AC-
Item No.-

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Civil Engineering

Second Year with Effect from AY 2020-2021

Third Year with Effect from AY 2021-2022

Final Year with Effect from AY 2022-2023

(REV-2019 'C' Scheme) from Academic Year 2019-2020

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019-2020)

Syllabus for Approval

Title of the Course	:	Final Year in Bachelor of Civil Engineering
Eligibility for Admission	:	After Passing First Year Engineering as per the Ordinance 0.6242
Passing Marks	:	40%
Ordinances / Regulations (if any)	:	Ordinance 0.6242
No. of Years / Semesters	:	8 semesters
Level	:	Under Graduation
Pattern	:	Semester
Status	:	New
To be implemented from Academic Year	:	With effect from Academic Year: 2022-2023

Dr. S. K. Ukarande

Associate Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

Dr. Anuradha Muzumdar

Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

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 Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty 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. 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. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Final Year of Engineering from the Academic year 2022-23.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill-based activities and project-based activities. Self-learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and Technology,
University of Mumbai, Mumbai

Preface

The 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 (POs) 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 (OBE) in the process of curriculum development from Rev-2012 onwards and continued to enhance the curriculum further based on OBE in Rev-2016 and Rev-2019 "C" scheme.

As Chairman and Members of Board of Studies in Civil Engineering, University of Mumbai, we are happy to state here that, the Program Educational Objectives (PEOs) 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, who are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The PEOs finalized for the undergraduate program in Civil Engineering are listed below;

1. To prepare the Learner with a sound foundation in 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 prepare the Learner for a successful career in Indian and Multinational Organisations and for excelling in post-graduate studies
4. To motivate learners for life-long learning
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process

In addition to the above listed PEOs, every institute is encouraged to add a few (2-3) more PEOs suiting their institute vision and mission

Apart from the PEOs, 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 OBE. We strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Board of Studies in Civil Engineering University of Mumbai			
Dr. S. K. Ukarande	Chairman	Dr. V. Jothiprakash	Member
Dr. D.D. Sarode	Member	Dr. K. K. Sangle	Member
Dr. S. B. Charhate	Member	Dr. D. G. Regulawar	Member
Dr. Milind Waikar	Member	Dr. A. R. Kambekar	Member
Dr. R.B. Magar	Member	Dr. Seema Jagtap	Member

Undergraduate Program Structure for Second year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2020-2021**)
Semester – III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC301	Engineering Mathematics – III	03	-	01	03	-	01	04
CEC302	Mechanics of Solids	04	-	-	04	-	-	04
CEC303	Engineering Geology	03	-	-	03	-	-	03
CEC304	Architectural Planning & Design of Buildings	02	-	-	02	-	-	02
CEC305	Fluid Mechanics – I	03	-	-	03	-	-	03
CEL301	Mechanics of Solids	-	02	-	-	01	-	01
CEL302	Engineering Geology	-	02	-	-	01	-	01
CEL303	Architectural Planning & Design of Buildings	-	02	-	-	01	-	01
CEL304	Fluid Mechanics – I	-	02	-	-	01	-	01
CEL305	Skill Based Lab Course – I	-	03	-	-	1.5	-	1.5
CEM301	Mini Project – 1A	-	03$	-	-	1.5	-	1.5
Total		**15**	**14**	**1**	**15**	**7**	**1**	**23**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract. /Oral	Total
		Test - I	Test – II	Avg.					
CEC301	Engineering Mathematics –III	20	20	20	80	03	25	-	125
CEC302	Mechanics of Solids	20	20	20	80	03	-	-	100
CEC303	Engineering Geology	20	20	20	80	03	-	-	100
CEC304	Architectural Planning & Design of Buildings	20	20	20	80	03	-	-	100
CEC305	Fluid Mechanics – I	20	20	20	80	03	-	-	100
CEL301	Mechanics of Solids	-	-	-	-	-	25	25	50
CEL302	Engineering Geology	-	-	-	-	-	25	25	50
CEL303	Architectural Planning & Design of Buildings	-	-	-	-	-	25	25	50
CEL304	Fluid Mechanics – I	-	-	-	-	-	25	25	50
CEL305	Skill Based Lab Course – I	-	-	-	-	-	50	-	50
CEM301	Mini Project – 1A	-	-	-	-	-	50	-	50
Total		**100**			**400**	**-**	**225**	**100**	**825**

$ indicates work load of Learner (Not Faculty), for Mini Project.

Undergraduate Program Structure for Second year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2020-2021**)
Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC401	Engineering Mathematics – IV	03	-	01	03	-	01	04
CEC402	Structural Analysis	04	-	-	04	-	-	04
CEC403	Surveying	03	-	-	03	-	-	03
CEC404	Building Materials & Concrete Technology	03	-	-	03	-	-	03
CEC405	Fluid Mechanics-II	03	-	-	03	-	-	03
CEL401	Structural Analysis	-	02	-	-	01	-	01
CEL402	Surveying	-	03	-	-	1.5	-	1.5
CEL403	Building Material Concrete Technology	-	02	-	-	01	-	01
CEL404	Fluid Mechanics-II	-	02	-	-	01	-	01
CEL405	Skill Based lab Course – II	-	02	-	-	01	-	01
CEM401	Mini Project – 1B	-	03$	-	-	1.5	-	1.5
Total		**16**	**14**	**01**	**16**	**07**	**01**	**24**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract. /Oral	Total
		Test - I	Test – II	Avg.					
CEC401	Engineering Mathematics-IV	20	20	20	80	03	25	-	125
CEC402	Structural Analysis	20	20	20	80	03	-	-	100
CEC403	Surveying	20	20	20	80	03	-	-	100
CEC404	Building Materials & Concrete Technology	20	20	20	80	03	-	-	100
CEC405	Fluid Mechanics-II	20	20	20	80	03	-	-	100
CEL401	Structural Analysis	-	-	-	-	-	25	25	50
CEL402	Surveying	-	-	-	-	-	50	25	75
CEL403	Building Material Concrete Technology	-	-	-	-	-	25	25	50
CEL404	Fluid Mechanics-II	-	-	-	-	-	25	25	50
CEL405	Skill Based lab Course - II	-	-	-	-	-	50	-	50
CEM401	Mini Project – 1B	-	-	-	-	-	25	25	50
Total		**100**			**400**	**-**	**225**	**125**	**850**

$ indicates work load of Learner (Not Faculty), for Mini Project.

