AC 15/04/2019
ITEM NO: 4.51

UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

FACULTY OF TECHNOLOGY

Civil Engineering

Second Year with Effect from A.Y. 2017-18

Third Year with Effect from A.Y. 2018-19

Final Year with Effect from A.Y. 2019-20

As per Choice Based Credit and Grading System

with effect from the A.Y. 2016–17

Dean, Faculty of Science and Technology

Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development. Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, semester-based credit and grading system is also introduced to ensure quality of engineering education. Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scales to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc. Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017- 18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Dean(I/c) Faculty of Science and Technology,

Member - Academic Council,

University of Mumbai, Mumbai

Chairman

Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome-based education in the process of curriculum development. As the Chairman, Board of Studies in Civil Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brain storming session, which was attended by more than 40 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The Program Educational Objectives finalized for the undergraduate program in Civil Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process
4. To prepare the Learner for a successful career in Indian and Multinational Organisations In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome-based education.

I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Dr. S. K. Ukarande

Chairman, Board of Studies in Civil Engineering,

University of Mumbai

University of Mumbai

Scheme of Instructions and Examination

Second Year Engineering (Civil Engineering)

(With effect from 2017- 2018)

(Semester-III)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C301	Applied Mathematics -III*	4	-	1	4	-	1	5
CE-C302	Surveying- I	4	2	-	4	1	-	5
CE-C303	Strength of Materials	4	2	-	4	1	-	5
CE-C304	Engineering Geology	3	2	-	3	1	-	4
CE-C305	Fluid Mechanics-I	3	2	-	3	1	-	4
Total		**18**	**8**	**1**	**18**	**4**	**1**	**23**

Subject Code	Subject Name	Examination Scheme							
		Theory					TW	Oral & Practical	Total
		Internal Assessment			End Sem Exam	Exam Duration			
		Test1	Test2	Avg					
CE-C301	Applied Mathematics- III	20	20	20	80	3	25	-	125
CE-C302	Surveying- I	20	20	20	80	3	25	25**	150
CE-C303	Strength of Materials	20	20	20	80	3	25	25	150
CE-C304	Engineering Geology	20	20	20	80	3	25	25	150
CE-C305	Fluid Mechanics -I	20	20	20	80	3	25	25	150
Total		--	--	**100**	**400**	-	**125**	**100**	**725**

*Common with Mechanical/ Automobile/ Mechatronics

** For the course ‘Surveying-I (CE-C 302)”, the oral examination will be conducted in conjunction with practical/s

University of Mumbai
Scheme of Instructions and Examination

Second Year Engineering (Civil Engineering)

(With effect from 2017- 2018)

(Semester -IV)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CE-C401	Applied Mathematics-IV*	4	-	1	4	-	1	5
CE-C402	Surveying-II	3	3	-	3	1.5	-	4.5
CE-C403	Structural Analysis-I	4	2	-	4	1	-	5
CE-C404	Building Design & Drawing	2	3	-	2	1.5	-	3.5
CE-C405	Building Materials & Construction Technology	4	2	-	4	1	-	5
CE-C406	Fluid Mechanics-II	3	2	-	3	1	-	4
Total		**20**	**12**	**1**	**20**	**6**	**1**	**27**

Subject Code	Subject Name	Examination Scheme							
		Theory					TW	Oral & Practical	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
CE-C401	Applied Mathematics- IV*	20	20	20	80	3	25	--	125
CE-C402	Surveying-II	20	20	20	80	3	50	25**	175
CE-C403	Structural Analysis-I	20	20	20	80	3	25	25	150
CE-C404	Building Design & Drawing	20	20	20	80	4	25	25@	150
CE-C405	Building Materials & Construction Technology	20	20	20	80	3	25	25	150
CE-C406	Fluid Mechanics-II	20	20	20	80	3	25	25	150
Total		--	--	**120**	**480**	--	**175**	125	**900**

* Common with Mechanical/ Automobile/ Mechatronics

** For the course ‘Surveying-II (CE-C 402), the oral examination will be conducted in conjunction with practical/s

@ For the course ‘Building Design and Drawing (CE-C 404)’, the oral examination shall be conducted in conjunction with the sketching examination.

University of Mumbai
Scheme of Instructions and Examination

Third Year Engineering (Civil Engineering)

(With effect from 2018- 2019)

(Semester -V)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Practs.	Tut.	Total
CE-C501	Structural Analysis – II	4	2	--	4	1	--	5
CE-C502	Geotechnical Engineering – I	3	2	--	3	1	--	4
CE-C503	Applied Hydraulics	3	2	--	3	1	--	4
CE-C504	Environmental Engineering -I	3	2	--	3	1	--	4
CE-C505	Transportation Engineering – I	3	2	--	3	1	--	4
CE-DLO506X	Department Level Optional Course – I	3	2	--	3	1	--	4
CE-C507	Business and Communication Ethics	--	4#	--	--	2	--	2
Total		**19**	**16**		**19**	**8**	**-**	**27**

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Practs.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (In Hrs.)				
		Test 1	Test 2	Avg						
CE-C501	Structural Analysis-II	20	20	20	80	3	25	--	25	150
CE-C502	Geotechnical Engineering – I	20	20	20	80	3	25	--	25	150
CE-C503	Applied Hydraulics	20	20	20	80	3	25	--	25	150
CE-C504	Environmental Engineering -I	20	20	20	80	3	25	--	25	150
CE-C505	Transportation Engineering – I	20	20	20	80	3	25	--	25	150
CE-DLO506X	Department Level Optional Course -I	20	20	20	80	3	25	--	25	150
CE-C507	Business and Communication Ethics	--	--	--	--	--	50*	--	--	50
Total		**--**	**--**	**120**	**480**	**--**	**200**	**--**	**150**	**950**

University of Mumbai
Scheme of Instructions and Examination
Third Year Engineering (Civil Engineering)
(With effect from 2018- 2019)
(Semester -VI)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Practs	Tut.	Total
CE-C601	Geotechnical Engineering. – II	3	2	--	3	1	--	4
CE-C602	Design and Drawing of Steel Structures	4	2	--	4	1	--	5
CE-C603	Transportation Engineering. – II	3	2	--	3	1	--	4
CE-C604	Environmental Engineering. – II	3	2	--	3	1	--	4
CE-C605	Water Resource Engineering –I	3	2	--	3	1	--	4
CE-DLO606X	Department Level Optional Course – II	3	2	--	3	1	--	4
CE-C607	Software Applications in Civil Engineering	--	2	--	--	1	--	1
Total		**19**	**14**	**--**	**19**	**7**	**--**	**26**

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (InHrs.)				
		Test1	Test2	Avg						
CE-C601	Geotechnical Engineering-II	20	20	20	80	3	25	--	25	150
CE-C602	Design and Drawing of Steel Structures	20	20	20	80	4	25	--	25@	150
CE-C603	Transportation Engineering- II	20	20	20	80	3	25	--	--	125
CE-C604	Environmental Engineering-II	20	20	20	80	3	25	--	25	150
CE-C605	Water Resource Engineering-I	20	20	20	80	3	25	--	25	150
CE-DLO606X	Department Level Optional Course-II	20	20	20	80	3	25	--	25	150
CE-C607	Software Applications in Civil Engineering	--	--	--	--	--	25		25	50
Total		**120**	**120**	**120**	**480**		**175**	**--**	**150**	**925**

For the course ‘Business and Communication Ethics (CE- C507), although 04 (Four) clock hours are mentioned under the head of Practical, 02 (Two) clock hours out of these 04 (Four) clock hours may be utilized as the Theory at the Institute/ College Level so as to enable the instructor (teacher) to impart the theoretical aspects of the said course. Accordingly, the provision may be made in the Time Table.

