structure.					
<b>MODULE 5: STRUCTURAL LIFE CYCLE MANAGEMENT AND HEALTH MONITORING</b>					<b>(9)</b>
Concept of SHM based life-cycle management of civil structures – Case studies, SHM-based loading assessments and models, SHM-based stress analysis, SHM-based bridge rating system and inspection.					
<b>On completion of the course, the students have to submit a term project report.</b>					
<b>TEXT BOOKS</b>					
1	Smart Materials and Structures, Gandhi and Thompson				
2	Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang				

**REFERENCE BOOKS**

1	Xu and He, "Smart Civil Structures", CRC Press, Taylor and Francis group, London;2017.
2	Ang and Tang, "Probability concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, Second Edition; 2007.

COURSE TITLE		NUMERICAL METHODS APPLIED TO CIVIL ENGINEERING		CREDITS	3	
COURSE CODE		CEA4725	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1	Estimate the errors and assess the accuracy of numerical solutions and also apply the method of direct solution of linear equations.				2,3,5,9	
2	Find out the direct solution of non-linear systems.				2,3,5,9	
3	Solve partial differential equations				2,3,5,9	
4	Solve typical initial and boundary value problems.				2,3,5,9	
5	Solve numerical integration of time dependent partial differential equations				2,3,5,9	
<b>Prerequisites:</b> Nil						
<b>MODULE 1: INTRODUCTION TO NUMERICAL METHODS AND DIRECT SOLUTION OF LINEAR SYSTEMS (9)</b>						
Sources of error in numerical solutions: truncation error, round off error. Order of accuracy - Taylor series expansion. Direct solution of linear systems- Gauss elimination, Gauss Jordan elimination - Pivoting, inaccuracies due to pivoting. Factorization, Cholesky decomposition -Diagonal dominance - Banded matrices, storage schemes for banded matrices, skyline solver. Iterative solution of Linear systems-Jacobi iteration-Gauss Seidel iteration-Convergence criteria.						
<b>MODULE 2: DIRECT SOLUTION OF NON-LINEAR SYSTEMS (9)</b>						
Newton Raphson iterations to find roots of a 1D nonlinear equation - Generalization to multiple dimensions-Newton Iterations, Quasi Newton iterations-Local and global minimum, rates of convergence, convergence criteria. Iterative Solution of Non Linear systems- Conjugate gradient-Preconditioning.						
<b>MODULE 3: PARTIAL DIFFERENTIAL EQUATIONS (9)</b>						
Introduction to partial differential equations - Definitions & classifications of first and second order equations - Examples of analytical solutions-Method of characteristics. Introduction to the Finite Element Method as a method to solve partial differential equations- Strong form of the differential equation-Weak form-Galerkin method: the finite element approximation-Interpolation functions: smoothness, continuity, completeness, Lagrange polynomials.						
<b>MODULE 4: NUMERICAL DIFFERENTIATION (9)</b>						
Difference operators (forward, backward and central difference)-Stability and accuracy of solutions-Application of finite difference operators to solve initial and boundary value problems-Numerical quadrature: Trapezoidal rule, Simpson's rule, Gauss quadrature.						
<b>MODULE 5: NUMERICAL INTEGRATION OF TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS (9)</b>						

Numerical solutions - Newmark's  $\beta$  method-Wilson  $\theta$  method-Numerical solutions for integral equations- Applications to linear and non-linear problems

**TEXT BOOKS**

1	J. B. Scarborough, Numerical mathematical analysis, Oxford & IBH Publishing CO Pvt., 2000
2	K. K. Jain, S. R. K Iyengar and R. K. Jain Numerical methods-problem and solutions, Wiley Eastern limited, 2001

**REFERENCE BOOKS**

1	R.W. Hamming, Numerical methods for scientist and engineers, McGraw Hill, 1998.
2	J. H. Mathews and K.D. Fink, Numerical methods using MATLAB, Pearson Education, 2004

COURSE TITLE		ADVANCED DESIGN OF STEEL STRUCTURES		CREDITS	3	
COURSE CODE		CEA4726	COURSE CATEGORY	ELE	L-T-P	3 -0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL3				
CO	COURSE OUTCOMES				PO	
The Students will be able to						
1	Solve the problems on wind load analysis				1,2,3,5,9,11	
2	Design Connections for Beam-Columns				1,2,3,5,9,11	
3	Design flexural and compression members using Light gauge steel sections				1,2,3,5,9,11	
4	Design steel chimneys and its foundation				1,2,3,5,9,11	
5	Analyse and Design Industrial Buildings.				1,2,3,5,9,11	
<b>Prerequisites : Nil</b>						
<b>MODULE 1: STABILITY, PLATE BUCKLING AND FATIGUE</b>					<b>(9)</b>	
Classification of structures-wind load analysis. Types of fatigue leading and failure- Fatigue test, endurance limit- S-N diagram- Various failure relations- Factors influencing fatigue strength- Influence of stress concentration on fatigue test						
<b>MODULE 2: BEAM- COLUMN CONNECTIONS/SEMI RIGID CONNECTIONS</b>					<b>(9)</b>	
Throat and Root Stresses in Fillet Welds – Seated Connections Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections						
<b>MODULE 3: DESIGN OF LIGHT GAUGE STEEL STRUCTURES</b>					<b>(9)</b>	
Types of cross sections - Local buckling and lateral buckling - Design of compression and tension members - Beams - Deflection of beams- Cold formed steel structures-Pre-engineered metal buildings- long span structures.						
<b>MODULE 4: DESIGN OF CHIMNEYS</b>					<b>(9)</b>	
Design of self-supporting chimney – Guyed Chimney – foundation design						
<b>MODULE 5: ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS</b>					<b>(9)</b>	
Review of loads on structures-Dead, Live, wind and Seismic loads as per National standard – Design of Purlins, louver rails, gable column and Gable wind girder-Analysis and design of Gable frames.						
<b>On completion of the course, students have to submit a term project report.</b>						
<b>TEXT BOOKS</b>						
1	Galyord and Galyord (2012), Design of Steel Structures, Tata McGraw Hill Education.					
2	N.Subramanyan (2010), Design of Steel Structures, Oxford Publication					
<b>REFERENCE BOOKS</b>						
1	IS 800:2007 General Construction in Steel – Code of Practice					
2	IS 801: 1975 Code of Practice for use of Cold-Formed Light Gauge Steel Structural Members in General Building Construction.					
3	Duggal.S.K., (2014), Limit State Design of Steel Structures, Tata McGraw-Hill Education, New Delhi.					

<b>COURSE TITLE</b>	<b>ADVANCED CONCRETE TECHNOLOGY</b>			<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CEA4727</b>	<b>COURSE CATEGORY</b>	<b>ELE</b>	<b>L:T:P:S</b>	<b>3-0-0-0</b>
<b>CIA</b>	<b>50%</b>			<b>ESE</b>	<b>50%</b>
<b>LEARNING LEVEL</b>	<b>BTL - 4</b>				
<b>CO</b>	<b>COURSE OUTCOMES</b>				<b>PO</b>
<b>The Students will be able to</b>					
1	Describe the properties of cement and its ingredients				1,2,3,4,5,6,7,12,PSO 2
2	Use appropriate admixtures in constructions				1,2,3,4,5,6,7,12,PSO 2
3	Describe the properties of aggregates				1,2,3,4,5,6,7,12,PSO 2
4	Carry out mix design for concrete				1,2,3,4,5,6,7,12,PSO 2
<b>Prerequisites : Construction Materials</b>					
<b>MODULE 1: CEMENT</b>					<b>(9)</b>
Composition of OPC-Manufacture-Modified Portland cements-Hydration process of Portland cements-Structure of Hydrated cement Pastes					
<b>MODULE 2: ADMIXTURES</b>					<b>(9)</b>
Mineral admixtures-Slags-Pozolanas and Fillers-Chemical Admixtures-Solutes Retarders-Air Entraining Agents-Water proofing compounds-Plasticizers and Super Plasticizers					
<b>MODULE 3: AGGREGATES</b>					<b>(9)</b>
Shape and Mechanical properties-Absorption and Physical durability-Chemical stability and packing Characteristics					
<b>MODULE 4: FRESH CONCRETE</b>					<b>(9)</b>
Mix proportioning-IS and ACI codal methods-Workability-Test -Mixes incorporating Fly-Ash Mixes for High performance concrete-Fibre reinforced concrete					
<b>MODULE 5: PROPERTIES AND DURABILITY OF CONCRETE</b>					<b>(9)</b>
Interfacial Transition zone-Fracture strength-Mechanical properties-High strength concrete-Shrinkage-Creep- Other properties. Basic consideration-Stability of constituents-Chemical Attack-Corrosion of Reinforcing steel.					
<b>TEXT BOOKS</b>					
1	Neville, A.M., "Properties of concrete ", 4th edition, Longman, In printed				
2	<i>M. S. Shetty, "concrete technology" ,S. Chand &amp;. Company Ltd, New Delhi.</i>				
<b>REFERENCE BOOKS</b>					
1	Metha P.K. and Montreio P.J.M., "Concrete Structure Properties and Materials ", 2nd edition, Prentice Hall, 1998.				
2	Mindaas and Young, "Concrete ", Prentice Hall, 1998				
<b>E BOOKS</b>					
1	<a href="https://civilread.com/download-concrete-tehnology/">https://civilread.com/download-concrete-tehnology/</a>				
<b>MOOC</b>					
1	<a href="https://nptel.ac.in/courses/105102012">nptel.ac.in/courses/105102012</a>				