Undergraduate Program Structure for Third year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2021-2022**)
Semester - V

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC501	Theory of Reinforced Concrete Structures	03	-	-	03	-	-	03
CEC502	Applied Hydraulics	03	-	-	03	-	-	03
CEC503	Geotechnical Engineering-I	03	-	-	03	-	-	03
CEC504	Transportation Engineering	04	-	-	04	-	-	04
CEDLO501X	Department Level Optional Course-1	03	-	-	03	-	-	03
CEL501	Theory of Reinforced Concrete Structures	-	02	-	-	01	-	01
CEL502	Applied Hydraulics	-	02	-	-	01	-	01
CEL503	Geotechnical Engineering-I	-	02	-	-	01	-	01
CEL504	Transportation Engineering	-	02	-	-	01	-	01
CEL505	Professional Communication and Ethics	-	02* +2	-	-	02	-	02
CEM501	Mini Project – 2A	-	04$	-	-	02	-	02
Total		**16**	**16**	**-**	**16**	**08**	**-**	**24**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract /Oral	Total
		Test - I	Test – II	Avg.					
CEC501	Theory of Reinforced Concrete Structures	20	20	20	80	03	-	-	100
CEC502	Applied Hydraulics	20	20	20	80	03	-	-	100
CEC503	Geotechnical Engineering-I	20	20	20	80	03	-	-	100
CEC504	Transportation Engineering	20	20	20	80	03	-	-	100
CEDLO501X	Department Level Optional Course -1	20	20	20	80	03	-	-	100
CEL501	Theory of Reinforced Concrete Structures	-	-	-	-	-	25	25	50
CEL502	Applied Hydraulics	-	-	-	-	-	25	25	50
CEL503	Geotechnical Engineering-I	-	-	-	-	-	25	25	50
CEL504	Transportation Engineering	-	-	-	-	-	25	25	50
CEL505	Professional Communication and Ethics	-	-	-	-	-	25	25	50
CEM501	Mini Project – 2A	-	-	-	-	-	25	25	50
Total		**100**			**400**	**-**	**150**	**150**	**800**

*** Theory class to be conducted for full class**

$ indicates work load of Learner (Not Faculty), for Mini Project

Undergraduate Program Structure for Third year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2021-2022**)
Semester - V

Department Level Optional Course – 1

Sr. No.	Course Code CEDLO501X	Department Level Optional Course – 1
1	CEDLO5011	Modern Surveying Instruments and Techniques
2	CEDLO5012	Building Services & Repairs
3	CEDLO5013	Sustainable Building Materials
4	CEDLO5014	Advanced Structural Mechanics
5	CEDLO5015	Air and Noise Pollution & Control
6	CEDLO5016	Transportation Planning & Economics
7	CEDLO5017	Advanced Concrete Technology

Undergraduate Program Structure for Third year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2021-2022**)
Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC601	Design & Drawing of Steel Structures	03	-	-	03	-	-	03
CEC602	Water Resources Engineering	03	-	-	03	-	-	03
CEC603	Geotechnical Engineering-II	03	-	-	03	-	-	03
CEC604	Environmental Engineering	04	-	-	04	-	-	04
CEDLO601X	Department Level Optional Course -2	03	-	-	03	-	-	03
CEL601	Design & Drawing of Steel Structures	-	02	-	-	01	-	01
CEL602	Water Resources Engineering	-	02	-	-	01	-	01
CEL603	Geotechnical Engineering-II	-	02	-	-	01	-	01
CEL604	Environmental Engineering	-	02	-	-	01	-	01
CEL605	Skill Based Lab Course – III	-	03	-	-	1.5	-	1.5
CEM601	Mini Project – 2B	-	03$	-	-	1.5	-	1.5
Total		**16**	**14**	**-**	**16**	**07**	**-**	**23**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract. /Oral	Total
		Test – I	Test - II	Avg.					
CEC601	Design & Drawing of Steel Structures	20	20	20	80	04	-	-	100
CEC602	Water Resources Engineering	20	20	20	80	03	-	-	100
CEC603	Geotechnical Engineering-II	20	20	20	80	03	-	-	100
CEC604	Environmental Engineering	20	20	20	80	03	-	-	100
CEDLO601X	Department Level Optional Course -2	20	20	20	80	03	-	-	100
CEL601	Design & Drawing of Steel Structures	-	-	-	-	-	25	25	50
CEL602	Water Resources Engineering	-	-	-	-	-	25	25	50
CEL603	Geotechnical Engineering-II	-	-	-	-	-	25	25	50
CEL604	Environmental Engineering	-	-	-	-	-	25	25	50
CEL605	Skill Based Lab Course-III	-	-	-	-	-	25	25	50
CEM601	Mini Project – 2B	-	-	-	-	-	25	25	50
Total		**100**			**400**	**-**	**150**	**150**	**800**

$ indicates work load of Learner (Not Faculty), for Mini Project

Undergraduate Program Structure for Third year Civil Engineering

University of Mumbai

(With Effect from A.Y. **2021-2022**)

Semester - VI

Department Level Optional Course – 2

Sr. No.	Course Code CEDLO601X	Department Level Optional Course – 2
1	CEDLO6011	Rock Mechanics
2	CEDLO6012	Biological Processes & Contaminant Removal
3	CEDLO6013	Construction Equipment & Techniques
4	CEDLO6014	Urban Infrastructure Planning
5	CEDLO6015	Open Channel Flow
6	CEDLO6016	Computational Structural Analysis
7	CEDLO6017	Traffic Engineering and Management
8	CEDLO6018	Introduction to Offshore Engineering

Undergraduate Program Structure for Final year Civil Engineering

Semester VII & VIII
UNIVERSITY OF MUMBAI
(With Effect from 2022-2023)
Semester - VII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC701	Design & Drawing of Reinforced Concrete Structures	03	-	-	03	-	-	03
CEC702	Quantity Survey, Estimation and Valuation	03	-	-	03	-	-	03
CEDLO701X	Department Level Optional Course – 3	03	-	-	03	-	-	03
CEDLO702X	Department Level Optional Course – 4	03	-	-	03	-	-	03
CEILO701X	Institute Level Optional Course – I	03	-	-	03	-	-	03
CEL701	Design & Drawing of Reinforced Concrete Structures	-	02	-	-	01	-	01
CEL702	Quantity Survey, Estimation and Valuation	-	02	-	-	01	-	01
CEP701	Major Project-Part I	-	06*	-	-	03	-	03
Total		**15**	**10**	**-**	**15**	**05**	**-**	**20**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract /Oral	Total
		Test - I	Test – II	Avg.					
CEC701	Design & Drawing of Reinforced Concrete Structure	20	20	20	80	04	-	-	100
CEC702	Quantity Survey, Estimation and Valuation	20	20	20	80	04	-	-	100
CEDLO701X	Department Level Optional Course – 3	20	20	20	80	03	-	-	100
CEDLO702X	Department Level Optional Course – 4	20	20	20	80	03	-	-	100
CEILO701X	Institute Level Optional Course – I	20	20	20	80	03	-	-	100
CEL701	Design & Drawing of Reinforced Concrete Structure	-	-	-	-	-	25	25	50
CEL702	Quantity Survey, Estimation and Valuation	-	-	-	-	-	25	25	50
CEP701	Major Project-Part I	-	-	-	-	-	25	25	50
Total		**100**			**400**	**-**	**75**	**75**	**650**