* Further, the oral examination in respect of the course ‘Business and Communication Ethics (CE-C 507)’ will be an internal oral and will be conducted in conjunction with seminar/ presentation.

@ For the course, Design and Drawing of Steel Structures (CE-C 602), the oral examination will be conducted in conjunction with sketching.

Department Level Optional Course –I	**Department Level Optional Course- II**
CE-DLO5061: Advanced Surveying	CE-DLO6061: Advanced Construction Equipment
CE-DLO5062: Advanced Concrete Technology	CE-DLO6062: Traffic Engineering and Management
CE-DLO5063: Building Services and Repairs	CE-DLO6063: Ground Improvement Techniques
CE-DLO5064: Advanced Structural Mechanics	CE-DLO6064: Advanced Structural Analysis

University of Mumbai
Scheme of Instructions and Examination
Fourth Year Engineering (Civil Engineering)
(With effect from 2019-2020)
(Semester -VII)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs.	Tut.	Theory	Pract.	Tut.	Total
CE-C701	Quantity Survey Estimation and Valuation	4	2	--	4	1	-	5
CE-C702	Theory of Reinforced Concrete Structures	4	--	2	4		2	6
CE-C703	Water Resource Engineering -II	3	--	2	3	--	2	5
CE-DLO704X	Department Level Optional Course-III	3	--	2	3	--	2	5
ILO701X	Institute Level Optional Course-I	3	--		3	--		3
CE-C705	Project – Part I	--	6	--	--	3	--	3
Total		**17**	**8**	**6**	**17**	**4**	**6**	**27**

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (InHrs.)				
		Test1	Test 2	Avg						
CE-C701	Quantity Survey Estimation and Valuation	20	20	20	80	4	25	--	25	150
CE-C702	Theory of Reinforced Concrete Structures	20	20	20	80	3	25	--	25	150
CE-C703	Water Resource Engineering-II	20	20	20	80	3	25	--	25	150
CE-DLO704X	Department Level Optional Course-III	20	20	20	80	3	25	--	25	150
ILO701X	Institute Level Optional Course I	20	20	20	80	3	--	--	-	100
CE-P705	Project – Part I	--	--	--	--	--	50	--	25@	75
Total		**100**	**100**	**100**	**400**		**150**	**--**	**125**	**775**

@ For Project Part-I (CE-P 705), the oral examination shall be based on the presentation/ seminar before the board of internal examiners to be appointed by the Head of the concerned Department.

University of Mumbai
Scheme of Instructions and Examination
Fourth Year Engineering (Civil Engineering)
(With effect from 2019-2020)
(Semester- VIII)

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practs	Tut.	Theory	Practs	Tut	Total
CE-C801	Design and Drawing of Reinforced Concrete Structures	4	2	--	4	1	-	5
CE-C802	Construction Management	4	2	--	4	1	-	5
CE-DLO803X	Department Level Optional Course- IV	4	2	--	4	1	--	5
ILO802X	Institute Level Optional Course- II	3	--	--	3	--	--	3
CE-P804	Project – Part II	--	12	--	--	6	--	6
Total		**15**	**18**	**-**	**15**	**9**	**-**	**24**

Subject Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (In Hrs.)				
		Test1	Test 2	Avg						
CE-C801	Design and Drawing of Reinforced Concrete Structures	20	20	20	80	4	25	--	25	150
CE-C802	Construction Management	20	20	20	80	3	25	--	25	150
CE-DLO803X	Department Level Optional Course-IV	20	20	20	80	3	25	--	25	150
ILO802X	Institute Level Optional Course II	20	20	20	80	3	25	--	--	100
CE-P804	Project – Part II	--	--	--			50	--	50#	100
Total		**80**	**80**	**80**	**320**		**150**		**125**	**650**

The oral examination for the Project- Part II (CE-P 804) shall be based on the presentation/ seminar to be delivered by the projectee/s before the board of examiners. The board of internal examiners will comprise of the internal examiners and the external examiners to be approved by the University from the pool of eligible examiners.

Guidelines for Project, i.e., Dissertation (Part-I and II)

(i) Students can form groups with minimum of 2 (Two) students and not more than 4 (Four) students.
(ii) Faculty load: In Semester VII: 01 (One) clock hour per week per project group and in Semester VIII: 02 (Two) clock hours per week per project group.
(iii) Each faculty member shall be permitted to guide maximum 04 (Four) project groups.

Department Level Optional Course – III (Semester – VII)	**Department Level Optional Course – IV** (Semester – VIII)
CE-DLO7041: Pre-stressed Concrete CE-DLO7042: Solid Waste management CE-DLO7043: Pavement Sub-grade and Materials CE-DLO7044: Structural Dynamics CE-DLO7045: Application of GIS and Remote Sensing CE-DLO7046: Foundation Analysis and Design	CE-DLO8031: Advanced Design of Steel Structures CE-DLO8032: Industrial Waste Treatment CE-DLO8033: Pavement Design and Construction CE-DLO8034: Bridge Engineering and Design CE-DLO8035: Appraisal and Implementation of Infrastructure Projects CE-DLO8036: Soil Dynamics CE-DLO8037: Applied Hydrology and Flood Control

Institute Level Optional Course – I (Semester –VII)	**Institute Level Optional Course – II** (Semester – VIII)
ILO7011: Product Lifecycle Management ILO7012: Reliability Engineering ILO7013: Management Information Systems ILO7014: Design of Experiments ILO7015: Operations Research ILO7016: Cyber Security and Laws ILO7017: Disaster Management and Mitigation Measures ILO7018: Energy Audit and Management ILO7019: Development Engineering	ILO8021: Project Management ILO8022: Finance Management ILO8023: Entrepreneurship Development and Management ILO8024: Human Resources Management ILO8025: Professional Ethics and Corporate Social Responsibility (CSR) ILO8026: Research Methodology ILO8027: Intellectual Property Rights and Patenting ILO8028: Digital Business Management ILO8029: Environment Management

Semester-VII

Semester VII		
Subject Code	**Subject Name**	**Credits**
CE-C 701	**Quantity Survey, Estimation & Valuation**	**5**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**02**	**--**	**04**	**01**	**--**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**04 Hrs.**	**25**	**-**	**25**	**150**

Rationale

Any structure, i.e., building, bridge, dam etc. consists of various building materials. Due to rise in the cost of materials, the structure has to be designed so that it is safe, serviceable and economical. Without proper design and estimation, it may lead to the increase in cost of construction and it further affects the economical aspect of the structure. A prior knowledge of various building materials is required for the construction and it controls the cost of the structure, save wastage of labour-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in scheduling of men, materials and machine to be used in the project at stages. The scope of the subject includes estimating, costing, analysis of rates, specification, valuation, tender and contracts etc.

Objectives

- To read, understand and interpret plans, sections, detailed drawings and specifications for a construction project.
- To study the various methods of detailed and approximate estimates.
- To emphasize the importance of relevant IS: 1200- 1964 codes and relevant Indian Standard specifications, taking out quantities from the given requirements of the work, and drafting specifications.
- To conduct a material and labour survey to understand the current market rates for the various materials required for construction and the different categories of labour required.
- To perform the rate analysis for various items: standard and non-standard and the use of DSR in this process.
- To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.