COURSE TITLE		SMART MATERIALS AND NEW TECHNOLOGIES		CREDITS	3	
COURSE CODE		CEA4728	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1.	Characterize and classify traditional and advanced materials and systems.				1,2,9	
2.	Identify different types of smart materials and be able to differentiate between their properties				1,2,3,9	
3.	Interpret control systems in intelligent environments and learn surroundings and environment control.				1,2,3,4,10	
4.	Apply the developments in concrete and metals in construction projects.				1,5,7,9	
5.	Explain applications of construction materials like glass, polymers, paints etc. in building construction.				1,3,9	
<b>Prerequisites : Nil</b>						
<b>MODULE 1: CHARACTERIZATION OF MATERIALS</b>					<b>(9)</b>	
Internal structure, properties and general classes of materials, classification systems for conventional and smart materials, characteristics of smart materials and systems.						
<b>MODULE 2: TYPES OF SMART MATERIALS</b>					<b>(9)</b>	
Types of smart materials- property changing and energy exchanging materials-chromics, smart conductors and piezoelectrics, electrorheological fluids, light emitting materials, shape memory alloys.						
<b>MODULE 3: CONTROL SYSTEMS, AUTOMATION AND INTELLIGENT STRUCTURES</b>					<b>(9)</b>	
Sensors, detectors, transducers and actuators - control systems – mems – sensor networks. Homes of the future – characterization of intelligent environments – complex environments.						
<b>MODULE 4: DEVELOPMENTS IN CONCRETES AND METALS</b>					<b>(9)</b>	
Special concretes – green cements, self-healing concrete, fibre reinforced concrete –polymer concrete composites – geopolymers concrete. Metals – steel, aluminum, metal alloys.						
<b>MODULE 5: GLASS AND OTHER MATERIALS</b>					<b>(9)</b>	
Various basic glass types, decoration on glass, other specialty glass, applications, glass fiber reinforced plastics, polymers – classification and uses – special paints – types and its application in construction, geosynthetics, nanomaterials.						
<b>TEXT BOOKS</b>						
1.	D. Michelle Addington, Daniel L. Schodek, “Smart Materials and New Technologies”, Architectural Press, Oxford, 2005 ISBN: 0 7506 62255					
2.	M L Gambhir, “Concrete Technology”, McGraw Hill, 2009					
3.	“Architectural Glass Guide”, Federation of Safety Glass					
<b>REFERENCES BOOKS</b>						
1.	Yehia M. Haddad, “Mechanical Behaviour of Engineering Materials: Vol 2 Dynamic Loading and Intelligent Material Systems”, Springer Netherlands, 2000.					
2.	Stefan Bosse, Dirk Lehmus, Walter Lang, Matthias Busse, “Material-Integrated Intelligent Systems: Technology and Applications, Wiley, 2017					

COURSE TITLE		ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION		CREDITS	3
COURSE CODE	CEA4729	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Describe energy usage in buildings, and energy production systems.			1,4,5,7,9	
2.	Design green buildings with respect to comfort and waste management methods.			1,4,5,7,9	
3.	Identify energy efficient design strategies and advanced building technology			1,4,5,7,9	
4.	Analyze energy efficiency in buildings and describe various conservative measures			1,4,5,7,9	
5.	Explain energy savings system and energy management			1,4,5,7,9	
<b>Prerequisites:</b> Nil					
<b>MODULE 1: FUNDAMENTALS OF ENERGY</b>					<b>(9)</b>
Fundamentals of Energy-Energy production Systems-Heating, Ventilating and Air conditioning-Solar Energy and conservation-Energy Economic Analysis-Energy conservation and audits-Domestic energy consumption-Savings-Challenges-Primary energy use in buildings-Residential-commercial-Institutional and public buildings.					
<b>MODULE 2: ENERGY AND RESOURCE CONSERVATION</b>					<b>(9)</b>
Energy and resource Conservation-Design of green Buildings-Evaluation tools for building energy-Embodied and operating energy-Peak demand-Comfort and indoor air quality-Visual and acoustical quality-Land, water and materials-Airborne emissions and Waste management.					
<b>MODULE 3: DESIGN CONSIDERATION</b>					<b>(9)</b>
Natural building design consideration-Energy efficient design strategies-Contextual factors-Longevity and process assessment-Renewable energy sources and design-Advanced building technologies-Smart buildings-Economies and cost analysis.					
<b>MODULE 4: ENERGY IN BUILDING DESIGN</b>					<b>(9)</b>
Energy in building design-Energy efficient and environmental friendly building-Thermal phenomena-Thermal comfort-Indoor air quality-Climate, Sun and solar radiation-Psychometrics-Passive heating and cooling systems- Energy analysis -Active HVAC systems-Preliminary investigations-Goals and policies-Energy audit-Types of Energy audit-Analysis of results-Energy flow diagram-Energy consumption/Unit production-Identification of wastage-Priority of conservative measures-Maintenance of energy management program.					

**MODULE 5: ENERGY MANAGEMENT****(9)**

Energy management of electrical equipment-Improvement of power factor-Management of maximum demand-Energy savings in pumps-Fans-Compressed air systems-Energy savings in lighting systems-Air conditioning systems-Applications-Facility operation and maintenance-Facility modifications-Energy recovery dehumidifier-Waster heat recovery-Steam plants and distribution systems-Improvement of boiler efficiency-Frequency of blow down-Steam leakage-Steam flash and condense return.

**TEXT BOOKS**

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|----|--|
| 1. | Moore F., "Environmental control systems", McGraw Hill, Inc., 2004 |
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**REFERENCES BOOKS**

- |   |   |
|---|---|
| 1 | Brown, G.Z, Sun, " Wind and Light: Architectural design Strategies ", John Wiley & Sons, 2005.                          |
| 2 | Cook, J, "Award - Winning Passive Solar Design ", McGraw Hill, 2004   |
| 3 | Waters J.R, "Energy Conservation in Building: A guide to part of the building regulations", Blackwell Publishing, 2003. |

COURSE TITLE		CONSTRUCTION PERSONNEL MANAGEMENT		CREDITS	3	
COURSE CODE		CEA4730	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES				PO	
<b>Students will be able to</b>						
1.	Understand manpower planning, organizing, controlling in human resource management.				1, 2,6,9,10	
2.	Apply knowledge of organization in staffing, planning, operations, development, placement and training.				1, 5,6,7, 9	
3.	Apply principles of basic psychology and human behaviour in leadership, management and organization of people				1,2,8,9,10	
4.	Implement safety and health practices in addition to laws related to insurance and welfare measures.				1,7,9,10	
5.	Apply management and development methods in managing special human resource problems, employee appraisal and assessment in the construction industry.				1,7,9,10	
<b>Prerequisites:</b> Nil						
<b>MODULE 1: MANPOWER PLANNING</b>					<b>(9)</b>	
Manpower Planning, Organizing, Staffing, directing and Controlling-Personnel Principles.						
<b>MODULE 2: ORGANISATION</b>					<b>(9)</b>	
Organization-Span of control-Organization charts-Staffing plan-Development and Operation of Human resources -Managerial Staffing-Recruitment-Selection-Placement, Training and Development.						
<b>MODULE 3: HUMAN BEHAVIOUR</b>					<b>(9)</b>	
Introduction to the field of management-basic individual psychology-motivation-job design and performance management-Managing groups at work-self managing work teams-Inter group behaviour and conflict in organizations-Leadership- Behavioural aspects of decision-making; and communication for people management.						
<b>MODULE 4: WELFARE MEASURES</b>					<b>(9)</b>	
Compensation - Safety and Health- GPF- EPF- Group- Insurance- Housing- Pension- Laws-related to welfare measures.						
<b>MODULE 5: MANAGEMENT AND DEVELOPMENT METHODS</b>					<b>(9)</b>	
Compensation-Wages and Salary, Employee Benefits ,employee appraisal and assessment-Employee services-Safety and Health-Discipline and Discharge-Special human resource problems, Performance appraisal-Employee hand book and personnel manual-Job descriptions and organization structure and Human relations-Productivity of Human resources.						

<b>TEXT BOOKS</b>	
1.	Carleton Counter II and Jill Justice Coulter, "The Complete Standard Hand Book of Construction Personnel Management", Prentice Hall, Inc., New Jersey, 1989.
2.	Memoria, C.B., "Personnel Management ", Himalaya Publishing Co., 1999.
<b>REFERENCES BOOKS</b>	
1.	Josy J. Familiaro, "Handbook of Human Resources Administration", McGraw Hill International Edition, 1987.
2.	Pringle Charles, "Management Longnecker " Emerricle Publishing Co., 1981.
3.	R.S.Dwivedi, "Human Relations and Organisational Behaviour ", 5th Edition, BH - 2005.