*** Faculty load- In Semester VII - 1/2 hour per week per project group**

Undergraduate Program Structure for Final year Civil Engineering

University of Mumbai

(With Effect from A.Y. **2022-2023**)

Semester - VII

Department Level Optional Course – 3

Sr. No.	Course Code CEDLO701X	Department Level Optional Course – 3
1	CEDLO7011	Pre-stressed Concrete
2	CEDLO7012	Applied Hydrology and Flood Control
3	CEDLO7013	Appraisal and Implementation of Infra Projects
4	CEDLO7014	Analysis of Offshore Structures
5	CEDLO7015	Advanced Construction Technology
6	CEDLO7016	Pavement Materials Construction and Maintenance

Department Level Optional Course – 4

Sr. No.	Course Code CEDLO702X	Department Level Optional Course – 4
1	CEDLO7021	Foundation Analysis and Design
2	CEDLO7022	Solid and Hazardous Waste Management
3	CEDLO7023	Ground Improvement techniques
4	CEDLO7024	Green building constructions
5	CEDLO7025	Legal Aspects in constructions
6	CEDLO7026	Environmental impact assessment
7	CEDLO7027	Advanced Design of Steel Structures

Institute Level Optional Course – I

Sr. No.	Course Code CEILO701X	Institute Level Optional Course – I
1	ILO7011	Product Life-cycle Management
2	ILO7012	Reliability Engineering
3	ILO7013	Management Information Systems
4	ILO7014	Design of Experiments
5	ILO7015	Operations Research
6	ILO7016	Cyber Security and Laws
7	ILO7017	Disaster Management and Mitigation Measures
8	ILO7018	Energy Audit and Management
9	ILO7019	Development Engineering

Undergraduate Program Structure for Final year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2022-2023**)
Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC801	Construction Management	03	-	-	03	-	-	03
CEDLO801X	Department Level Optional Course – 5	03	-	-	03	-	-	03
CEDLO802X	Department Level Optional Course – 6	03	-	-	03	-	-	03
CEILO801X	Institute Level Optional Course – II	03	-	-	03	-	-	03
CEL801	Construction Management	-	02	-	-	01	-	01
CEP801	Major Project – Part II	-	12$	-	-	06	-	06
Total		**12**	**14**	**-**	**12**	**07**	**-**	**19**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract. /Oral	Total
		Test - I	Test – II	Avg.					
CEC801	Construction Management	20	20	20	80	03	-	-	100
CEDLO801X	Department Level Optional Course – 5	20	20	20	80	03	-	-	100
CEDLO802X	Department Level Optional Course – 6	20	20	20	80	03	-	-	100
CEILO801X	Institute Level Optional Course – II	20	20	20	80	03	-	-	100
CEL801	Construction Management	-	-	-	-	-	25	25	50
CEP801	Major Project – Part II	-	-	-	-	-	50	100	150
Total		**80**			**320**	**-**	**75**	**125**	**600**

$: Faculty load- In Semester VIII - 1 hour per week per project group

Undergraduate Program Structure for Final year Civil Engineering
University of Mumbai
(With Effect from A.Y. **2022-2023**)
Semester VIII
Department Level Optional Course – 5

Sr. No.	Course Code CEDLO801X	Department Level Optional Course – 5
1	CEDLO8011	Bridge Engineering
2	CEDLO8012	Design of Hydraulics Structures
4	CEDLO8013	Construction Safety
5	CEDLO8014	Pavement Design
6	CEDLO8015	Industrial Waste Treatment
7	CEDLO8016	Soil Dynamics

Department Level Optional Course – 6

Sr. No.	Course Code CEDLO802X	Department Level Optional Course – 6
1	CEDLO8021	Repairs, Rehabilitation and Retrofitting of structures
2	CEDLO8022	Physico-Chemical Treatment of Water and Waste Water
3	CEDLO8023	Transportation System Engineering
4	CEDLO8024	Smart Building Materials
5	CEDLO8025	Structural Dynamics
6	CEDLO8026	Ground Water Engineering

Institute Level Optional Course – II

Sr. No.	Course Code CEILO801X	Institute Level Optional Course – II
1	ILO8011	Project Management
2	ILO8012	Finance Management
3	ILO8013	Entrepreneurship Development and Management
4	ILO8014	Human Resources Management
5	ILO8015	Professional Ethics and Corporate Social Responsibility (CSR)
6	ILO8016	Research Methodology
7	ILO8017	Intellectual Property Rights and Patenting
8	ILO8018	Digital Business Management
9	ILO8019	Environmental Management

Faculty may design and conduct practicals for elective subjects wherever possible, under the head ‘content beyond syllabus’.

Semester VII

Semester VII

Course Code	Course Name	Credits
CEC701	Design and Drawing of Reinforced Concrete Structures	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	04 Hrs.	--	--	--	100

Rationale

Reinforced concrete construction is widely used for residential, commercial and industrial structures. IS code has specified the use of Limit State Method (LSM) design philosophy for design of structures. During previous semester students have studied design of basic elements by LSM. This course covers complete design of G+3 RCC framed building in addition to other structures like water tank and retaining wall. Pre-stressed Concrete structures are another class of structures used for bridge girders, long span slabs etc. Civil Engineers must have knowledge of designing and detailing of RCC and PSC structures to make structures safe and serviceable during its life span. The knowledge about response of structures during an earthquake is prerequisite for Civil Engineers. The course introduces Prestressed concrete and Earthquake Resistant Design of structures with drawing and detailing as per IS Code specifications.

Objectives

1. To explain the LSM design procedure of G+3 RCC framed building by application of IS code clauses including loading calculations, analysis and design of individual elements with detailing of reinforcements.
2. To explain the concepts in the design of water tanks.
3. To explain the concepts in the design of retaining walls.
4. To introduce the basics of structural dynamics, structural behavior under the dynamic load and the effect of damping.
5. To introduce earthquake resistant design approach.
6. To develop the practice of design using charts and tables from SP:16 published by BIS.