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Detailed Syllabus			
Module	**Sub-Modules/ Contents**		**Hrs**
I.	**Introduction**		**04**
	1.1	Importance of Course	
	1.2	Measurement systems for various items of civil engineering structures.	
	1.3	Units of measurement of various items of works	
	1.4	I.S1200	
II.	**Specifications & Rate Analysis**		**09**
	2.1	Types & importance of specifications, rules to be followed for drafting the specifications of various items of work etc	
	2.2	Rate analysis, its importance & necessity, Factors affecting rate analysis, Task work, sources of materials, Study of IS 7272 regarding labour output ,District Schedule of Rates(DSR) Rate analysis of important items of construction works.	
III.	**Estimates**		**14**
	3.1	**Approximate Estimate** Definition & Purposes of approximate estimates, Methods for preparing approximate estimates & numerical based on methods, Various terms such as administrative approval, Technical sanction, Contingencies, Work charged establishments etc.	
	3.2	**Detailed Estimate** Definition & purposes of detailed estimate, Data required for preparation of detailed estimate. Methods of taking out quantities such as long wall & short wall method, Centre line method etc Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structural elements as per code IS2502.Preparation of detailed estimate of R.C.C framed structures	
IV.	**Estimation of Earthwork for Roads & Canals**		**06**
	4.1	Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula, Trapezoidal formula, Spot level method etc. & numericals based on methods. Mass haul diagram & its necessity, Terms like lead & lift etc.	
V.	**Tenders & Contracts**		**09**
	5.1	**Tenders** Definition & types of tenders, Tender notice & its inclusions, Pre-qualification of contractors, Pre-bid meeting, Procedure for submission & Opening of tender, acceptance & rejection of tender, Tender validity period, E-Tendering	
	5.2	**Contracts** Definition, basic forms such as Valid, void & voidable contract. General types of contract with their suitability, conditions of contract	
	5.3	**Dispute resolution methods** Causes of disputes & disputes resolution methods such as litigation, mediation & arbitration	

VI.	**Valuation**		**10**
	6.1	Difference between cost, price & value. Types of value, Valuation & its purposes. Various terms such as depreciation, sinking fund, capitalized value, years purchase etc. Methods for calculating depreciation of building	
	6.2	Methods of valuation such as Rental method, land & building method, Belting method etc.	
	6.3	Freehold Properties, Leasehold Properties, Easement rights	
	6.4	Numericals based on valuation	

Contribution to Outcomes

On completion of the course, the learners will be able to:

- **Apply** the measurement systems to various civil engineering items of work.
- **Draft** the specifications for various items of work & determine unit rates of items of works
- **Estimate** approximate cost of the structures by using various methods & **prepare** detailed estimates of various civil engineering structures by referring drawings.
- **Assess** the quantities of earthwork &**construct** mass haul diagrams.
- **Draft** tender notice &**demonstrate** the significance of the tender as well as contract process.
- **Determine** the present fair value of any constructed building at stated time.

Theory examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** based on computation of quantities of various items of work by referring drawings.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the modules shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral examination will be based on the entire syllabus and the term work.

Term Work:

The term work shall consist of the following:

- At least **eight** assignments based on entire syllabus

- Detailed estimate of any **Three** of the following with the required material survey for the same.

- Single Storied building (RCC)
- Load bearing structure
- Road work
- Cross drainage work

- Valuation report in a standard format of the Government/ Private company/Firm.

The use of quantity survey software and the use of worksheets/databases while solving some of the afore-mentioned assignments is desirable.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weight age of marks shall be given for different components of the term work.

Assignments : 20 Marks **Attendance : 05 Marks**

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1) Estimating, Costing, Specifications and Valuation: *Chakraborty, M.,* Kolkata.

2) Building and Engineering Contracts: *Patil, B. S.,* University Press, Hyderabad.

3) Estimating and costing: *Datta, B. N.,* UBS Publications

4) Relevant Indian Standard Specifications, BIS Publications

5) World Bank approved contract documents

Semester VII		
Subject Code	**Subject Name**	**Credits**
CE-C 702	**Theory of Reinforced Concrete Structures**	**06**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**-**	**02**	**04**	**-**	**02**	**06**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**04 Hrs.**	**25**	**-**	**25**	**150**

Rationale

Working stress Method (WSM) makes use of the concept of modular ratio based on the higher factor of safety in evaluating the stresses in two different materials of the RCC i.e. steel and the concrete. The limit state method (LSM) is based on the statistical probability which provides the rational solution to the design problem. The philosophy lies behind LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states. The subject involves the application of working stress and limit state method in the analysis and design of various elements of the civil engineering structures.

Objectives

- To develop the clear understanding of design philosophy amongst the students for the design of reinforced concrete structure using (WSM) working stress method and (LSM) limit state method.
- To study the various clauses of IS: 456-2000 and its significance in the RCC design.
- To apply the concepts of LSM in the analysis and design of beams, slabs and columns.
- To study the concept of Serviceability and durability for deflection and crack width calculation in RCC structures.
- To study the concept of reinforced concrete footing design subjected to axial load and moment.
- To develop the concept of design using ready charts and curves for column subjected to axial load and moments.

Detailed Syllabus

Module	Contents	Hrs
I.	**Working Stress Method** Concept of reinforced concrete, Working Stress Method (WSM) of design for reinforced concrete, permissible stresses as per IS-456-2000; stress- strain curve of concrete and steel, characteristics of concrete steel reinforcement. Concept of balanced, under reinforced and over reinforced sections. Analysis design of singly reinforced and doubly reinforced rectangular beams for flexure, shear by WSM, Analysis and design of Cracked and un-cracked RCC column sections by WSM	**12**
II.	**Limit State Method** Introduction to limit state method of design as per IS-456-2000; concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to various limit states.	**03**
III.	**Limit State of Collapse – Flexure, Shear, Bond and Torsion** Limit state of collapse in flexure, shear and Limit state of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of beam subjected to bending and torsion. Requirements governing reinforcement detailing. Deflection and crack width calculation for RCC members.	**15**
IV.	**Design of Slabs using LSM:** Design of one way, one way continuous slab and two way slabs with all end conditions as per IS-456-2000.	**06**
V.	**Limit State of Collapse – Compression:** Limit state of collapse compression for short and slender column. Members subjected to combined axial and uni-axial as well as biaxial bending. Development of interactive curves and their use in column design.	**08**
VI.	**Design of Foundations:** Isolated square and rectangular footings subjected to axial load and moments. Design of combined rectangular pad footings, slab beam type footing. Design of Raft foundations (No numerical to be asked on raft foundations in the exam)	**08**

Contribution to Outcomes

On successful completion of the course, the student shall be able to:

- Understand the pros and cons of the WSM and LSM.
- Understand the various clauses specified in IS: 456-2000 for designing structural members with the safety and economy.
- Carry out analysis and design of various elements of the reinforced concrete structures such as beam, slab, column, footings using the concept of Limit state method.
- Understand and the use of readymade design curves from Special publications of Bureau of Indian standards.

Theory Examination:-

- **Use of IS:456-2000 shall be allowed in the examination.**
- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately further; and the weightage of marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems on each modules/ sub-modules contents thereof. At least one numerical on raft foundation shall be included in assignments.

Distribution of Term-work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Mark

Recommended Books:-

1. Design of Reinforced Concrete Structures*: Dayaratnam, P;* Oxford and IBH.
2. Limit State Design – Reinforced Concrete: *Jain A. K*, Nemchand and Bros., Roorkee
3. Limit State Design – Reinforced Concrete: *Shah and Karve*, Structure Publications, Pune.
4. Ultimate Strength Design for Structural Concrete: *Arthur, P. D. and Ramakrishnan, V.*, Wheeler and Co. Pvt. Ltd.
5. Reinforced Concrete: *H.J. Shah*, Charotar Publishers, Anand.
6. Fundamentals of Reinforced Concrete: *Sinha& Roy*, S. Chand and Co. Ltd.
7. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune.
8. Reinforced Concrete Design: *Wang, C. K., Salmon, C. G., and Pincheira, J. A*, John Wiley (2007), 7th Edition.