COURSE TITLE		SHORING, SCAFFOLDING AND FORMWORK		CREDITS	3
COURSE CODE	CEA4731	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Understand and execute the economical form work construction.			1,2,3,7,9	
2.	Identify various materials and equipment involved in form work construction.			1,4,7,9,	
3.	Identify and execute shore and scaffolds safety practices.			1,3,5,6,7,9	
4.	Describe the basic concept of formwork design in construction			1,3,5,7,9,10	
5.	Identify and appreciate the different systems of formwork and safety factors.			1,2,3,4,7,9,10	
<b>Prerequisites:</b> Nil					
<b>MODULE 1: FORMWORK AND OVER-ALL PLANNING</b>					<b>(9)</b>
General-Requirement of formwork-Types of forms-Concrete form work-Formwork specification, Finishes, Tolerances-Development of a basic system-Planning for maximum reuse-Economical form construction-Other cost affected by formwork plan-Planning examples-trial plan, crane size, efficient scheduling, planning form sizes cost estimate, pier strut forming, scheduling, recheck plan details-Detailing the forms.					
<b>MODULE 2: MATERIALS AND EQUIPMENT</b>					<b>(9)</b>
Permissible stress, Materials as form facing-Timber and wood – based materials-Woos –based face contact materials-Plywood and other sheet materials- Structural properties of sheet materials, design factors-Metals-Plastic, Rubber and fabrics-Cement based materials-Proprietary equipment Permanent formwork-Form ties-Reinforcement spacer systems-Surface treatments-Ancillary materials and items-Form liners.					
<b>MODULE 3: SHORES, SLIPFORMS AND SCAFFOLDS</b>					<b>(9)</b>
Simple wood stresses-Slenderness ratio-Allowable load-Tubular steel shores patented shores-Site preparation, Size and spacing-Steel Tower Frames-Safety practices-Horizontal shores shoring for multi stories-More concentrated shore loads T-heads-Tow Tier Wood shores-Ellis Shores-Dayton sure grip and baker Ross shores-Safeway Symons shores-Beaver-advanced shores dead shore-Raking and Flying shores. Principles-Types-Advantages-Functions of Various components-Planning-Desirable Characteristics of concrete-common problems faced-Safety in slip forms special structures built with slip form technique-Codal provisions- Types of Scaffolds-Putlog and independent Scaffold-Single pole scaffolds-Fixing ties-Spacing of ties plan-Bracing-Knots-Safety net-General safety requirements-precautions against particular hazards-Truss suspended-Gantry and system scaffolds.					
<b>MODULE 4: FORMWORK DESIGN</b>					<b>(9)</b>
Preamble to design, loadings – Self weight of formwork, imposed loads, concrete pressure on formwork. Design – General design considerations – basic simplification – wall, slab and beam form design – allowable stresses – check for deflection, bending and lateral stability – examples – formwork drawing and calculations.					

**MODULE 5: DIFFERENT SYSTEMS OF FORMWORK AND SAFETY REQUIREMENTS (9)**

Formwork Systems – Form wall footing – column footings – slab on grade and paving work – highway airport paving – external vibration – prefabricated panel systems – giant forms – curved wall forms – erection practices – column head or girder form – suspended form – concrete joint construction – flying system of forms – shell form – tunnel forming components – curb and gutter forms – invert forms – arch forms – concrete placement methods – causes of failures – case studies – finish of exposed concrete – design deficiencies – safety factors – stripping sequence – re shoring installation – advantages of re shoring – ACI – permitted and graduated irregularities.

**TEXT BOOKS**

- |    |   |
|----|---|
| 1. | Roy Chudley and Roger Greeno, "Advanced Construction Technology", Pearson Education Limited, 4th edition, 2006, ISBN-10 0-132-01985-X ,SBN-13 |
| 2. | Robertwade Brown, "Practical foundation engineering hand book ", McGraw Hill Publications, 2nd Edition, 2000                                  |
| 3. | Sharma S.C. "Construction Equipment and Management", Khanna Publishers, Delhi, Edition:1, 2016 ISBN: 9789382609056, 9382609059                |

**REFERENCES BOOKS**

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|----|--|
| 1. | Mcgraw Higher Ed, "Construction Planning, Equipment and Methods", Clifford J. Schexnayder, 7 th Edition, 2013.         |
| 2. | Patrick Powers. J., " Construction Dewatering: New Methods and Applications ", John Wiley and Sons, 3rd Edition, 2007. |
| 3. | Jerry Irvine, "Advanced Construction Techniques ", CA Rocketr, 1984.   |

COURSE TITLE		INDUSTRIAL STRUCTURES		CREDITS	3	
COURSE CODE		CEA4732	COURSE CATEGORY	ELE	L-T-P	3 -0- 0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL3				
CO	COURSE OUTCOMES				PO	
The Students will be able to						
1	Implement the Factories Act in planning the industrial buildings.				1,2,3,9,10	
2	Design suitable roofing for industrial buildings.				1,2,3,9,10,11	
3	Design various components of power plant structures.				1,2,3,9,10,11	
4	Design transmission Line towers.				1,2,3,9,10,11	
5	Design gantry girders and plate girders				1,2,3,9,10,11	
<b>Prerequisites: Nil</b>						
<b>MODULE 1: PLANNING AND FUNCTIONAL REQUIREMENTS</b>					<b>(9)</b>	
Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines from Factories Act.						
<b>MODULE 2: INDUSTRIAL BUILDINGS</b>					<b>(9)</b>	
Roofs for Industrial Buildings - Steel and RC - Folded Plates and Shell Roofs - Design of Corbels and Nib -Machine Foundations.						
<b>MODULE 3: POWER PLANT STRUCTURES</b>					<b>(9)</b>	
Bunkers and Silos - Chimney and Cooling Towers - Design of Steel storage tanks – Nuclear containment structures.						
<b>MODULE 4:POWER TRANSMISSION STRUCTURES</b>					<b>(9)</b>	
Cables - Transmission Line Towers - Substation structures - Tower foundations - Testing towers.						
<b>MODULE 5: GIRDERS</b>					<b>(9)</b>	
Gantry Girders – Plate Girders- Stiffeners.						
<b>On completion of the course, the students have to submit a term project report.</b>						
<b>TEXT BOOK:</b>						
1	P.C. Varghese, Design of Reinforced Concrete Shells and Folded Plates,P.H.I Learning Private Limited, New Delhi,2010.					
2	A.R. Santhakumar and S.S. Murthy, Transmision Line Structures, Tata McGraw-Hill 1992.					
<b>REFERENCE BOOKS</b>						
1	Procs. of advanced course on Industrial Structures, Structural Engineering Research Centre, 1982.					
2	S.N. Manohar, Tall Chimneys - Design and Construction, Tata McGraw-Hill, 1985					

COURSE TITLE		DESIGN OF BRIDGES			CREDITS	3
COURSE CODE		CEA4733	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL-3				
CO	COURSE OUTCOMES					PO
The student will be able to:						
1	Explain the general design considerations for the construction of bridges					1,2,3,9,10
2	Design reinforced concrete tee beam and slab bridges for various IRC Loading.					1,2,3,5,9,10
3	Describe the design principles of various long span girders.					1,2,3,9,10
4	Design the pre-stressed concrete bridges.					1,2,3,5,9,10
5	Design plate girder bridges.					1,2,3,5,9,10
<b>Prerequisites : Nil</b>						
<b>MODULE 1: INTRODUCTION</b>						<b>(9)</b>
Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.						
<b>MODULE 2: SHORT SPAN BRIDGES</b>						<b>(9)</b>
Load distribution theories, analysis and design of slab culverts, T beam and slab bridges. Design of panel and cantilever for IRC loading.						
<b>MODULE 3: LONG SPAN GIRDER BRIDGES</b>						<b>(9)</b>
Design principles of continuous bridges, box girder bridges, balanced cantilever bridges - Bearings, Footings, Drilled shaft foundations and Caissons for bridges.						
<b>MODULE 4: DESIGN OF PRESTRESSED CONCRETE BRIDGES</b>						<b>(9)</b>
Design of prestressed concrete bridges - Preliminary dimensions - Flexural and torsional parameters - Courbon's theory - Distribution coefficient by exact analysis - Design of girder section - Maximum and minimum prestressing forces - Eccentricity - Live load and dead load shear forces - cable zone in girder - Check for stresses at various sections - Check for diagonal tension - Diaphragms - End block - Short term and long term deflection.						
<b>MODULE 5: DESIGN OF PLATE GIRDER BRIDGES</b>						<b>(9)</b>
Design of plate girder railway bridges for railway loading - - Wind effects - Design of web and flange plates - Vertical and horizontal stiffeners.						
On completion of the course, the students have to submit a term project report.						
<b>TEXT BOOK:</b>						
1	Krishnaraju, N., "Design of Bridges", Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 2018.					
2	Ponnuswamy "Bridge Engineering" Tata McGraw-Hill Education, 2008					
<b>REFERENCE BOOKS:-</b>						
1	Teruhiko Yoda and Weiwei Lin Bridge Engineering: Classifications, Design Loading, and Analysis 2017					
2	Daniel Benjamin Luten "Reinforced Concrete Bridges" 2017					
3	John F. Unsworth "Design of Modern Steel Railway Bridges", CRC Press 2010					