7. To introduce concept of Pre-stressed Concrete.

Detailed Syllabus

Module	Contents		Periods
I	**Comprehensive Design of Building**		11
	1.1	Analysis and design of residential/commercial/industrial (G+ 3) RCC framed building.	
	1.2	Load transfer mechanism, arrangement of beams, slabs and columns.	
	1.3	Design of Staircase (Dog legged and Open well type), Slabs (One way and Two way with continuity), Beams (Simply supported, Cantilever, Continuous), Columns (Axially loaded and Eccentrically loaded), Footings (Isolated and Combined).	
II	**Design of Retaining Wall**		06
	2.1	Design of Cantilever retaining wall	
	2.2	Design of Counterfort retaining wall	
III	**Design of Water Tank**		07
	3.1	Classification of Water Tank, Permissible Stresses, and Design of circular and rectangular water tanks resting on ground and underground. Codal provisions as per IS 3370:2020. Use of IS coefficient method and approximate method.	
	3.2	Introduction to design of elevated water tank, frame and shaft type of staging.	
IV	**Introduction to Structural Dynamics**		06
	4.1	Definition of basic terms used in structural dynamics. Static and dynamic loads, types of dynamic load.	
	4.2	Introduction to single degree of freedom system (SDOF), evaluation of dynamics response of SDOF system. Approximate method for determination of time period of vibration.	
V	**Earthquake Resistant Design of Structures**		06
	5.1	Earthquake motion and response of structure.	
	5.2	Design load calculation by seismic coefficient method.	
	5.3	Ductile design and detailing as per IS: 13920.	
VI	**Introduction to Pre-stressed Concrete**		03
	6.1	Prestressed Concrete: basic principles of prestressed concrete, materials used, systems of prestressing.	
	6.2	Losses in prestress.	
		Total	**39**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Design G+3 RCC framed building using IS code recommendations.
2. Design different types of retaining walls with detailing of reinforcement
3. Design different types of water tanks with detailing of reinforcement.
4. Apply the basic concepts of structural dynamics
5. Evaluate the response of structure during an earthquake and calculate design forces.
6. Explain principles of Pre-stressed Concrete and its losses.

Internal Assessment 20 Marks

Consisting of two class tests - first test based on approximately 40% of content and second test based on remaining content (approximately 40% but excluding content covered in first test). Average of marks will be considered for IA.

End Semester Examination 80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. **Use of relevant IS codes shall be allowed in the examination.**
2. Question paper will comprise of total six questions, each carrying 20 marks.
3. Question 1 will be compulsory based on entire syllabus.
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Four questions need to be solved in total.

Recommended Books:

1. Design of Reinforced Concrete Structures*: Dayaratnam, P;* Oxford and IBH.
2. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand & bro.
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi
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. Earthquake resistant design of structures: Pankaj Agarwal, Manish Shrikhande, PHI, New Delhi.

Reference Books:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.
2. Reinforced Concrete: Syal and Goel, Wheeler Publishers.
3. Reinforced Concrete Design: Pillai, S.U. and Menon Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.
4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.
5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.
6. Pre-stressed concrete: N. Rajgopalan, Narosa Publishers.
7. Relevant IS Codes: BIS Publications, New Delhi.

Semester VII		
Course Code	**Course Name**	**Credits**
CEC702	**Quantity Survey, Estimation & Valuation**	**03**

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

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.	--	--	--	100

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 ofvarious building materials is required for the construction and it controls the cost of the structure, save wastage of labor-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in scheduling of men, materialsand 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

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand Measurement systems for various items of civil engineering structures
2. To draft the specifications for various items of work & determine unit rates of items of works & to prepare the rate analysis for various items of work using DSR for reference.
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork using various methods.
5. 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.
6. To explain the concept of valuation & to determine the present fair value of any constructed building at stated time.

Detailed Syllabus			
Module	**Sub-Modules/ Contents**		**Hrs.**
I.	**Introduction**		**03**
	1.1	Importance of Course	
	1.2	Measurement systems for specific items of civil engineering structures	
	1.3	Units of measurement of various items of works	
	1.4	IS1200: - Introduction, deduction rules for Masonry & Plastering work	
II.	**Specifications & Rate Analysis**		**06**
	2.1	Types & importance of specifications, rules to be followed for drafting the specifications of important 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 labor output, District Schedule of Rates (DSR) Rate analysis of important items of construction works.	
III.	**Estimates**		**12**
	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. Introduction of detailed estimate of load bearing structure. Methods of taking out quantities such as long wall & short wall method, Centre line method for R.C.C. framed structure, Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structuralelements as per code IS2502.	
IV.	**Estimation of Earthwork for Roads & Canals**		**04**
	4.1	Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula, Trapezoidal formula etc. & numerical based on methods. Introduction of Mass Haul diagram, Terms like lead & lift etc.	
V.	**Tenders & Contracts**		**06**
	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 contracts with their suitability, conditions of contract	

VI.	**Valuation**		**08**
	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 such as Straight-line method, Sinking fund method Freehold Properties, Leasehold Properties, Easement rights	
	6.2	Methods of valuation such as Rental method, land & building method, Belting method etc. Numerical based on valuation	

Contribution to Outcomes

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

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

Internal Assessment **20 Marks**

Consisting of two Compulsory Class Tests – First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in first test). Average of marks will be considered for IA.

End Semester Examination: **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1) Question paper will comprise of **six** questions; each carrying 20 marks.
2) The **first** question will be **compulsory** based on computation of quantities of various items of work by referring drawings.
3) 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.

4) The students will have to attempt any **three** questions out of remaining five questions.
   Total **four** questions need to be attempted.
5) There can be an internal choice in various sub-questions/ questions in order to accommodate the questions on all the topics / sub-topics.

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) Professional Practice: Dr. Roshan H. Namavati
6) World Bank approved contract documents

Semester VII

Course Code	Course Name	Credits
CEDLO7011	Department Level Optional Course-3: Pre-stressed Concrete	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs	--	--	--	100

Rationale

The course is aimed to make the learners aware about highly mechanized technology in civil engineering construction and to develop the basic understanding of prestressed concrete which is used in a wide range of civil structures like high rise buildings, residential slabs and bridges etc. Prestressed Concrete improves performance/efficiency of the section. It reduces cross sectional dimensions that results in material saving when compared with simple reinforced concrete sections.

Objectives

1 To make the learner to understand difference between PSC and RCC section in terms of material and method / technique used for construction.