9. Reinforced Concrete Fundamentals: *Ferguson, P. M., Breen, J. E., and Jirsa, J. O.*, John Wiley & Sons (1988) 5th Edition.
10. RCC Design (WSM and LSM): *Punmia, B. C., Jain, A. K., and Jain,Arun, K.*, Laxmi Publications.
11. Limit State Design of Reinforced Concrete (as per IS: 456-2000): *Punmia, B. C., Jain, A. K., and Jain,Arun, K.,* Laxmi Publications.
12. Design of RCC structural Elements (RCC Vol-I): *Bhavikatti, S. S.*, New Age International Publications.
13. Reinforced Concrete: *Syal and Goel*; Wheeler Publishers.
14. Relevant IS Codes: BIS Publications, New Delhi.
15. Reinforced Concrete Design: *Pillai,S.U.*and*Menon,Devdas,* Tata Mc-Graw Hill Publishing House, New Delhi.
16. Reinforced Concrete Designby S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.
17. Theory of Reinforced concrete structures by N. Subramanian , Oxford University Press.

Semester VII		
Subject Code	**Subject Name**	**Credits**
CE-C 703	**Water Resources Engineering II**	**05**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**-**	**02**	**03**	**-**	**02**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Rationale

This subject provides necessary knowledge about design of gravity dams, earthen dams, energy dissipaters, canal headwork's, and canal structures. This subject is also useful with respect to facts, concepts, principles and procedures related to canal design, canal lining, cross drainage works and water logging. Further students will be able to plan and execute the construction of these structures.

Objectives

- To understand different types of dams and its suitability to a particular region.
- To study design consideration of earthen dams
- To study various types of Spillways
- To understand the importance of silt theories for design of irrigation channels
- To study the classification of canals and design of canal system.

Detailed Syllabus

Module	Topics	Hrs
I	**Gravity dams**	**08**
	Definition, typical cross section, forces acting on gravity dam, modes of failure and structural stability analysis, profile of dam- elementary and practical profile, low and high gravity dam, design consideration and fixing of section of dam, methods of design, construction of galleries in dams, types of joints, temperature control in concrete dams, foundation treatment, Arch dams, types of arch dams	
II	**Earth and rock fill dams:**	**06**
	Types of earth dams, method of construction, causes and failures of earth dams, design criteria, selecting suitable preliminary section, seepage line for different conditions and its location, seepage control through embankment and through foundations, Swedish circle method with pore pressure, details of	

	construction and maintenance, types of rock fill dams, stability analysis, advantages	
III	**Spillways and flood control works:**	**06**
	Introduction, location of spillway, design consideration of main spillway, controlled and uncontrolled spillway, types of spillways, design principles of ogee spillway. Chute spillway. Siphon spillway and shaft spillway, energy dissipation below overflow and other types of spillways, design of bucket type energy dissipater and stilling basin, flood mitigation reservoirs. Crest gates, types, advantages, design of radial gate, outlet works through dams, intake structures.	
IV	**Irrigation Channels (Silt Theories)**	**07**
	Kennedy's theory, Kennedy's methods of channel designs silt supporting capacity according to Kennedy's theory. Drawbacks in Kenned' % theory Lacey's regime theory, Lacey's theory applied to channel design. Comparison of Kennedys and Lace 'S theory defects in Lacey's theory. Introduction to Sediment transport in channels.	
V	**Canal Head works and Distribution System**	**06**
	Canals: Classification, canal alignment, canal losses, estimation of discharge, cross sections of irrigation canals, maintenance of irrigation canal, canal lining, economics of canal lining, water logging, effect of water logging, remedial measures.	
VI	**Canal structures**	**06**
	Canal falls, types of canal falls, canal escapes, types, canal head regulators, cross regulators, canal outlets and its types cross drainage works and types of cross drainage works.	

Course Outcomes

On completion of this course the student will be able to:

- Design the section of gravity dams, earth and rockfill dams, arch dams and buttress dams.
- Design spillways and energy dissipaters.
- Apply silt theories to design irrigation canals.
- Explain various types of canals and its maintenance.
- Explain different cross drainage works of a canal system.

Theory examination:

1. The question paper will comprise of six questions; each carrying 20 marks.

2. The first question will be compulsory and will have short questions having weightage of 4-5 marks covering the entire syllabus.

3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.

4. The students will have to attempt any three questions out of remaining five questions.

5. Total four questions need to be attempted.

Oral Examination:

The oral Examination shall be based upon the entire syllabus and the term work consisting of the assignments.

Term Work:

The term work shall comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each sub-modules and contents thereof further. It is advisable to arrange dam visit.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments.

The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:

1. Irrigation and Water Power Engineering: *B.C. Punmia, PandeB.B.Lal, A.K Jain*. Laxmi Publications Pvt, Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures: *S.K. Ukarande*,Ane Books Pvt. Ltd.ISBN,9789383656899.
3. Irrigation Water Resources and Water Power Engineering: *P.N. Modi*, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
4. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: *S. K. Sharma*, S. Chand and Co.
6. Theory and Design of Irrigation Structures: *R. S. Varshney and R, C. Gupta*, Nem Chand
7. Engineering for Dams, Vol. I to III:*Crager, Justin and Hinds*, John Wiley
8. Design of Small Dams: USBR.
9. Hydro Power Structures: *R. S. Varshney*, Nem Chand and Bross.
10. Concrete *Dams: R. S. Varshney*, Oxford and IBH Publishing Co.

Semester-VII		
Subject Code	**Subject Name**	**Credits**
CE-DLO 7041	**Department Level Elective: Pre-stressed Concrete**	**5**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorials**	**Theory**	**Practical**	**TW/Tutorials**	**Total**
3	**-**	**2**	**3**	**-**	**2**	**5**

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Avg						
20	**20**	**20**	**80**	**3Hr**	**25**	**-**	**25**	**150**

Rationale

The course is aimed to make the student to be aware of highly mechanized technology in civil engineering construction and to develop the basic understanding of pre-stressed concrete which is used in a wide range of building and civil structures. A Pre-stressed Concrete section improves performance/efficiency, reduces structural thicknesses, and material savings compared with simple reinforced concrete sections. Typical applications of pre-stressed concrete include high rise buildings, residential slabs and bridge structures etc.

Objectives

- To bring the students to such a level so as to enable them to take the appropriate decision in respect of choice of pre-stressed section over R. C. C. as a civil engineer.
- To make the candidate to understand the analysis of Pre-stressed Concrete sections and losses in pre-stress.
- To make the candidate able to understand and implement the guidelines of Indian Standard code for analysis and design sections using limit state philosophy.

Detailed Syllabus		
Module	**Sub module/Contents**	**Hrs**
I	**Introduction to pre-stressed concrete and analysis of pre-stressed concrete section :** Basic concept and general principles, materials used and their properties, methods, techniques and systems of pre-stressing	**04**
II	**Analysis of Pre-stressed Concrete Section:** Loading stages, stress method, load balancing method and internal resisting couple method of analysis, cable profiles, pressure line, kern points, choice and efficiency of sections	**10**
III	**Losses in pre-stress:** Loss of stresses due to elastic deformation of concrete, creep in concrete, creep in steel, shrinkage in concrete, relaxation in steel, anchorage slip and friction	**06**
IV	**Analysis of Pre-stressed Concrete Members in Limit State of Serviceability deflection:** Short time and long time deflection of uncracked members, permissible limits	**05**

V	**Analysis and Design of Pre-stressed Concrete Members for Limit State of Collapse Shear** Calculation of principle tension, permissible principle tension, Analysis and Design of members in shear (sections uncracked in flexure)	**05**
VI	**Analysis and Design of Pre-stressed Concrete Members for Limit State of Collapse Flexure and Serviceability Cracking** General philosophy of design, Analysis and design of members in flexure, permissible stresses in concrete and steel at different stages, suitability of section, safe cable zone	**09**

Contribution to outcome

On successful completion of the course, the students shall be able:

- To understand the basic concept, application and behaviour of pre-stressing over that of the RC structure.
- To have knowledge of modern engineering tools necessary for pre-tensioning and post-tensioning technology.
- To evaluate various losses occurring in pre-stressed concrete structure
- To analyze the various pre-stressed components of the structure and design the same for flexure as well as shear using relevant IS Code.
- To analyze pre-stressed concrete members for limit state of serviceability for cracking and deflection

Theory Examination:-

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:

The oral Examination shall be based upon the entire syllabus, site visit and the term work.