COURSE TITLE		STABILITY OF STRUCTURES			CREDITS	3
COURSE CODE		CEA4734	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES					PO
Students will be able to						
1	Describe the stability of columns and the buckling modes.					3,10
2	Execute inelastic analysis of columns					1,2,3,5,9,10, 11
3	Evaluate the buckling of beam-columns, portal frames and stability of multi-storeyed frames.					1,2,3,5,9,10, 11
4	Evaluate the lateral buckling of beams, torsional buckling and flexural torsional buckling.					1,2,3,5,9,10, 11
5	Apply the concept of buckling of thin isotropic rectangular plates.					1,2,3,5,9,10
<b>Prerequisites:</b> Nil						
<b>MODULE 1: STABILITY OF COLUMNS</b>						<b>(9)</b>
Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium; Energy and Imperfection approaches - Non-prismatic columns- Built up columns- orthogonality of buckling modes- Effect of shear on buckling load - Large deflection theory.						
<b>MODULE 2: METHODS OF ANALYSIS AND INELASTIC BUCKLING</b>						<b>(9)</b>
Approximate methods - Rayleigh and Galerkin methods - numerical methods - Finite difference and finite Element - analysis of columns - Experimental study of column behaviour - South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour-Tangent modulus and Double modulus Theory						
<b>MODULE 3: BEAM COLUMNS AND FRAMES</b>						<b>(9)</b>
Beam column behaviour- standard cases- Continuous columns and beam columns - Column on elastic foundation - Buckling of frames - Single storey portal frames with and without side sway - Classical and stiffness methods - Approximate evaluation of critical loads in multi-storied frames - Use of Wood's charts.						
<b>MODULE 4: BUCKLING OF BEAMS</b>						<b>(9)</b>
Lateral buckling of beams - Energy method- Application to Symmetric and simply symmetric I beams- simply supported and Cantilever beams - Narrow rectangular cross sections- - Numerical solutions - Torsional buckling - Uniform and non-uniform Torsion on open cross section – Flexural torsional buckling - Equilibrium and energy approach.						
<b>MODULE 5: BUCKLING OF THIN PLATES</b>						<b>(9)</b>
Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges -Use of Energy methods - Plates with stiffeners - Numerical Techniques.						
<b>TEXT BOOKS</b>						
1	Ashwinikumar, "Stability of Structures", Allied Publishers Ltd, (1998)					
2	NGR Iyengar, "Structural Stability of Columns and Plates" Affiliated East- West Press Pvt. Ltd (1986)					

REFERENCE BOOKS	
1	Allen, H.G and Bulson, P.S., Background to Buckling McGraw-Hill Book Company, 1980
2	Chajes, A. Principles of Structures Stability Theory, Prentice Hall 1974.
3	Dewey H Hodges George J Simitses Hodges Simitses "Fundamentals of Structural Stability"

COURSE TITLE		DESIGN OF TALL STRUCTURES		CREDITS	3	
COURSE CODE		CEA4735	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES				PO	
The Students will be able to						
1	Describe the various structural systems used in the construction of Tall structures.				1,2,3,9,10	
2	Analyze tall structures using computer-based methods and approximate methods.				1,2,3,9,10,11	
3	Describe various types of systems for structural systems.				1,2,3,9,10	
4	Model and analyse framed and shear wall structures				1,2,3,9,10,11	
5	Execute non-linear analysis of Tall Structures.				1,2,3,9,10,11	
<b>Prerequisites: Nil</b>						
<b>MODULE 1: DESIGN CRITERIA</b>					<b>(9)</b>	
Design Philosophy, Materials - Modern concepts - High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self-Compacting Concrete						
<b>MODULE 2: LOADING</b>					<b>(9)</b>	
Gravity Loading - Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading - Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading - Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads.						
<b>MODULE 3: BEHAVIOUR OF STRUCTURAL SYSTEMS</b>					<b>(9)</b>	
Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In filled frames, Shear walls, Coupled Shear walls, Wall - Frames, Tubular, Outrigger braced, Hybrid systems.						
<b>MODULE 4: ANALYSIS AND DESIGN</b>					<b>(9)</b>	
Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for member forces, drift and twist. Computerized 3D analysis. Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance.						
<b>MODULE 5: STABILITY ANALYSIS</b>					<b>(9)</b>	
Overall buckling analysis of frames, wall - frames, Approximate methods, Second order effect of gravity loading, P-Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.						
<b>TEXT BOOKS</b>						
1	Bryan Stafford Smith and Alex Coull, "Tall Building Structures", Analysis and Design, John Wiley and Sons, Inc., 2011					
2	Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw-Hill, 2011.					

**REFERENCE BOOKS**

1	LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers", John Wiley, 1994.
2	Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1996.

COURSE TITLE		OPTIMIZATION IN STRUCTURAL DESIGN		CREDITS	3	
COURSE CODE		CEA4736	COURSE CATEGORY	ELE	L-T-P	3 -0- 0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL3				
CO	COURSE OUTCOMES				PO	
The Students will be able to						
1	Acquire information about concepts like minimum weight, minimum cost design, Objective function, constraints, classical methods.				1	
2	Get acquainted with Linear programming, Integer Programming, Quadratic Programming, Dynamic Programming and Geometric Programming methods for Optimal design of structural elements.				2	
3	Attain proficiency on Linear Programming methods for plastic design of frames, Computer search methods for univariate and multivariate Minimization.				3	
4	Do optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stresses design with deflection constraints, optimality criterion methods.				4	
5	Utilise optimization methods for optimal design of structural components.				5	
<b>Prerequisites: Nil</b>						
<b>MODULE 1: INTRODUCTION</b>					<b>(6)</b>	
Basic concepts of minimum weight, minimum cost design, Objective function, constraints, classical methods						
<b>MODULE 2: OPTIMIZATION TECHNIQUES AND ALGORITHMS</b>					<b>(10)</b>	
Linear programming, Integer Programming, Quadratic Programming, Dynamic Programming and Geometric Programming methods for Optimal design of structural elements.						
<b>MODULE 3: COMPUTER SEARCH METHODS</b>					<b>(10)</b>	
Linear Programming methods for plastic design of frames, Computer search methods for univariate and multivariate Minimization.						
<b>MODULE 4: OPTIMIZATION THEOREMS</b>					<b>(9)</b>	
Optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stresses design with deflection constraints, optimality criterion methods.						
<b>MODULE 5: STRUCTURAL APPLICATIONS</b>					<b>(10)</b>	
Optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Design of R.C. structures such as multi-storey buildings, water tanks, bridges, shell roofs using Optimisation techniques. Use of Software packages for optimization						
<b>TEXT BOOKS</b>						
1	S.S.Rao, Optimization Theory and Applications, Wiley Eastern Limited, New Delhi, 1977					

2	A. Ravindran , K.M. Ragsdell G.V. Reklaitis “Engineering Optimization: Methods and Applications”, 2006
<b>REFERENCE BOOKS</b>	
1	Uri Krisch, Optimum Structural Design, McGraw-Hill Book Co. 1981.
2	Richard Bronson, Operation Research, Schaum's Outline Series, McGraw-Hill Book Co, Singapore, 1983.
3	D. T. Pham “Intelligent optimisation techniques”, Springer, 2012.

COURSE TITLE		OFFSHORE STRUCTURES			CREDITS	3
COURSE CODE		CEA4737	COURSE CATEGORY	ELE	L-T-P	3 -0- 0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES					PO
The Students will be able to						
1	Describe wave generation process and theories.					3,10
2	Apply concepts of forces in offshore structures and offshore soil and structure modelling.					1,2,3,10
3	Model and analyse offshore structures					1,2,3,5,6,10,11
4	Analyze foundations for offshore structures					1,2,3,5,6,10,11
5	Design different components of offshore structures.					1,2,3,6,10,11
<b>Prerequisites: Nil</b>						
<b>MODULE 1: WAVE THEORIES</b>						<b>(9)</b>
Wave generation process, small, finite amplitude and nonlinear wave theories.						
<b>MODULE 2: FORCES OF OFFSHORE STRUCTURES</b>						<b>(9)</b>
Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.						
<b>MODULE 3: OFFSHORE SOIL AND STRUCTURAL MODELLING</b>						<b>(9)</b>
Different types of offshore structures, foundation modelling, fixed jacket platform structural modelling.						
<b>MODULE 4: ANALYSIS OF OFFSHORE STRUCTURES</b>						<b>(9)</b>
Static method of analysis, foundation analysis and dynamics of offshore structures.						
<b>MODULE 5: DESIGN OF OFFSHORE STRUCTURES</b>						<b>(9)</b>
Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.						
<b>TEXT BOOKS</b>						
1	Reddy.D.V and Swamidass A.S.J.,Essential of offshore structures.CRC Press.2013					
2	Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.					
<b>REFERENCES BOOKS</b>						
1	API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms Working Stress Design - API Publishing Services, 2005					
2	Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005					
3	Chakrabarti, S.K., Hydrodynamics of Offshore Structures, WIT press, 2001.					
4	Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983					
5	James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.					
6	Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, 1991.					