2 To make the learner to understand the principle of prestressing, analysis of prestressed concrete sections and losses in prestress.

3 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	Course Module / Contents		Periods
I	**Introduction of Pre-stressed Concrete**		02
	1.1	Basic concept and general principle	
	1.2	Materials used and their properties, need of high strength concrete and steel	
	1.3	Techniques and systems of prestressing	
	1.4	Advantages of Prestressed Concrete	
II	**Analysis of Pre-stressed Concrete Beams**		10
	2.1	Loading stages, permissible stresses in concrete in compression and tension at transfer and service stages as per limit state of serviceability, maximum compression and limit state of serviceability cracking, permissible stresses in steel, stress method of analysis	
	2.2	Load balancing method of analysis, cable profile	
	2.3	Kern points, pressure line, efficiency of section, internal resisting couple method of analysis,	
III	**Losses in Prestress**		06
	3.1	Loss of stresses in steel due to elastic deformation of concrete, creep in concrete, shrinkage in concrete, relaxation in steel, anchorage slip and friction	
IV	**Analysis of Pre-stressed Concrete Beams in Limit State of Serviceability Deflection**		04
	4.1	Deflection at transfer, short time and longtime deflection of uncracked beams, permissible limits	
V	**Analysis and Design of Pre-stressed Concrete Beams in Limit State of Collapse**		10
	5.1	Shear - Principal tension, permissible limit, analysis and design of beams in shear (sections uncracked in flexure)	
	5.2	Flexure - General philosophy of design, assumptions, analysis and design of beams in flexure	
VI	**Design of Pre-stressed Concrete Beams in Limit State of Serviceability, Maximum Compression and Cracking**		07
	6.1	Suitability of section modulus	
	6.2	Optimum pre-stressing force and corresponding eccentricity	
	6.3	Safe cable zone	

Contribution to Outcome

On completion of this course, the students will be able to:

1 Explain the concept of pre-stressing, its casting techniques and applications.

2 Describe difference between RCC and PSC elements and their behavior.

3 Estimate the loss of stresses in pre-stressing steel.

4 Analyze and design the pre-stressed concrete element using relevant IS Code.

Site Visit:

The learners shall visit a construction site of pre-stressed concrete and submit a report.

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Average of marks will be considered for IA.

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

Recommended Books/Code:

1 Prestressed Concrete*: N. Krishna Raju*, Tata McGraw-Hill Publishing Company Limited, New Delhi

2 Fundamentals of Prestressed Concrete: *N.C Sinha* and *S.K. Roy*, S. Chand Publishing

3 Prestressed Concrete: *N. Rajagopalan*, Narosa Publishing House

4 Prestressed Concrete Structures: *P. Dayaratnam*, Oxford and IBH Publishing Co. Pvt. Ltd.

5 Prestressed Concrete*: S. Ramamrutham*, Dhanpat Rai Publishing Company Pvt. Ltd, New Delhi

6 IS code: IS:1343-2012

Reference Books:

1 Design of Prestressed Concrete Structures: T. Y. Lin and N.H. Burns, Wiley India Pvt. Ltd.

2 Design of Prestressed Concrete: *Arthur H. Nilson*, Wiley

Semester VII

Course Code	Course Name	Credits
CEDLO7012	Department Level Optional Course-3: Applied Hydrology & Flood Control	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
3	--	--	3	--	--	3

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	3 hrs	-	-	-	100

Rationale

This subject deals with the various processes involved in hydrological cycle and provides in depth understanding of the theories and concepts of surface, subsurface and ground water hydrology. It focuses on types and forms of precipitations. It also explains the application of hydrographs, unit hydrographs and further describes various techniques of estimating stream flows. It further describes the various techniques of estimating streamline flows. It also describes the importance of floods, flood routing and ground water hydrology.

Objectives

1. To explain the various processes involved in the hydrological cycle.
2. To measure rainfall, computation of average rainfall, various water losses etc.
3. To differentiate the various stream flow measurement and its importance.
4. To interpret the hydrograph and unit hydrographs, applications of unit hydrograph concept.
5. To evaluate various flood control methods, estimate design flood, and flood routing
6. To describe the concepts of ground water movement, steady and unsteady flow towards fullypenetrating wells and well yields.

Detailed Syllabus

Module	Sub-Modules/ contents	Periods
	1.1 Introduction: Hydrological cycle, scope of hydrology, water budget equation, data sources.	

I	**1.2 Precipitation:** Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area -Duration relationship, Intensity-Duration - Frequency relationship, Probable Maximum Precipitation.	**8**
II	**2.1 Abstractions from Precipitation:** Evaporation and transpiration, evapo-transpiration, interception, depression storage, infiltration and infiltration indices, determination of water losses.	**6**
	2.2 Stream Flow Measurement: Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.	
III	**3.1 Runoff:** Catchment, watershed and drainage basins, Factors affecting runoff, rainfall-runoff relationship, runoff estimation, droughts	**6**
IV	**4.1 Hydrograph Analysis:** Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.	**7**
V	**5.1 Floods:** Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk-reliability and safety factor. Flood routing: Hydrologic and hydraulic routings.	**6**
VI	**6.1 Ground Water Hydrology**: Yield, transmissibility, Darcy's law, Dupuitt's theory of unconfined flow, steady flow towards fully penetrating wells (confined and unconfined). Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.	**6**
	Total	**39**

Contribution to Outcomes

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

1. Explain hydrologic cycle and various methods of Measurement of rainfall.
2. Calculate optimum number of rain gauge stations for average rainfall and missing rainfall over catchment
3. Describe various methods of measurement of stream flow and to calculate abstraction losses over the catchment
4. Develop rainfall runoff relationship and calculating runoff over catchment
5. Perform hydrologic and hydraulic routing
6. Calculate the discharge of well for confined and unconfined aquifer

Internal Assessment **20 Marks**

Consisting of two Compulsory Class Tests – First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in first test). Average of marks will be considered for IA

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only four questions need to be solved in total

Recommended books:

1. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-978-93-83656-89-9
2. Irrigation and Water Power Engineering: B.C. Punmia, Pande B.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi

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. Engineering Hydrology: *K. Subramanya*, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. Hydrology: *H. M. Raghunath*, New Age International Publishers, New Delhi
7. Elementary Hydrology: *V. P. Singh*, Prentice Hall
8. Engineering Hydrology: Principles and practice*: V. M. Ponce*, Prentice Hall

Semester VII		
Course Code	**Name of the Course**	**Credits**
CEDLO7013	**Department Level Optional Course 3: Appraisal & Implementation of Infrastructure Projects**	**03**

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

Evaluation Scheme								
Theory					**TW/ Pract/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.	-	-	-	100

Rationale

For any Civil Engineering project, a range of alternative schemes meeting project goals are feasible. Thus to identify the most suitable out of it, project evaluation has to be carried out in terms of financial viability, environmental impact, utility to the society, engineering feasibility, profitability, etc. This course is intended to make students aware of this evaluation (appraisal) criterion for any Civil engineering project. Students will understand the importance of feasibility studies and get acquainted to the process of preparing a project report, both being crucial role players while deciding the viability of a project. The professional construction engineering practice will be rendered meaningful if students learn about ways to raise project funds, their effective planning and optimum utilisation. This course is devised to help students in understanding financial and economic aspects of a project.