Site Visit/ Field Visit:

The students shall visit the site where the construction of structure using pre-stressed concrete is going on. The students shall prepare the detailed report thereof and submit as a part of the term work.

Term Work:

The term work shall consist of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems/ questions on each modules/ sub-modules and contents thereof further. The report of the site visit/ field visit shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, properly compiled report of the site visit /field visit and the minimum passing marks to be obtained by the student.

The following weightage of marks shall be given for different components of the term work.

Assignments:	15 Marks
Report of the Site Visit/Field Visit:	05 Marks
Attendance:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to:

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Prestressed Concrete*: N. Krishna Raju*, McGraw Hill, New York.
2. Prestressed Concrete: *N. Rajgopalan*, Narosa Publishing House.
3. Fundamentals of Prestressed Concrete: *Sinha, N.C.*and*S.K. Roy*, S.C. Chand and Company.
4. Prestressed Concrete Structures: *Dayaratnam, P.*, Oxford andIBH
5. Design of Prestressed Concrete Structures: *T.Y.Lin*and*N.H. Burns*, John Willey, New York.
6. Design of Prestressed Concrete: *Nilson Arthur*, McGraw Hill Book Company.
7. Prestressed Concrete Vol—I*: IY.Guyon*, Contractors Record, London.
8. Prestressed Concrete*: S. Ramamurtham*, DhanpatRaiandSon's
9. Relevant latest IS codes (IS:1343-2012)

Semester-VII		
Subject Code	**Subject Name**	**Credits**
CE-DLO 7042	**Department Level Elective: Solid Waste Management**	**5**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorials**	**Theory**	**Practical**	**TW/Tutorials**	**Total**
3	**-**	**2**	**3**	**-**	**2**	**5**

Evaluation Scheme

Theory					Teamwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Average						
20	**20**	**20**	**80**	**3Hr**	**25**	**-**	**25**	**150**

Rationale

This course will be of interest to those wishing to understand the principles and techniques of solid waste management, including the legislative, environmental, economic and social drivers. Students will be introduced to the selection and design of appropriate methods of storage, collection, transfer, treatment and disposal in both industrialized and developing countries. The course also provides the opportunity to visit recycling facilities and disposal sites to better understand links between theory and practice.

Objectives

- To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.
- To provide knowledge of different types of sources, sampling and characteristics of solid waste.
- To impart knowledge and skills in the collection, storage, transport and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.
- To fully appreciate the current practices available and implement the systems available in solid waste management.
- To be aware of the significance of recycling, reduce, reuse of solid wastes and also to impart students with the skill of design and operation of disposal system based on latest technology.
- To provide students prerequisite knowledge necessary for higher studies and research in the field of Solid waste management.

Module	Sub Modules/Contents	Hrs
I	**Introducing Municipal Solid Waste Management** Overview: problems and issues of solid waste management - Need for solid waste management-Functional elements such as waste generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.	**03**
II	**Generation and characteristics of waste** Sources, Types, composition, quantity, sampling and characteristics of waste, factors affecting generation of solid wastes	**03**
III	**Waste collection, storage and transport** Collection and storage of municipal solid waste; Methods of collection - House to House collection -collection routes; on site storage methods-materials used for containers -Recycling and Reuse of waste -Need for transfer and transport; transfer station-selection of location, operation and maintenance; transportation Methods-manual, Mechanical methods with or without compaction, economy in transportation of waste optimization of transportation routes.	**10**
IV	**Waste processing techniques** Processing techniques-biological and chemical conversion technologies – composting and its methods, Vermi-composting, mechanical composting, In vessel composting, incineration, pyrolysis, gasification.	**04**
V	**Disposal of Solid Waste** Segregation, Volume reduction at source, recovery and recycle; dumping of solid waste-sanitary waste- sanitary landfills-site selection-design and operation of sanitary landfill - leachate and landfill gas management-landfill closure and environmental monitoring-landfill remediation; Municipal solid waste in Indian conditions, legal aspects of solid waste disposal, Plastic waste disposal.	**10**
VI	**Types of Solid Waste** **Industrial** Waste products during manufacturing and packing, operation of pollution control facilities, generation, and minimization at source, recycling, disposal. **Hazardous waste** Definition, sources, hazardous characteristics, management, treatment and disposal **Electronic waste** Waste characteristics, generation, collection, transport and disposal **Biomedical waste** Definition, sources, classification, collection, segregation- Color coding, treatment and disposal.	**09**

Contribution to outcomes

On completion of this course, the students will be able to understand the various methods of disposal of solid waste. They will have better understanding of the nature and characteristics of solid waste and regulatory requirements regarding solid waste management and further they will have an ability to plan waste minimization. Besides, they will be prepared to contribute practical solutions to environmental problems in our society.

After the completion of the course the student should be able to

- Explain generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.
- Understand the characteristics of different types of solid waste and the factors affecting variation.
- Identify the methods of collection, storage and transportation of solid waste.
- Suggest suitable technical solutions for processing of wastes.
- Ability to plan waste minimization and disposal of municipal solid waste.
- Ensure the safe handling and treatment of Hazardous, Electronic and Biomedical waste.

Theory Examination:-

- Question paper will comprise of six questions; each carrying 20 marks.
- The first question will be compulsory which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:-

The oral Examination shall be based upon the entire syllabus and the term work consisting of the Assignments, Tutorials including the site visit report.

Mini Project- Student should perform activities related to solid waste management at institute level forming groups 4 to 5 students, Report of the activity should be part of term work

Site Visit: The students will visit landfilling /composting site in the nearby vicinity and prepare detailed report thereof. This report will form a part of the term work.

Term Work:-

The Term Work shall comprise essentially of the following assignments covering the entire syllabus. The report of the site visit/ field visit and mini-project shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments. Each student shall prepare a report on any industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal.

The following weightage of marks shall be given for different components of the term work.

a. Report (on any industrial/hazardous/municipal solid waste/site visit): 05 Marks
b. Seminar/Mini Project : 05Marks
c. Attendance : 05 Marks
d. Assignments and Tutorials :10 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Integrated Solid Waste Management: Techobanglous, Thisen and Vigil, McGraw Hill International.
2. Hazardous Waste Management: Lagrega, Buckingham and Evans, McGraw Hill International.
3. Solid Waste Management in Developing Countries: A.D. Bhide, Nagpur publications.
4. Environmental Pollution Control Engineering: C.S. Rao, Wiley Eastern, Manual of solid waste of management, CPHEEO.
5. E-Waste: Implications, Regulations, and Management in India and Current Global Best Practices, Rakesh Johri, The Energy and Resources Institute.
6. Biomedical Waste Management in India: Jugal Kishore and G. K. Ingle, Century Publications.