COURSE TITLE		PRESTRESSED CONCRETE STRUCTURES			CREDITS	3
COURSE CODE		CEA4738	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1	Describe the systems and methods of prestressing and find the deflection of pre-stressed elements.				1,2,3,9,10	
2	Design the pre-stressed concrete elements for flexure as per the codal provisions.				1,2,3,9,10	
3	Design the pre-stressed concrete elements for shear, torsion and anchorage zone as per the codal provisions.				1,2,3,9,10	
4	Analyze statically indeterminate structures				1,2,3,5,9,10	
5	Design pre-stressed concrete tanks, poles and sleepers.				1,2,3,9,10	
<b>Prerequisites:</b> Nil						
<b>MODULE 1: PRINCIPLES AND ANALYSIS FOR FLEXURE</b>						<b>(9)</b>
Principles of Prestressing - Types of prestressing systems - Materials - Systems and devices - Analysis and design for flexure- Behaviour of prestressed concrete elements - General concept of prestress - Force transmitted by pretensioned and post tensioned systems - losses in prestress - analysis for Ultimate strength - Comparison of codal provisions - at service load and Magnel's approach .						
<b>MODULE 2: DESIGN FOR FLEXURE</b>						<b>(9)</b>
Concept of Limit State design - Limit state of Collapse and serviceability - Design using allowable stresses - Stress range approach - Lin's approach - Magnel's approach						
<b>MODULE 3: DESIGN FOR SHEAR, TORSION AND ANCHORAGE ZONE</b>						<b>(9)</b>
Shear resistance in beams - Design for shear in rectangular and flanged beams – Behaviour under torsion -Modes of failure - Design for torsion, shear and bending Anchorage Zone - analysis and design of pretensioned and post tensioned end blocks - IS code provisions - Comparison of other codes.						
<b>MODULE 4: STATICALLY INDETERMINATE STRUCTURES</b>						<b>(9)</b>
Analysis of indeterminate structures - Continuous beams - Concept of concordance and linear transformations - Single storied rigid frames - Choice of cable profiles.						
<b>MODULE 5: PRESTRESSED SPECIAL STRUCTURES</b>						<b>(9)</b>
Concept of circular prestressing - Design of prestressed concrete pipes and cylindrical water tanks - Composite construction- types, behaviour, flexural stresses, longitudinal shear transfer, transverse shear - Compression members - Design of poles and piles - Partial pre stressing - Principles, analysis and design concepts.						
<b>TEXT BOOKS</b>						
1	N. Rajagobalan , "Prestressed Concrete" Norosa Publishing House (2002)					
2	N.Krishnaraju, "Prestressed Concrete" Tata McGraw-Hill Publishing Company 3rd Ed (2012)					

3	Charles William Dolan and H. R. (Trey) Hamilton "Prestressed Concrete: Building, Design, and Construction Charles William Dolan and H. R. (Trey) Hamilton" 2018
<b>REFERENCE BOOKS</b>	
1	T.Y.Lin&Nedbhurns "Design of Prestressed Concrete Structures"3rd edition (1982), John Wiley & Sons
2	N.C.Sinha&S.K.Roy, "Fundamentals of Prestressed Concrete" S.Chand& Co, New Delhi (1985)

COURSE TITLE		DISASTER MANAGEMENT		CREDITS	3	
COURSE CODE		CEA4739	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES			PO		
Students will be able to						
1.	Identify the nature and extent of disasters and describe phase I of the disaster management cycle			1,2,3,9		
2.	Describe and appreciate the different phases in the disaster management cycle including preparation, planning, response and recovery			1,7,8,9		
3.	Identify and implement emergency management programmes by various organizations and assess the various methods of the same.			1,2,7,9		
4.	Identify community based initiatives during disasters and describe the various aspects under them.			1,3,7,9		
5.	Plan for disasters and be aware of disaster response personnel and their duties.			1,3,7		
<b>Prerequisites : Nil</b>						
<b>MODULE 1: NATURE OF DISASTERS</b>					<b>(9)</b>	
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. Disaster Management Cycle –Phase I: Mitigation, and strategies; hazard Identification and vulnerability analysis. Disaster Mitigation and Infrastructure, impact of disasters on development programs, vulnerabilities caused by development, developing a draft country-level disaster and development policy.						
<b>MODULE 2: DISASTER MANAGEMENT CYCLE</b>					<b>(9)</b>	
Phases-Disaster Management Cycle – Phase II: Preparedness, Disaster Risk Reduction(DRR), Emergency Operation Plan (EOP), Mainstreaming Child Protection and Gender in Emergency Planning, Assessment, Phases III and IV: Response and recovery, Response aims, Response Activities, Modern and traditional responses to disasters, Disaster Recovery, and Plan , Disasters as opportunities for development initiatives. Disaster Management – Financing relief expenditure, legal aspects, rescue operations. Casual management, risk management.						
<b>MODULE 3: EMERGENCY MANAGEMENT AND ORGANIZATIONS</b>					<b>(9)</b>	
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. Various organizations registered with Government and NGO’s working for disaster relief- Challenges faced by organizations. Methods of assessment of impact of disasters such as photogrammetric methods, media survey, ground data collection.						
<b>MODULE 4: DISASTER COMMUNITY</b>					<b>(9)</b>	
Disaster Community-Community-based Initiatives in Disaster management, need for Community-Based Approach, categories of involved organizations: Government, Non-government organizations (NGOs), Regional And International Organizations, Panchayaths, Community Workers, National And Local Disaster Managers, Policy Makers, Grass-Roots						

Workers, Methods Of Dissemination Of Information, Community-Based Action Plan, Advantages/Disadvantages Of The Community-Based Approach.	
<b>MODULE 5: DISASTER PLANNING (9)</b>	
Disaster Planning-Disaster Response Personnel and duties, Community Mitigation Goals, Pre-Disaster Mitigation Plan, Personnel Training, Volunteer Assistance, School-based Programmes, Hazardous Materials, Ways of storing and safely handling hazardous materials, Coping with Exposure to Hazardous Materials. International adopted practices for disaster mitigation. Rules and regulations, Monitoring aspects of disaster mitigations programs.	
<b>TEXT BOOKS</b>	
1.	Ayaz,. “Disaster Management: Through the New Millennium”, Anmol Publications. (2009)
2.	Dave, P. K.. “Emergency Medical Services and Disaster Management: A Holistic Approach”, New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., 2009
3.	Narayan, B. “Disaster Management”, New Delhi: A.P.H. Publishing Corporation ,2009
4.	Kumar, N.. “Disaster Management”. New Delhi: Alfa Publications. ,2009
5.	Ghosh, G. K., “Disaster Management”, New Delhi: A.P.H Publishing Corporation. ,2008
6.	Goel, S. L., “Disaster Management”, New Delhi: Deep & Deep Publication Pvt. Ltd. ,2008
7.	Singh, R. B. , “Disaster Management”, New Delhi: Rawat Publications., 2008.
<b>REFERENCES BOOKS</b>	
1.	An Introduction to Disaster Management –Natural Disasters and Man Made Hazards, S.Vaidyanathan, Ikon Books
2.	Construction Engineering and Management – Seetharaman, Umesh Publ.
3.	NICMAR Publications
4.	Different sites on internet on disaster management
5.	Project Management – K Nagarajan – New Age International Ltd.
6.	Disaster Management Handbook by Jack Pinkowski – CRC Press (Taylor and Francis group)

COURSE TITLE	BUILDING ACOUSTICS AND NOISE CONTROL			CREDITS	3
COURSE CODE	CEA4740	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES				PO
Students will be able to					
1.	Describe properties of sound waves and the characteristics of the human ear.				1,2,4,9
2.	Identify and select acoustic material for building construction based on their properties.				1,2,4,7,9
3.	Apply the principles of transmission of sound in its control and insulation.				1,2,4,7,9
4.	Identify and select apt insulation for different building components and machinery.				1,2,4,7,9
5.	Apply basic principles of acoustic design for different building applications.				1,2,4,7,9
<b>Prerequisites : Nil</b>					
<b>MODULE 1: INTRODUCTION</b>					<b>(9)</b>
Sound waves, Frequency, Intensity, Wave length, Measurement of sound, Decibel scale speech and music frequencies, human ear characteristics-Tone structure.					
<b>MODULE 2: PROPERTIES OF ACOUSTIC MATERIAL</b>					<b>(9)</b>
Outdoor noise levels - acceptable indoor noise levels-IS codes –sono meter, determinate of density of a given building material, absorption co-efficient and measurements, choice of absorption material, resonance, reverberation, echo, exercises involving reverberation time and absorption co-efficient.					
<b>MODULE 3: NOISE CONTROL</b>					<b>(9)</b>
Types of noises, transmission of noise, transmission loss, noise control and sound insulation, remedial measures and legislation					
<b>MODULE 4: INSULATION OF MACHINERY</b>					<b>(9)</b>
Walls/partitions, floors/ceilings, windows/doors, insulating fittings and gadgets machine mounting and insulation of machinery.					
<b>MODULE 5: BASIC PRINCIPLES IN ACOUSTICS DESIGN</b>					<b>(9)</b>
Site selection, shape, volume, treatment for interior surfaces-basic principles in designing open air theatres, cinemas, broadcasting studios, concert halls, class rooms, lecture halls and theatres for acoustics.					
<b>TEXT BOOKS</b>					
1.	Narasimhan. V.Dr., "An introduction to Building Physics", Kabeer printing works, chennai-5, 2004.				
2.	Groomet. D.J, "Noise, Building and People", Pergumon Press, 2007.				
<b>REFERENCES BOOKS</b>					

1.	Fair G.M., Geyer J.C. and Okun. D, "Water and waste Engineering ", Vol. II, John Wiley & sons, Inc., New York. 2008.
2.	Hopkinson. R.G and Kay. J. D, "The Lighting of buildings", Faber and Faber, London, 2009.
3.	"Hand book for Building Engineers in Metric systems", NBC, New Delhi, 2008.
4.	"Philips Lighting in Architecture Designs", McGraw Hill, New York, 2004.
5.	" <i>Time saver Standards for Architecture Design Data</i> ", Callendar JH, McGraw Hill, 2004.
6.	William H. Severns and Julian R. Fellows, " <i>Air conditioning and refrigeration</i> ", John Wily and sons, London, 2008.