Objectives

1. To know the procedure of feasibility studies for any infrastructure project.
2. To learn the procedure of appraisals required for deciding the worthiness of any project.
3. To learn the procedure of forecasting demand and know the uncertainties involved.
4. To know the components and importance of technical & managerial appraisal.
5. To get acquainted with decision making tools like Break even analysis, SWOT analysis etc.
6. To get acquainted with different methods of project finance and implementation.

Detailed Syllabus			
Module	**Sub-Modules/ Contents**		**Hrs**
I.	**Construction Projects and Report Preparation**		**03**
	1.1	Classification of construction projects. Project Formulation and phases involved in it.	
	1.2	Feasibility studies, SWOT analysis. Preparation of Project report.	
II.	**Project Appraisal**		**06**
	2.1	Importance and phases in a project development cycle for major infrastructure projects.	
	2.2	Importance of Appraisal, its need and steps involved in it.	
III.	**Market Appraisal**		**09**
	3.1	Importance and methods of carrying out demand analysis. Sources to gather project related information and ways to carry out market survey.	
	3.2	Methods to forecast demands. Uncertainties involved in demand forecasting.	
IV.	**Technical and Managerial Appraisal**		**06**
	4.1	Method to study the technical appraisal/viability of a project in terms of its location, type of land and intended use of building, technology requirements of the project, Size and complexity of tools and plants, raw materials to be used and their impact on the vicinity, energy requirements, water supply and disposal of effluents if any.	
	4.2	Study of managerial requirements of a project, Desirable organisational structure and hierarchy to manage as well as implement the project, Method of assessment of entrepreneurs.	
V.	**Financial analysis and Economic Appraisal**		**09**
	5.1	Various costs related to a project, Methods to determine the profitability of a project, Break even analysis.	
	5.2	Economic appraisal: Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.	
VI.	**Project Financing and Implementation**		**06**
	6.1	Types and Sources of finance in local, National and International context. Issues related to project financing.	
	6.2	Agencies involved in the implementation of a project. Methods of implementation like Built, operate and Transfer and its other variants like B.O.O, B.O.O.T, B.L.T, EPC ,etc.	
		Total	**39**

Contribution to Outcomes

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

1) **classify** the projects and **describe** the phases involved in project formulation.
2) **prepare** a detailed project report on the basis of various feasibility studies and SWOT analysis.
3) **devise** a project's development cycle and get acquainted with the different appraisals in the process of deciding the worthiness of a project.
4) **exhibit** and **apply** the managerial skills and knowledge of financial aspects required during the implementation of projects.
5) **identify** various sources for project finance.
6) **know** the various agencies involved in project implementation as well as **select** the method of project implementation which is best suited for a particular project.

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.

Recommended Books:

1) Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
2) Infrastructure Development & Financing in India - N. Mani (New Century Publications).
3) Infrastructure & economic development - Anu Kapil (Deep &Deep Publications).
4) Construction Management: Planning and finance - Cormican D.(Construction press, London).
5) Engineering Economics – Kumar (Wiley, India).
6) Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).
7) The cost management toolbox; A Managers guide to controlling costs and boosting profits. - Oliver, Lianabel (Tata McGraw Hill).

Semester- VII

Course Code	Course Name	Credits
CEDLO 7014	Department Level Optional Course 3: Analysis of Offshore Structures	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hrs	--	--	--	100

Rationale

Offshore Engineering discipline deals with the design and construction of structures intended to work in the ocean environment. The majority of offshore structures are used in the Oil and Gas industry. offshore construction is the installation of structures and facilities in a marine environment. Civil Engineering graduates will be able to study analysis and design in the specialized field of ocean and coastal environment.

Objectives

The objectives of this course are

1. to explain the types and materials used in offshore structures.
2. to provide an understanding of the structural response of offshore structures based on both component and system
3. to address the general engineering analysis and design concepts of offshore structures

Detailed Syllabus		
Module	**Course Modules / Contents**	**Hrs.**
I	**Types of offshore structures** Types of offshore structures, planning and design aspects, Overview of functional, environmental and accidental loads for marine structures, with emphasis on wind - and wave induced loads.	**05**
II	**Materials and their behaviour** Hydrodynamic interaction, Effects and dynamic response, Materials and their behaviour under static and dynamic loads, allowable stresses, various design methods and codes, design consideration, design loads.	**06**
III	**Analysis of offshore structures** Basics of Hydrodynamics, Structural dynamics, Advanced structural analysis techniques, Statistics of extremes: Airy Wave Theory, Higher order wave theories, Irregular Sea States, Short and long term statistics of wind; static wind load, Aerodynamic admittance function and gust factor.	**06**
IV	**Estimation of wave forces** The Morison's equation, wave force, lift force on members, wave slam, maximum force and moments using linear theory, Vertical Piles, Horizontal Bracings, Diagonal Front Face Bracings, Diagonal Side Face Bracings, wave forces on large diameter members, Froude-Krylov Theory, Diffraction Theory, Drift force, Spectral and statistical analysis of wave forces.	**06**
V	**Vibrations** Mass-spring system, Free Vibrations with Damping, Forced Vibrations, Forced Damped Vibrations, Torsional Vibrations, Elements of single d.o.f. system, Dynamics of multi d.o.f. systems, Eigen values and vectors; Iterative and transformation methods; Mode superposition, Fourier series and spectral method of response of single d.o.f. systems, Vibration of bars, beams, Behavior of concrete gravity platform as a rigid body on soil as a continuum	**10**
VI	**Corrosion and allowances** Corrosion and other allowances, consideration of stress concentration, Ingredient materials and protective measure, Behavior of concrete gravity platform as a rigid body on soil as a continuum	**06**
	Total	**39**

Contribution to Outcome

Upon completion of the course, students shall have ability to:

1. Explain the types and materials used in offshore structures
2. Evaluate of the structural response of offshore structures based on both component and system.
3. Apply general engineering and design concepts to offshore structures
4. Apply Morison's equations to calculate wave force, lift force, etc.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests:**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

Recommended Books:

1. Subrata K. Chakrabarti (2005): Handbook of offshore engineering Volume–I & II, Elsevier, The Boulevard Langford Lane, Kidlington, Oxford OX5 l GB, UK.
2. Deo M C (2013): Waves and Structures, http://www.civil.iitb.ac.in/~mcdeo/waves.html
3. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Load and Resistance Factor Design, 1st Edition, 1993. (TP690.A642 RP2A-LRFD)
4. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design, 21st ed., 2000. (TP690.A642 RP2A-WSD).
5. Brebbia C.A. and Walker, "Dynamic Analysis of offshore structures", Newness butterworth, London, 1978.
6. Sarpakaya T. and Isaacson M., "Mechanics of Wave Forces on Offshore Structures", Van Nostrand Rainhold, NewYork, 1981.

7. Hallam M.G., Heaf N.J. and Wootton, L.R., "Dynamics of Marine Structures", CIRIA Publicartions, Underwater Engg. Group, London, 1978.
8. Graff W.J., "Introduction to Offshore Structures", Gulf Publishing Co., Houston, Texas, 1981.
9. Clough R.W. and Penzien J., "Dynamics of Structures", IInd Edition, McGraw hill, 1992.
10. Simiu E. and Scanlan R.H., “wind effects on Structures", Wiley,New York, 1978.
11. Codes of Practices (latest versions) such as API R-2A, bureau Veritas etc.
12. Rules for the design, construction and inspection of fixed offshore structures, 1977. Defnorske Veritas
13. Energy Department, U.K., Guidance of Design and Construction of Offshore Installation, 1974.
14. O.C. Zienkiewicz, R., Wlewis and K.G. Stagg, Numerical Methods in Offshore Engineering, Wiley Interscience Publication, 1978.

Semester VII

Course Code	Course Name	Credits
CEDLO7015	Department Level Optional Course-3 Advanced Construction Technology	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hours	--	--	--	100

Rationale

In today's times the construction activities are undergoing lots of changes/developments due to internal and globalized market demands of quality and faster completion of project works using modern techniques, use of modern and waste materials, and through mechanized construction. Today, we require high-capacity machines with better output and greater efficiency to make construction process less stressful. This course has been designed so that civil engineers would be able to use advanced construction technology. Student will be introduced to some emerging technologies in the field of Civil engineering which will make them more industry ready.

Objectives

1. To study and understand the latest construction techniques applied to engineering construction for sub structure.
2. To summarize the students about various techniques of super structure construction.
3. To give an experience in the implementation of new technology concepts which are applied in field of advanced construction in special structures.
4. To know the different methods of some advanced construction techniques and ground improvement techniques.
5. To present the new technology related to dredging system and its concepts related advanced construction technology.
6. To study different methods of rehabilitation and strengthening in construction to successfully achieve the structural design.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Sub Structure Construction**		06
	1.1	Box jacking, Pipe jacking, Underwater drilling, blasting, and concreting. Underwater construction of diaphragm walls and basement	
	1.2	Driving well and caisson, sinking cofferdam, cable anchoring, and grouting. Driving diaphragm walls, sheet piles	
	1.3	Laying operations for built-up offshore system, Shoring for deep cutting, large reservoir construction, and well points. Dewatering for underground open excavation.	
II	**Super Structure Construction for building**		06
	2.1	Vacuum dewatering of concrete flooring, Concrete paving technology	
	2.2	Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections, Erection techniques of tall structures, large span structures, launching techniques for heavy decks, in-situ prestressing in high rise structures, post-tensioning of the slab, aerial transporting, Handling, and erecting lightweight components on tall structures	
III	**Construction of Special Structures**		06
	3.1	Erection of lattice towers - Rigging of transmission line structures, Construction sequence in cooling towers, Silos, chimneys, skyscrapers. Construction sequence and methods in domes, Support structure for heavy equipment and machinery in heavy industries, Erection of articulated structures and space decks.	
	3.2	Roof truss: erection problems Building / Industrial component, Equipment and tackles used for erecting these. Plate girder Launching a portion of bridge girder, large span lattice girder. Erection of chimney**,** Erection of overhead tank.	
IV	**Advancement in Construction techniques**		08
	4.1	Building construction techniques: Zero energy building, green building, pre-engineering building, Solar Paints, Building Integrated Photovoltaic (BIPV), Earthquake Resisting Controls-Isolation and Dissipation.	
	4.2	Coastal construction techniques: Sound Proofing walls, water-resistant roofs, high-performance doors and windows, air and moisture barriers.	
	4.3	Road construction techniques: 3D Printing, Road Printer, smart roads	
	4.4	Ground improvement techniques: Advanced piling techniques - Stone Column, Vibro Floatation, Grouting, Geotextile application, Micro Piles, and Soil Nailing. Vertical drains-Sand Drains, Pre-Fabricated Vertical Drains. Thermal Methods- soil heating and soil freezing.	
V	**Dredging**		06
	5.1	Dredging System, Mechanism, Hydraulic dredger in waves, dredging equipment, Water & Booster System, dredging in the navigation system, Agitation dredging system, silt dredging system, water injection system,	

		Pneumatic dredging system, Amphibious & scrapper dredging system.	
	5.2	Advantages & Disadvantages of Various Dredging Systems, Production Cycle for Dredgers, Application, Capacity of dredgers, & its economical use, dredging economics	
VI	**Rehabilitation and Strengthening Techniques**		07
	6.1	Seismic retrofitting, strengthening of beams, strengthening of columns, strengthening of the slab, strengthening of a masonry wall, Protection methods of structures, Mud jacking and grouting for foundation, Micro piling and underpinning for strengthening floor and shallow profile, Subgrade waterproofing, Soil Stabilization techniques	
	6.2	Repair of steel structures, bridge, building, towers etc., monuments and historical structures. Prevention of water leakage in structures; Underwater repair; Durability of repairing material. Maintenance of underground railways.	
		Total	39

Contribution to Outcome

On completion of this course, the students will be able to:

1. Evaluate the procedure of construction techniques for sub structure of major civil engineering projects.
2. Get a thorough knowledge of various stages of construction of super structure of major civil engineering projects.
3. Gain an experience in the implementation of new construction technology on engineering concepts which are applied in field Advanced construction technology in special structures.
4. Get a diverse knowledge of the different methods of advancement in construction techniques and ground improvement techniques.
5. Learn various dredging systems for major civil engineering projects.
6. Explain the theoretical and practical aspects of rehabilitation and strengthening techniques in civil engineering along with the design and management applications.