Semester-VII		
Subject Code	**Subject Name**	**Credits**
CE-DLO 7043	**Department Level Elective: Pavement Subgrade and Materials**	**5**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorials**	**Theory**	**Practical**	**TW/Tutorials**	**Total**
3	**-**	**2**	**3**	**-**	**2**	**5**

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Average						
20	20	20	80	3Hr	25	-	25	150

Rationale

Highway and airways mode of transportation contributes to the economical, industrial, social and cultural development of any country. For the design and construction of highway and airfield, it is imperative to know the properties of the materials such as soil, aggregates and bitumen used in the construction of pavements. The various tests are required to be conducted to evaluate the properties of these materials for the scientific design of the pavements and economic utilization of the different materials. The course also deals with the soil survey, stresses in soil and various ways and means of improving the soil and implementing techniques of improvement. The course also deals with the various surface and sub-surface drainage.

Objectives

- To give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards.
- To study the significance of the soil subgrade along with its functions.
- To study the soil classification for highway engineering purpose as per different classification system.
- To understand the concept of stresses in soil.
- To enable the student to identify the basic deficiencies of various soil deposits and to arrive upon the various ways and means of improving the soil and implementing the techniques of improvement.
- Learn bituminous mix and cement concrete mix designs
- Learn basic principles of superpave technology of bituminous mixes

Detailed Syllabus

Module	Sub-Modules/ Contents	Hrs
I.	**Soil: Soil-Classification methods, Tests:**CBR test, effect of lateral confinement on CBR and E value of Subgrade soil, Consistency, Engineering Properties and Modulus of sub-grade reaction ofsoil, estimation of modulus of subgrade reaction, Static and cyclic plate load test, correction for plate size, correction for worst moisture content. Soil classification as per HRB.	**08**
II.	**Stresses in Soil:** Theories of elastic and plastic behavior of soils, Cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus Stabilized Soils: Method of sampling and Preparation of Stabilized Soils for testing , Relation for Moisture content and Dry Density of Stabilized mixes, UCS of Stabilized soil, test for: soil bituminous, soil lime and soil fly ash mixes.	**06**
III.	**Aggregate:** Classification, requirements, Blending of aggregates, Importance of aggregate shape factor in mix design. Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials),	**04**
IV.	**Bitumen, Tar and Bituminous Mix Design**; requirements, criteria for selection of different binders, Temperature susceptibility, Bituminous emulsion and Cutbacks, fillers, extenders Polymers, Crum rubber, and rubber modified bitumen and anti-Stripping agents on pavement performance.	**08**
V.	**Bituminous Mix Design:** selection of different grade of bitumen, skid qualities, types of bituminous surfaces, bituminous mix design, Marshall Stability test, design aspect of paving concrete.Experimental characteristics of road aggregate.	**06**
VI.	**Introduction to Super pave Technology:** Methods of selection of suitable ingredient for super pave method, Gyratory compaction, rolling thin film oven, pressure aging vessel, rotational viscometer, dynamic shear rheometer, bending beam rheometer, direct tension test. Use of super pave perform and grade binder specifications. Comparison between Marshal Mix method and Super pave method.	**07**

Contribution to Outcomes

On the successful completion of the course, the students shall be able to:

- Understand the soil classification in accordance with various soil classify the system and evaluate the ability of the soil as a subgrade material.
- Understand the requirements and desirable properties of the various materials to be used in the construction of pavements.
- Understand the characterization of different paving materials along with the tests to be conducted on these materials.
- Know the various ground improvement methods.
- Understand subgrade soil strength in terms of standard engineering parameters.
- Application of basic principles of mix design of cement concrete and bituminous mixes

Theory Examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work.

Term Work:

The term-work shall comprise of the neatly written report comprising of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems/ two questions on each modules/ sub-modules and contents thereof further.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work which will comprise of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the termwork; and the minimum passing marks to be obtained by the students.

The following weightage of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Principles of Pavement Design, Second Edition, 1975: *Yoder, E.J.* , John Wiley and Sons, Inc., New York.
2. Concrete Roads: *HMSO*, Road Research Laboratory, London.
3. Highway Engineering: *Khanna, S.K., Justo, C,E.G. and Veeraragavan, A.*,Nem Chand and Brothers, Roorkee (10^{th} Revised Edition, 2014)
4. Principles and Practices of Highway Engineering; *Dr. L. R. Kadiyali and Dr. N. B.Lal*, Khanna Publishers, New Delhi.
5. Highway Engineering, *Sharma, S.K.*, S. Chand Technical Publishers, New Delhi (3^{rd} Revised Edition, 2013).
6. Principles of Transportation and Highway Engineering: *Rao, G.V.* , Tata Mc-Graw Hill Publications, New Delhi

Semester-VII		
Subject Code	**Subject Name**	**Credits**
CE-DLO 7044	**Department Level Elective: Structural Dynamics**	**5**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorials**	**Theory**	**Practical**	**TW/Tutorials**	**Total**
3	**-**	**2**	**3**	**-**	**2**	**5**

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessments			ESE	Duration of ESE	TW/TU	PR	OR	
IAE-I	IAE-II	Avg.						
20	20	20	80	3Hr	25	-	25	150

Course Objective

- To expose the students to understand the basic theory of structural dynamics, structural behaviour under vibratory load and the effect of damping.
- To study the difference between static load and different types of dynamic loads.
- To study the free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system subjected to different dynamic loads.
- To study the dynamic degrees of freedom and calculation of the frequencies and mode shapes for lumped mass for discrete Two DOF systems,
- To study the modal analysis of Two DOF systems and analysis of systems with distributed mass for continuous system.

Details Syllabus

Module	Contents	Hrs
I	**Introduction to structural Dynamics- Definition of Basic Problem in Dynamics.** Static vs. Dynamic loads. Different types of dynamics loads	**4**
II	**Introduction to single Degree of freedom (SDOF) Systems.** Undamped vibration of SDOF system natural frequency and period of vibration Damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement. Forced vibration, response to periodic loading, response to pulsating forces, dynamic load factor. Response of structure subjected to General dynamic load, Duhamel's Integral Numerical Evaluation of Dynamics Response of SDOF system. Equivalent stiffness of spring in series and parallel	**8**

III	**Introduction to vibration isolation**. Distributed mass system idealized as SDOF system, use of Rayleigh's method. Response of SDOF system subjected to ground motion	**4**
IV	**Lumped mass multi-degree of freedom (Two DOF) system, coupled and uncoupled system** Direct determination of frequencies of vibration and mod shape. Orthogonality principle. Vibration of Two DOF systems with initial conditions Approximate method of determination of natural frequencies of vibration and mode shapes – Energy methods	**9**
V	**Earthquake analysis – Introduction.** Seismicity of a region, causes of earthquake Intensity of earthquake, Richter Scale, Measurement of Earthquake ground motion, Seismogram, construction of seismograph Application of modal analysis concept to seismic disturbance, Introduction to Response spectrum method.	**8**
VI	**I.S code provisions for seismic analysis of buildings.** Approximate method of earthquake analysis– Seismic co-efficient method and its limitation Introduction to time history analysis.(6)	**6**

Contributions to Outcomes

The students will be able to

- Understand the difference between static and dynamic loads and analysis.
- Evaluate the response of SDOF and Two DOF systems to different types of dynamic loads including ground motions.
- Understand the basics of random vibrations and the application of this concept
- Analyze Linear SDOF systems.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-module content thereof further. There shall be theory questions as well.

Distribution of Term-work Marks

The marks of term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments: 20 Marks
- Attendance: 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Theory Examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
- There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination

Oral examination will be based on entire syllabus and the afore-mentioned term work.