COURSE TITLE		BUILDING SERVICES		CREDITS	3
COURSE CODE	CEA4741	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES			PO	
Students will be able to					
1.	Apply principles of structural integrity and building services engineering to building construction including intelligent buildings.			1,4,7,9	
2.	Apply general principles of water treatment, plumbing and sewage systems in buildings.			1,4,7,9	
3.	Identify and appreciate electrical wiring systems and apply the concepts of lighting and HVAC to building construction.			1,4,7,9	
4.	Identify and apply various fire safety measures.			1,4,7,9,10	
5.	Coordinate and manage the installation and maintenance of different service systems in a building.			1,4,7,9	
<b>Prerequisites : Nil</b>					
<b>MODULE 1: BUILDING SERVICES SYSTEMS</b>					<b>(9)</b>
Integrated design: factors affecting selection of services/systems, Provision of space in the building to accommodate building services, Structural integrity of building services equipment. Sound and vibration attenuation features, Provisions for safe operation and maintenance, Building services engineering system for intelligent buildings: Introduction to information transmission systems, communication and protection system, call systems, public address system and Building automation/management systems.					
<b>MODULE 2: WATER AND SEWAGE TREATMENT SYSTEMS</b>					<b>(9)</b>
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 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.					
<b>MODULE 3: WIRING AND HVAC SYSTEMS</b>					<b>(9)</b>
Types of wires, wiring systems and their choice –planning electrical wiring for building –main and distribution boards –transformers and switch gears –modern theory of light and color – synthesis of light –luminous flux –candela- lans of illumination-lighting design-design for modern lighting. Ventilation and its importance-natural and artificial systems-Window type and packaged air-conditioners-chilled water plant –fan coil systems-water piping –cooling load –air conditioning systems for different types of buildings –protection against fire to be caused by AC.Systems.					
<b>MODULE 4: FIRE SAFETY SYSTEMS</b>					<b>(9)</b>

Causes of fire in buildings-safety regulations-NBC-planning considerations in buildings like Non-combustible materials, construction, staircases and A.C. systems, special features required for physically handicapped and elderly in building types-heat and smoke detectors-dry and wet risers-Automatic sprinkler.

**MODULE 5: INSTALLATION AND MAINTENANCE OF SYSTEMS (9)**

Co-ordination and management of design and installation of various building services systems during the design and construction stages in particular the builder’s works. Computer-aided design and installations of building services. Testing and commissioning of building services systems: fire safety systems, vertical transportation equipment ventilation systems, etc. Sick building syndrome. The impacts of life-cycle-cost on planning and implementation. An appreciation of capital and operating costs. Implication of low cost, inefficient equipment, poor installation, inadequate access for maintenance.

**TEXT BOOKS**

1.	Building Services—S.M.Patil (ISBN-978-81-7525-980-5)
2.	Society A.K.Vaidya Marg, Goregaon (E),Mumbai-65
3.	Building Maintenance Management, 2 <sup>nd</sup> edition,---Chanter, Wiley India
4.	Maintenance of Buildings—A.C.Panchodhari—New Age International Publishers.

**REFERENCES BOOKS**

1.	Fair G.M., Geyer J.C. and Okun. D, “Water and waste Engineering “, Vol. II, John Wiley & sons, Inc., New York. 2008.
2.	Hopkinson. R.G and Kay. J. D, “The Lighting of buildings”, Faber and Faber, London, 2009.
3.	“Hand book for Building Engineers in Metric systems”, NBC, New Delhi, 2008.
4.	“Philips Lighting in Architecture Designs”, McGraw Hill, New York, 2004.
5.	“Time saver Standards for Architecture Design Data”, Callendar JH, McGraw Hill, 2004.
6.	William H. Severns and Julian R. Fellows, “Air conditioning and refrigeration”, John Wily and sons, London, 2008.

COURSE TITLE		RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION			CREDITS	3
COURSE CODE		CEA4742	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES					PO
Students will be able to						
1.	Identify the resources required for construction project					1,2,7,10
2.	Apply principles of resource planning , utilization of resources with procurement and inventory control					1,2,7,10
3.	Implement the construction project by calculating the material, equipment and labour requirement in respect of productivity					1,2,7,10
4.	Apply principles of time management and cost control in planning and management of projects.					1,2,7,10
5.	Apply the method of resource allocation with use of computers in construction projects.					1,2,5,7,10
<b>Prerequisites:</b> Nil						
<b>MODULE 1: INTRODUCTION TO RESOURCES</b>						<b>(9)</b>
Introduction to resources, Characteristics of resources-Types of resources, manpower, Equipment, Material, Money, Time - Tools for measurement of resources.						
<b>MODULE 2: RESOURCE PLANNING</b>						<b>(9)</b>
Resource Planning- Planning for material, Labour, time and cost-Resources Utilization, material, Labour, time and cost - Procurement- inventory control						
<b>MODULE 3: MATERIAL, EQUIPMENT AND LABOUR</b>						<b>(9)</b>
Material: identification of materials, quantity of material, sources, Transportation, Delivery and Distribution- purchase management-store management. Equipment: types of equipment used in construction, Planning and selection of equipment, equipment maintenance and replacements of an equipment. Labour: Introduction to Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour, labour productivity.						
<b>MODULE 4: TIME MANAGEMENT</b>						<b>(9)</b>
Time Management- planning and scheduling - Managing time on the project- forecasting the future, Critical path measuring the changes and their effects. Cost control- objectives of cost, time and quality ,Cash flows and cost control, Time-cost trade off.						
<b>MODULE 5: RESOURCE ALLOCATION</b>						<b>(9)</b>
Resource allocation- resource leveling, resource smoothing- - examples of resource list, Resource allocation graph, Resource loading- Computer application in resource management -Value Management.						
<b>TEXT BOOKS</b>						
1.	Glenn .A, Sea's and Reichard, Clough .H, "Construction Project Management", John Wiley and Sons, Inc, 2009					

2.	Harvey, A. Levine, "Project Management using Micro Computers", Obsome McGraw Hill C.A. Publishing Co., Inc. 2008
3.	James, A., Adrain, "Quantitative Methods In Construction Management", American Elsevier Publishing Co., Inc., 2003.
<b>REFERENCES BOOKS</b>	
1.	Andrew, D. Szilagg, "Hand Book of Engineering Management", 2002.

COURSE TITLE		FORENSIC ENGINEERING			CREDITS	3
COURSE CODE	CEA4743	COURSE CATEGORY	ELE	L-T-P	3-0-0	
CIA	50%			ESE	50%	
LEARNING LEVEL	BTL 2					
CO	COURSE OUTCOMES				PO	
Students will be able to						
1.	Describe the scope of forensic engineering, and be aware of the ethics and responsibilities.				1,2,4,7,10	
2.	Analyze and identify the different causes of failure in buildings and structures				1,2,4,7,10	
3.	Inspect failures and damages and conduct forensic investigations				1,2,4,7,8,10	
4.	Develop theoretical analyses and failure hypotheses for damaged structures.				1,2,4,7,8,10	
5.	Prepare forensic reports, be aware of legal issues and appear as expert witnesses.				1,3,7,10	
<b>Prerequisites : Nil</b>						
<b>MODULE 1: FORENSIC ENGINEERING PRACTICE</b>						<b>(9)</b>
Introduction- qualification of the forensic engineer, ethics and professional responsibilities, resource and professional organizations, opportunities in forensic engineering practice, learning from failures- historical context, definition, causes, failure reduction strategies, expert consultant and witness.						
<b>MODULE 2: CAUSES OF FAILURE</b>						<b>(9)</b>
Wind damage to residential structures, lightning damage, building collapse due to roof leakage, hail damage and water infiltration, damage due to blasts and explosion, fire, electrical shorting, industrial accidents, vehicle impact and traffic accidents, bridge failure.						
<b>MODULE 3 : INVESTIGATION OF FAILURES</b>						<b>(9)</b>
The first steps after a failure- safety, preserve perishable evidence, collapse configuration, reserving samples, failed and un failed components, documentation of conditions – photographs, video, interviews, field tests - civil engineering investigation, structural and geotechnical investigations, laboratory.						
<b>MODULE 4: INSPECTION ASSESSMENT</b>						<b>(9)</b>
Document collection and review, theoretical analyses, failure hypothesis, data analysis. Forensic inspection assessment of damage to residential buildings, concrete and steel structures, masonry structures, foundation walls, roof systems, bridges, traffic accident reconstruction.						
<b>MODULE 5: REPORTS AND LEGAL ASPECT</b>						<b>(9)</b>
Report- thinking and planning, conducting the investigation, data distillation and distribution, delivery. Forensic photogrammetry – photographic testimony and techniques, reconstruction methods. Legal concerns after failure – ethical consideration, claim analysis, litigation and dispute resolution.						

<b>TEXT BOOKS</b>	
1.	Kenneth L. Carper, "Forensic Engineering", CRC Press, 2001
2.	Randall K Noon, "Forensic Engineering Investigation", CRC Press, 2001
<b>REFERENCES BOOKS</b>	
1.	Stephen E. Petty, "Forensic engineering-damage assessments for residential and commercial structures", CRC Press, 2013, ISBN: 13:978-1-4398-9974-8
2.	Proceedings of the 7 <sup>th</sup> Congress on Forensic Engineering, ASCE, Florida 2015

COURSE TITLE		DESIGN OF SUBSTRUCTURES		CREDITS	3	
COURSE CODE		CEA4744	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 3				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1	Execute subsurface exploration and select appropriate drilling, sampling and field testing techniques for different soils.				1,2,3,9,10	
2	Design shallow foundation.				1,2,3,5,9,10	
3	Design deep foundation.				1,2,3,5,9,10	
4	Design foundations for tower and caisson foundation.				1,2,3,5,9,10	
5	Design machine foundation used in industrial structures.				1,2,3,5,9,10	
<b>Prerequisites:</b> Nil						
<b>MODULE 1: SUB SURFACE EXPLORATION</b>					<b>(9)</b>	
Purpose - Programme and Procedures - Interpretation of bore logs, soil data and exploration reports.						
<b>MODULE 2: SHALLOW FOUNDATIONS</b>					<b>(9)</b>	
Types of foundations and their specific applications - depth of foundation - bearing capacity and settlement estimates - structural design of isolated footings, strip, rectangular and trapezoidal combined footings - strap - balanced footings - raft foundation - Approximate flexible method of raft design - Compensated foundations.						
<b>MODULE 3: DEEP FOUNDATIONS</b>					<b>(9)</b>	
Types of Piles and their applications - Load capacity - Settlements - Group action - Design of piles and pile caps - Lateral load capacity of piles.						
<b>MODULE 4: FOUNDATIONS FOR BRIDGES AND OTHER MISCELLANEOUS STRUCTURES</b>					<b>(9)</b>	
Drilled shaft foundations and caissons for bridges - Foundations for towers - Chimneys - Silos - Structural Design of supports for foundation excavations - Design of Anchors.						
<b>MODULE 5: MACHINE FOUNDATIONS</b>					<b>(9)</b>	
Types - General requirements and design criteria - General analysis of machine-foundations-soil system - Stiffness and damping parameters - Tests for design parameters - Guide lines for design of reciprocating engines, impact type machines, rotary type machines, framed foundation						
<b>TEXT BOOKS</b>						
1	Thomlinson, M.J. and Boorman. R. "Foundation Design and Construction", ELBS Longman VI edition, 1995.					
<b>REFERENCE BOOKS</b>						
1	Nayak, N.V., "Foundation Design manual for Practicing Engineers", DhanpatRai and Sons, 1982.					
2	Winterkorn H.F., and Fang H.Y., "Foundation Engineering Hand Book - Van Nostrard - Reinhold - 1976					

COURSE TITLE		SYSTEM INTEGRATION IN CONSTRUCTION		CREDITS	3	
COURSE CODE		CEA4745	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1.	Describe properties of sound waves and the characteristics of the human ear.				1,2,4,9	
2.	Identify and select acoustic material for building construction based on their properties.				1,2,4,7,9	
3.	Apply the principles of transmission of sound in its control and insulation.				1,2,4,7,9	
4.	Identify and select apt insulation for different building components and machinery.				1,2,4,7,9	
5.	Apply basic principles of acoustic design for different building applications.				1,2,4,7,9	
<b>Prerequisites : Nil</b>						
<b>MODULE 1: INTRODUCTION</b>					<b>(9)</b>	
Sound waves, Frequency, Intensity, Wave length, Measurement of sound, Decibel scale speech and music frequencies, human ear characteristics-Tone structure.						
<b>MODULE 2: PROPERTIES OF ACOUSTIC MATERIAL</b>					<b>(9)</b>	
Outdoor noise levels - acceptable indoor noise levels-IS codes –sono meter, determinate of density of a given building material, absorption co-efficient and measurements, choice of absorption material, resonance, reverberation, echo, exercises involving reverberation time and absorption co-efficient.						
<b>MODULE 3: NOISE CONTROL</b>					<b>(9)</b>	
Types of noises, transmission of noise, transmission loss, noise control and sound insulation, remedial measures and legislation						
<b>MODULE 4: INSULATION OF MACHINERY</b>					<b>(9)</b>	
Walls/partitions, floors/ceilings, windows/doors, insulating fittings and gadgets machine mounting and insulation of machinery.						
<b>MODULE 5: BASIC PRINCIPLES IN ACOUSTICS DESIGN</b>					<b>(9)</b>	
Site selection, shape, volume, treatment for interior surfaces-basic principles in designing open air theatres, cinemas, broadcasting studios, concert halls, class rooms, lecture halls and theatres for acoustics.						
<b>TEXT BOOKS</b>						
1.	Narasimhan. V.Dr., "An introduction to Building Physics", Kabeer printing works, chennai-5, 2004.					
2.	Groomet. D.J, "Noise, Building and People", Pergumon Press, 2007.					
<b>REFERENCES BOOKS</b>						
1.	Thomas D. North wood, "Architecture acoustics", dowden, Hutchinson and Ross Inc., 2007					

2.	Smith B. J., R. J. Peters, Stephanie Owen, "Acoustics and Noise Control", Longman Group Ltd.- New york ,USA, 2002
3.	<a href="http://www.sounddesigns.net">http: www.sounddesigns.net</a>
4.	<a href="http://www.acs-psu.edu">http: www.acs-psu.edu</a>

COURSE TITLE		DESIGN OF PLATES, SHELLS AND SPATIAL STRUCTURES		CREDITS	3
COURSE CODE	CEA4746	COURSE CATEGORY	ELE	L-T-P	3 -0- 0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL3				
CO	COURSE OUTCOMES			PO	
The Students will be able to					
1	Describe Bending of rectangular and circular plates.			1,2,3,9,10	
2	Analyse and Design folded plates.			1,2,3,9,10	
3	Design cylindrical and circular shells.			1,2,3,9,10	
4	Describe the design concepts of space frames.			1,2,3,9,10	
5	Design space frames.			1,2,3,9,10	
<b>Prerequisites: Nil</b>					
<b>MODULE 1: THIN PLATES WITH SMALL DEFLECTION</b>					<b>(9)</b>
Equation of equilibrium and deformation of plates - Bending of rectangular plates and circular plates. Navier's solution and Levy's method.					
<b>MODULE 2: ANALYSIS OF PLATES AND FOLDED PLATES</b>					<b>(9)</b>
Energy method, finite difference and finite element methods for solution of plate bending problems. Principles of design of folded plates					
<b>MODULE 3: ANALYSIS AND DESIGN OF SHELLS</b>					<b>(9)</b>
Geometry of shells - Classification of Shells - membrane theory of circular and cylindrical shells - Detailed Analysis and design of cylindrical shells - Detailing of Reinforcement in shells, edge beams and transfer beam					
<b>MODULE 4: DESIGN OF SPACE FRAMES</b>					<b>(9)</b>
Space frames - configuration - types of nodes - general principles of design Philosophy - Behaviour.					
<b>MODULE 5: ANALYSIS AND DESIGN OF SPACE FRAMES</b>					<b>(9)</b>
Analysis of space frames - Formex Algebra, FOR MAIN - detailed design of space frames					
<b>TEXT BOOKS</b>					
1	P.C.Varghese, Design of Reinforced Concrete Shells and Folded Plates,2010.				
2	Ramasamy, G.S. Design and Construction of Concrete shells roofs, CBS Publishers, 1986.				
3	J. N. Reddy Theory and Analysis of Elastic Plates and Shells (Series in Systems and Control) 2006				
<b>REFERENCE BOOKS</b>					
1	Principles of space structures by Dr.N. Subramanian - 1999, Wheeler Publishing Co.				
2	Proceedings of International Conference on Space structures, Anna University, November 1997.				