Recommended Books:-

1. Craig R.R.: 'Structural Dynamics-An Introduction to Computer Methods',*John Wiley and Sons.*

2. Anil K. Chopra: 'Dynamics of Structures', *Prentice Hall India Pvt. Ltd.*

3. Cloguhand Penzein: 'Dynamics of Structures'*TataMc-Graw Hill Pvt. Ltd.*

4. John M. Biggs: 'Structural Dynamics',*TataMc-Graw Hill.*

5. Mario Paz: 'Structural Dynamics Theory and Computation', *CBS Publisher.*

Semester VII		
Subject Code	**Subject Name**	**Credits**
CE-DLO 7045	**Department Level Elective: Applications of Geographic Information Systems & Remote Sensing**	**05**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**02**	**03**	**--**	**02**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Avg.**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Rationale

Geographic Information Systems & Remote Sensing Applications provides power of mapping to civil engineers. GIS lets us visualize, question, analyze and interpret date to understand relationships, patterns and trends. In this subject, the students get acquainted with the detailed study of GIS & Remote sensing. Data models of spatial and non-spatial information are also explained. An overview on digitizing, editing and structuring of map data is also provided for error detection, correction and appropriate topology creation. Digital Elevation Models (DEM) and their needs are also incorporated along with the applications of Remote Sensing and GIS. Solution can be provided for Various Civil Engineering problems using Integration GIS-GPS & Remote Sensing Techniques.

Objectives

- To study principles of physics of Electromagnetic radiation as applied to remote sensing.
- To learn the GIS data & its processing using Softwares
- To get acquainted with GPS Satellite & their segments
- To understand the GIS & RS Applications in various fields of Civil Engineering

Module	Content	Hrs
I	**Remote sensing (RS):** Introduction, physics of remote sensing- electromagnetic radiations and their characteristics, thermal emissions, multi-concept in remote sensing, remote sensing satellites and their data products, sensors and orbital characteristics, spectral reflectance curves for earth surface features, methods of remotely sensed data interpretation- visual interpretation, concept of fcc, digital image processing- digital image and its characteristics, satellite data formats, image rectification and restoration, image enhancement- contrast manipulation, spatial feature manipulation, multi-image manipulation.	**8**

II	**Geographical Information System (GIS):** History, Introduction, spatial and non- spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS Commercially available GIS hardware and Software Field data, statistical data, maps, aerial Photographs, satellite data, points , lines, and areas features, vector and raster data, data entry through keyboard, digitizer and scanners, pre-processing of data rectification and registration , interpolation techniques, introduction to GIS softwares (Arc GIS, QGIS, Gram++, etc.)	**8**
III	**Global Positioning System (G.P.S) :** G.P.S. Segments: Spaces Segment, Control Segment, User Segment Features of G.P.S. Satellites, Principle of Operation Surveying with G.P.S.: Methods of observations, Absolute Positioning, Relative Positioning, differential G.P.S., Kinematics of G.P.S. G.P.S. Receivers: Navigational Receivers, Surveying Receivers, Geodetic Receivers, Computation of Co-ordinates:- Transformation from Global to Local Datum , Geodetic Coordinates to map co- ordinates , G.P.S. Heights and mean sea level Heights Applications of G.P.S	**5**
IV	**Application of G.I.S.& R.S. in Water Resources & Environmental Studies:** Site selection of Hydraulic Structures, Surface water delineation, surface keys for subsurface water, Steps in water investigations of the area, Water management	**6**
V	**Application of G.I.S.& R.S. in Infrastructure Management;** Role of GIS in Town Planning, Urban Transport Planning, Underground Infrastructure Management	**6**
VI	**Application of G.I.S.& R.S in Disaster Management :** RS and GIS applications for disaster vulnerable zones, fire hazards, flood and storm water inundations, earthquake impact assessment, post Tsunami/ cyclone damage assessment.	**5**

Contribution to Outcomes

After completion of course, student will be able to:

- Explain the principles of physics of Electromagnetic radiation as applied to remote sensing.
- Describe Spatial and non-spatial database of geographic information system
- Demonstrate the GPS Satellites & their Segments.
- Apply the GIS & RS techniques in Urban Planning, Water Resources & Environmental Management.
- Integrate the GIS-GPS & RS techniques for Infrastructure Management
- Illustrate applications of GIS& RS in Disaster Management

Theory examination:

- Question paper will comprise of **six** questions; each carrying 20 marks.
- The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.

- The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
- There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
- The students will have to attempt any **three** questions out of remaining five questions.
- Total **four** questions need to be attempted.

Oral Examination:
The oral examination will be based on the entire syllabus and the term work.

Term Work:
The term work will comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and /or questions on each sub-modules and contents thereof further

Distribution of Term Work Marks:
The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weight age of marks shall be given for different components of the term work.

Assignments : 20 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Introduction to Geographic Information Systems: Kang-Tsung Chang,TataMcGrawHill.
2. Text book on Remote Sensing –C.S. Agrawal and P.K.Garg,Wheeler Publishing, New-Delhi.
3. G.I.S- Anji Reddy, publishers- MGH.
4. GIS, Spatial Analysis, and Modeling: Maguire, D., M.Batty,andM.Goodchild.2005. ESRIPress.
5. Remote sensing in Civil Engineering – T. J. M. Kennie and M. C. Mathews, Surry University press, London
6. Principles of Remote Sensing- P.N.Patel and Surendra Singh, Scientific Publishers, Jodhapur.
7. Remote Sensing and Image Interpretation: Lillesandand Kiefere:, JohnWiley,1987.
8. Global Positioning System: Signals, Measurements, and Performance, Pratap Misraand Per Enge (2nd Ed.), 2006.
9. Introduction to Geomatics –QGIS user guide – Mr.C.V. Nishinkanth, Mrs.Annu Nishinkanth, Dr S S Vasudevan, Dr P Ramkumar

10. Fundamental of Remote sensing: George Joseph, Universities Press Publications.
11. Remote Sensing and GIS, Basudeb Bhatta, Publisher: Oxford University Press, India, Latest Edition

Semester VII		
Subject Code	**Subject Name**	**Credits**
CEC-DLO7046	**Foundation Analysis and Design**	**5**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**-**	**02**	**03**	**-**	**02**	**05**

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	**20**	**20**	**80**	**03 Hrs.**	**25**	**-**	**25**	**150**

Objectives

- To study the bearing capacity and settlement of shallow foundations and To understand the design concepts for shallow foundations including strip and raft foundations
- To study the estimation of vertical stresses in soil
- To study different types of well foundations
- To study the load carrying capacity of pile and design of under reamed piles
- To study Cantilever sheet piles including anchored sheet piles in cohesion-less and cohesive soils and to analyse braced cuts
- To learn different types of machine foundations and understand the design philosophy; and carry out the design thereof.

Detailed Syllabus		
Module	**Sub Modules/Contents**	**Hrs**
I	**Estimation of stresses in soils:** Boussinesque and Westergaard's theories, Newmark Chart, Practical applications.	**06**
II	**Shallow Foundation**: Basic requirements of foundation, types and selection of foundation, design of shallow foundations by Terzaghi's and IS code method; total settlement analysis including elastic settlements; Structural design of strip and raft foundation.	**07**
III	**Pile Foundation**: Introduction, Necessity of piles, Types of pile foundation, load carrying capacity of single pile and pile in group, , group efficiency, group settlements, design of single pile and pile cap, design of under-reamed pile foundation	**06**
IV	**Floating Foundation and Well Foundation:** Floating Foundation- Introduction, Floatation, bottom elastic heave, Design of floating foundation on piles, Well Foundation- Introduction, forces acting on well foundation.	**06**
V	**Sheet piles and Braced cuts:** Cantilever sheet piles including anchored sheet piles in cohesion-less and cohesive soils: lateral earth pressure diagram,	**08**

	computation of embedment depth. Difference in open cut and retaining wall theories, apparent earth pressure diagram, Average apparent earth pressure diagram for cohesion-less and cohesive soils. Estimation of strut loads in braced cuts placed in cohesion-less and cohesive soils.	
VI	**Machine Foundations:** Introduction, Dynamic soil properties, types of machine vibrations, basic principal of machine foundation.	**06**

Contribution to outcomes

- On successful completion of the course, the learner shall have an: 1. Ability to identify, formulate and solve geotechnical engineering problem.
- Ability to design a suitable foundation system from economic and safe aspects
- Ability to design machine foundations
- Ability to relate easily to allied subjects such soil dynamics; advanced engineering geology, rock mechanics etc.
- Ability to understand design of sheet pile
- Ability to analyze vertical stresses developed in soil and used in practical problems

Theory Examination:-

- Question paper will comprise of six questions; each carrying 20 marks.
- The first question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
- The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
- The students will have to attempt any three questions out of remaining five questions.
- Total four questions need to be attempted.