COURSE TITLE		PRE-FABRICATED STRUCTURES			CREDITS	3
COURSE CODE		CEA4747	COURSE CATEGORY	ELE	L:T:P	3-0-0
CIA		50%			ESE	50%
LEARNING LEVEL		BTL - 4				
CO	COURSE OUTCOMES					PO
<b>The Students will be able to</b>						
1	Describe prefabrication system					1,2,3,4,5,6,12 ,PSO 1,2
2	Describe various Prefabricated components					1,2,3,4,5,6,12 ,PSO 1,2
3	Adopt the principles involved in prefabrication					1,2,3,4,5,6,12 ,PSO 1,2
4	Describe the joints involved in structural connections					1,2,3,4,5,6,12 ,PSO 1,2
5	Design prefabrication components for earthquakes and cyclones					1,2,3,4,5,6,12 ,PSO 1,2
<b>Prerequisites : Construction Techniques Equipment &amp; Practices</b>						
<b>MODULE 1: INTRODUCTION</b>						<b>(9)</b>
Need for prefabrication - Principles - Materials - Modular coordination - Standardization - Systems - Production - Transportation - Erection.						
<b>MODULE 2: PREFABRICATED COMPONENTS</b>						<b>(9)</b>
Behaviour of structural components - Large panel constructions - Construction of roof and floor slabs - Wall panels - Columns - Shear walls						
<b>MODULE 3: DESIGN PRINCIPLES</b>						<b>(9)</b>
Disuniting of structures- Design of cross section based on efficiency of material used - Problems design because of joint flexibility - Allowance for joint deformation.						
<b>MODULE 4: JOINT IN STRUCTURAL</b>						<b>(9)</b>
Joints for different structural connections - Dimensions and detailing - Design of expansion joints						
<b>MODULE 5: DESIGN FOR ABNORMAL LOADS</b>						<b>(9)</b>
Progressive collapse - Code provisions - Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.						
<b>TEXT BOOKS</b>						
1	CBRI, Building materials and components, India, 1990					

2	Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
<b>REFERENCE BOOKS</b>	
1	Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
2	Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
<b>E BOOKS</b>	
1	<a href="http://rtvacademy.org/a14e5/design-principles-of-prefabricated-structures.pdf">rtvacademy.org/a14e5/design-principles-of-prefabricated-structures.pdf</a>
2	<a href="http://Personal.cityu.edu.hk/~bswmwong/photo_lib/pdf/prefabricated.pdf">Personal.cityu.edu.hk/~bswmwong/photo_lib/pdf/prefabricated.pdf</a>
3	<a href="https://books.google.com/books/about/Prefabricated_Structures">https://books.google.com/books/about/Prefabricated_Structures</a>
<b>MOOC</b>	
1	<a href="http://www.tatainteractive.com/.../Designing_MOOCs-A_White_Paper_on_ID_for_MOOCs...">www.tatainteractive.com/.../Designing_MOOCs-A_White_Paper_on_ID_for_MOOCs...</a>

COURSE TITLE		PROJECT ECONOMICS AND FINANCIAL MANAGEMENT		CREDITS	3
COURSE CODE	CEA4748	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA	50%			ESE	50%
LEARNING LEVEL	BTL 2				
CO	COURSE OUTCOMES				PO
Students will be able to					
1.	Describe economics in relation to civil engineering, market demand and supply choice of technology				1,7,9
2.	Apply knowledge of construction economics in housing, transport, infrastructure, environment, materials and labour.				1,2,3,7,9 10
3.	Apply principles of finance in borrowing, generation of funds, budgeting, analysis of financial statement, balance sheet, Investment and financing decision.				1,2,3,5,7,9
4.	Identify and apply different accounting methods in different stages of completion of projects and be aware of tax reporting.				1,2,5,7,9,1 0
5.	Describe and identify security and risk aspects in the loans and interim construction financing.				1, 7,8,9, 10
<b>Prerequisites : Nil</b>					
<b>MODULE 1: ECONOMICS</b>					<b>9</b>
Role of Civil Engineering in Industrial Development-Advances in Civil Engineering and engineering economics-Support matters of Economy as related top Engineering-Market demand and supply-Choice of technology- Quality control and Quality Production-Audit in economic law of returns governing production.					
<b>MODULE 2: CONSTRUCTION ECONOMICS</b>					<b>9</b>
Development in housing, Transport and other infrastructures-Economics of Ecology, environment, energy resources-Local material selection-Form and Functional designs-Construction workers-Urban problems-Poverty-Migration-Unemployment-pollution.					
<b>MODULE 3: FINANCING</b>					<b>9</b>
The need for financial management-Types of financing-Short term borrowing-Long term borrowing-Leasing -Equity financing-Internal generation of funds-External commercial borrowings-Assistance from Government Budgeting support and International finance corporations-Analysis of financial statements-Balance sheet-Profit and loss account-Cash flow and fund flow analysis-Ratio analysis-Investment and financing decision-Financial control-Job control and Centralized management.					
<b>MODULE 4: ACCOUNTING METHOD</b>					<b>9</b>
General Overview-Cash basis of accounting-Accrual basis of accounting-Percentage completion method-Completed contract method-Accounting for Tax reporting purposes and Financial reporting purposes.					
<b>MODULE 5: LENDING TO CONTRACTORS</b>					<b>9</b>
Loans to Contractors-Interim construction financing-Security and risk aspects.					
<b>TEXT BOOKS</b>					
1.	Warneer Z Hirsch, "Urban Economics", Macmillan, New York, 1993.				

2.	Prasanna Chandra, "Projects - Planning Analysis Selection Implementation & Review", Fourth Edition, Tata McGraw Hill Publishing Co., Ltd, New Delhi, 1995.
<b>REFERENCES BOOKS</b>	
1.	Kwaku A., Tenah and Jose M. Guevera, "Fundamental of Construction Management and Organization", Prentice Hall of India, 1995.
2.	Halpin, D.W., "Financial and cost concepts for construction Management", John Wiley and Sons New York, 1985.
3.	Madura J. and Veit, E.T., "Introduction to Financial Management", West Publishing Co., St.Paul, 1988.

COURSE TITLE		CONSTRUCTION EQUIPMENT MANAGEMENT		CREDITS	3	
COURSE CODE		CEA4749	COURSE CATEGORY	ELE	L-T-P	3-0-0
CIA		50%		ESE	50%	
LEARNING LEVEL		BTL 2				
CO	COURSE OUTCOMES				PO	
Students will be able to						
1.	Describe the equipment management in construction projects.				1,2,3,7,9	
2.	Explain the various construction equipment involved in earth work excavation				1,2,7,9	
3.	Identify and explain the different components involved in under water and underground equipment.				1,2,7,9	
4.	Describe the basic concept of different material handling techniques in construction				1,2,7,9	
5.	Identify the latest equipment involved in aggregate production, concreting, asphalt mixing and laying				1,2,3,7,9	
<b>Prerequisites : Nil</b>						
<b>MODULE 1: CONSTRUCTION EQUIPMENT MANAGEMENT</b>					<b>(9)</b>	
Identification-Planning-Equipment management in projects –Spare Parts Management- Economics of construction Equipment-Maintenance management- Replacement-Cost control of Equipment-Depreciation Analysis-Safety Management						
<b>MODULE 2: EQUIPMENT OF EARTHWORK</b>					<b>(9)</b>	
Fundamentals of earthwork operations- Equipment for compaction -Earth moving operations- Types of Earthwork Equipment-Tractors, Motor Graders, Scrapers, Front end waders, Earth Movers.						
<b>MODULE 3: OTHER CONSTRUCTION EQUIPMENT</b>					<b>(9)</b>	
Equipment for Dredging, Trenching, Tunnelling, Drilling, Blasting- Erection Equipment-Types of pumps used in construction-Equipment for Dewatering and Grouting-Foundation and Pile Driving Equipment.						
<b>MODULE 4: MATERIALS HANDLING EQUIPMENT</b>					<b>(9)</b>	
Forklifts and Related Equipment-Portable Material Bins-Conveyors-Hoists, Cranes, Hauling Equipment.						
<b>MODULE 5: AGGREGATE PRODUCTION, CONCRETING AND ASPHALT EQUIPMENTS</b>					<b>(9)</b>	
Crushers-Feeders-Screening Equipment-Handling Equipment-Batching and Mixing Equipment Asphalt mixing plant, Asphalt laying Equipment, Air compressors-Equipment Hauling, Pouring and Pumping Equipment-Transporters.						
<b>TEXT BOOKS</b>						
1	Roy Chudley and Roger Greeno, “ Advanced Construction Technology” , Pearson Education Limited, 4th edition, 2006, ISBN-10 0-132-01985-X ,SBN-13 978-0-13-201985-9					
2	Robertwade Brown, "Practical foundation engineering hand book ", McGraw Hill Publications, 2nd Edition, 2000					
3	Sharma S.C. “Construction Equipment and Management”, Khanna Publishers, Delhi, Edition:1, 2016 ISBN: 9789382609056, 9382609059					

**REFERENCES BOOKS**

1	Mcgraw Higher Ed, "Construction Planning, Equipment and Methods" , Clifford J. Schexnayder, 7 th Edition, 2013.
2	Patrick Powers. J., " Construction Dewatering: New Methods and Applications ", John Wiley and Sons, 3rd Edition, 2007.
3	Jerry Irvine, "Advanced Construction Techniques ", CA Rocketr, 1984.