Oral Examination:-

The oral Examination shall be based upon the entire syllabus and the term work consisting of the Assignments, Tutorials.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments. Each student shall prepare a report on any industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal.

The following weightage of marks shall be given for different components of the term work.

- Attendance : 05 Marks
- Assignments and Tutorials :20 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to

75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:-

1. Bowels J.E.: 'Analytical and Computer Methods in Foundation', *McGraw Hill Book Co. New York, 1974*
2. Das, B. M.: 'Geotechnical Engineering Handbook', *J. Ross Publishing, 2010*
3. Verghese, P. C.: 'Foundation Engineering', *PHI Learning Private Limited, Delhi, 2012*
4. Verghese, P. C.: 'Design of Reinforced Concrete Foundations', *PHI Learning Private Limited, Delhi, 2011*
5. N. Subramanian: 'Reinforced Concrete Structures', *Oxford University Press, 2013*
6. Alam Singh: 'Soil Mechanics and Foundation Engineering', Vol. I- II. *Standard Book House, Delhi*
7. Swami Saran: 'Analysis and Design of Substructures', *Oxford and IBH publishing company, Delhi 1998*

SemesterVII		
Course Code	**Course Name**	**Credits**
CE-C ILOC-7011	**Institute Level Elective: Product Life cycle Management**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Development

Module	Detailed Contents	Hrs
I	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	**10**
II	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	**09**
III	**Product Data Management (PDM):**	**05**

	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
IV	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	**05**
V	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	**05**
VI	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	**05**

Contribution to Outcomes:

Students will be able t

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six questioncarrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. SaaksvuoriAntti, ImmonenAnselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Lifecycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7012	**Institute Level Elective: Reliability Engineering**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives

- To familiarize the students with various aspects of probability theory
- To acquaint the students with reliability and its concepts
- To introduce the students to methods of estimating the system reliability of simple and complex systems
- To understand the various aspects of Maintainability, Availability and FMEA procedure

Module	Detailed Contents	Hrs
I	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	**08**
II	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	**08**
III	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	**05**
IV	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	**08**
V	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics,	**05**

	Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
VI	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	**05**

Outcomes

Students will be able to…

- Understand and apply the concept of Probability to engineering problems
- Apply various reliability concepts to calculate different reliability parameters
- Estimate the system reliability of simple and complex systems
- Carry out a Failure Mode Effect and Criticality Analysis

Assessment:
Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:
In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. L.S. Srinath, “Reliability Engineering”, Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7013	**Institute Level Elective: Management Information System**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- The course is blend of Management and Technical field.
- Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
- Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
- Identify the basic steps in systems development

Module	Detailed Contents	Hrs
I	**Introduction To Information Systems (IS):** Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	**4**
II	**Data and Knowledge Management**: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	**7**
III	**Ethical issues and Privacy**: Information Security. Threat to IS, and Security Controls	**7**
IV	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	**7**
V	**Computer Networks Wired and Wireless technology**, Pervasive computing, Cloud computing model.	**6**
VI	**Information System within Organization**: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. **Acquiring Information Systems and Applications**: Various System development life cycle models.	**8**

Contribution to Outcomes

Students will be able to:

- Explain how information systems Transform Business
- Identify the impact information systems have on an organization
- Describe IT infrastructure and its components and its current trends
- Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
- Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

SemesterVII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7014	**Institute Level Elective: Design of Experiments**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- To understand the issues and principles of Design of Experiments (DOE)
- To list the guidelines for designing experiments
- To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Module	Detailed Contents	Hrs
I	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	**06**
II	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	**08**
III	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	**07**
IV	**Two-Level Fractional Factorial Designs** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design	**07**

	4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	
V	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	**07**
VI	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	**04**

Contribution to Outcomes

Students will be able to

- Plan data collection, to turn data into information and to make decisions that lead to appropriate action
- Apply the methods taught to real life situations
- Plan, analyze, and interpret the results of experiments

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7015	**Institute Level Elective: Operation Research**	**03**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- Formulate a real-world problem as a mathematical programming model.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.

Module	Detailed Contents	Hrs
I	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	**14**
II	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	**05**

III	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	**05**
IV	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	**05**
V	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	**05**
VI	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	**05**

Outcomes:

Students will be able to

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six questioncarrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7016	**Institute Level Elective: Cyber Security and Laws**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- To understand and identify different types cybercrime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Module	Detailed Contents	Hrs
I	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime andinformation security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	**4**
II	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures forHandling Mobile, Devices-Related Security Issues, OrganizationalSecurity Policies and Measures in Mobile Computing Era, Laptops	**9**
III	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	**6**
IV	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	**8**

V	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	**6**
VI	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	**6**

Outcomes

Students will be able to:

- Understand the concept of cybercrime and its effect on outside world
- Interpret and apply IT law in various legal issues
- Distinguish different aspects of cyber law
- Apply Information Security Standards compliance during software design and development

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six questioncarrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7017	**Institute Level Elective: Disaster Management and Mitigation Measures**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives

- To understand physics and various types of disaster occurring around the world
- To identify extent and damaging capacity of a disaster
- To study and understand the means of losses and methods to overcome /minimize it.
- To understand role of individual and various organization during and after disaster
- To understand application of GIS in the field of disaster management
- To understand the emergency government response structures before, during and after disaster

Module	Detailed Contents	Hrs
I	**Introduction** **1.1** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	**03**
II	**Natural Disaster and Manmade disasters:** 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	**09**
III	**Disaster Management, Policy and Administration** 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration:	**06**

	Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	
IV	**Institutional Framework for Disaster Management in India:** 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	**06**
V	**Financing Relief Measures:** 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	**09**
VI	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	**06**

Outcomes:

Students will be able to…

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structure associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six question carrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Semester VII		
Course Code	**Course Name**	**Credits**
CE-C ILOC7018	**Institute Level Elective: Energy Audit and Management**	**03**

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
03	**--**	**--**	**03**	**--**	**--**	**03**

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Avg						
20	**20**	**20**	**80**	**03 Hrs.**	**--**	**--**	**--**	**100**

Objectives:

- To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Module	Detailed Contents	Hrs
I	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	**04**
II	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	**08**
III	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers.	**10**

	Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
IV	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	**10**
V	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	**04**
VI	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	**03**

Outcomes:

Students will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyze the data collected during performance evaluation and recommend energy saving measures

Assessment:

Internal:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approximately 40% syllabus is completed and second class test when additional 40% syllabus is completed. The average marks of both the test will be considered for final Internal Assessment. Duration of each test shall be of one hour.

End Semester Theory Examination:

In question paper, weightage of each module will be approximately proportional to number of respective lecture hours as mentioned in the syllabus.

- Question paper will comprise of total six questioncarrying20 marks
- Question no. 1 is compulsory. Any 3 out of remaining 5 need to be solved
- Remaining question (Q.2 to Q.6) will be selected from all the modules.
- Questions may be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) may be from any module other than module 3)

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in