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in first test)

Average of marks will be considered for IA.

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

Recommended Books:

1 Roy Chudley and Roger Greeno , Construction Technology , Prentice Hall, 2005.

2 Dr. B.C. Punamia (2008); "Building Construction" Laxmi Publications (P) Ltd.ISBN13: 978-8131804285. 666p.

3 S. S. Bhavekatti (2012); "Building Construction" Vikas Publishing House Pvt Ltd. ISBN-13: 978-9325960794. 356p.

4 Peter. H. Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.

5 S. P. Arora and S. P. Bindra (2010); "Textbook of Building Construction", Dhanpat Rai & Sons publication, ISBN-13: 978-8189928803. 688p

6 Sushil Kumar (2010); "Building Construction" Standard Publishes-Distributors. ISBN-13: 978-8180141683. 796p.

7 S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand

Reference Books:

1 Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

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

3 Mahesh Varma , Construction Equipment Planning and Applications –

4 R. Chudley (revised by R. Greeno), Building Construction Handbook, Addison Wesley, Longman Group, England, 3rd ed.

5 S.S. Ataev, Construction Technology, Mir Publishers, Moscow

6 Robertwade Brown, "Practical foundation engineering hand book", McGraw Hill Publications.

7 Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons

8 Jerry Irvine, Advanced Construction Techniques, CA Rocketr

Semester VII

Course Code	Course Name	Credits
CEDLO7016	Department Level Optional Course-3: Pavement Materials, Construction and Maintenance	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	--	--	--	100

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

1. To give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards. To study the soil classification for highway engineering purpose as per different classification system.
2. 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.
3. To understand the requirements of aggregates as per IRC code.
4. To learn bituminous types and mix designs.
5. To understand the different types of distresses in pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements. To study the construction of the concrete roads and low volume roads
6. To learn basic principles of super pave technology of bituminous mixes

Detailed Syllabus

Module	Course Module / Contents		Periods
I	Soil		05
	1.1	Soil-Classification methods	
	1.2	Tests on Soil: CBR test, effect of lateral confinement on CBR and E value of Subgrade soil, Consistency, Engineering Properties and Modulus of sub-grade reaction of soil, estimation of modulus of subgrade reaction, Static and cyclic plate load test, correction for plate size, correction for worst moisture content.	
	1.3	Soil classification as per HRB.	
II	Stresses in Soil		08
	2.1	Theories of elastic and plastic behavior of soils, Cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus.	
	2.2	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. (IRC: SP:89 (Part II)-2018)	
III	Aggregates		04
	3.1	Classification, requirements, Blending of aggregates, Importance of aggregate shape factor in mix design	
	3.2	Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials),	
IV	Bitumen, Tar and Bituminous Mix Design		09
	4.1	Binders: 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.	
	4.2	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.	
V	Evaluation and strengthening		09
	5.1	Flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkelman beam deflections, skid resistance and measurement	
	5.2	Highway construction: Construction of WBM roads, Bituminous pavements, cement concrete roads, Reinforced concrete pavements construction.	
	5.3	Quality control (QC) and Quality assurance (QA) during construction of various pavements.	
	5.4	Low-Cost Roads (Rural Areas) (IRC-SP-20-2002) Classification of low-	

		cost roads, construction of low-cost roads.	
VI	Introduction to Super pave Technology		04
	6.1	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.	
	6.2	Use of super pave perform and grade binder specifications. Comparison between Marshal Mix method and Super pave method.	

Contribution to Outcome

On completion of this course, the students will be able to:

1 Explain the soil classification in accordance with various soil classify the system and evaluate the ability of the soil as a subgrade material in terms of standard engineering parameters.
2 Describe the stress distribution in subgrade soil and the various ground improvement methods.
3 Evaluate the requirements and desirable properties of the aggregate to be used in the construction of pavements.
4 Compare the characterization of different surface paving (Bitumen) materials as per IRC code.
5 Explain the various causes leading to failure of pavement and remedies for the same and the construction of the concrete roads and low volume roads
6 Apply basic principles of mix design of cement concrete and bituminous mixes.

Internal Assessment 20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I) Average of marks will be considered for IA.

End Semester Examination 80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.
2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4 Only Four questions need to be solved.

Recommended Books:

1 Highway Engineering: *Khanna, S.K., Justo, C,E.G. and Veeraragavan, A.*,Nem Chand and Brothers, Roorkee (10th Revised Edition, 2014)
2 Principles and Practices of Highway Engineering; *Dr. L. R. Kadiyali and Dr. N. B.Lal*, Khanna Publishers, New Delhi.
3 Highway Engineering, *Sharma, S.K.*, S. Chand Technical Publishers, New Delhi (3rd Revised Edition, 2013).

4 Principles of Transportation and Highway Engineering: *Rao, G.V.,* Tata Mc-Graw Hill Publications, New Delhi

Reference 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.

Semester VII

Course Code	Course Name	Credits
CEDLO7021	Department Level Optional Course-4 Foundation Analysis and Design	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Practical	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

Rationale

Foundation design is an important aspect of the vast field of civil engineering in general and geotechnical engineering in particular. A foundation designer has many diverse and important encounters with foundation design problems. The knowledge of foundation design is essential in design problems related to buildings, bridges, highways. tunnels, canals, or dams. The suitability of various types of foundations i.e. shallow foundation, pile foundation, well foundation etc. depends upon the bearing capacity of the soil, the pattern of stress distribution in the soil beneath the loaded area, the probable settlement of the foundation, effect of ground water, effect of vibrations, the magnitude of loads and ground water conditions etc. This course provides some important geotechnical aspects of the analysis and design of foundations.

Objectives

1 To estimate the vertical stresses in soil and to study the various practical applications.

2 To understand the design concepts for shallow foundations including strip and raft foundations and to understand applications of geocells.

3 To study the load carrying capacity and design of pile foundation.

4 To understand different types of well foundations and concept of floating foundations.

5 To analyze cantilever sheet piles including anchored sheet piles and to understand braced cuts system

6 To learn different types of machine foundations and understand the design philosophy.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Estimation of Stresses in Soils**		04
	1.1	Boussinesque and Westergaard's theories	
	1.2	Newmark Chart	
	1.3	Practical applications.	
II	**Shallow Foundation**		06
	2.1	Determination of bearing capacity of shallow foundation by IS Code method	
	2.2	Settlement analysis of shallow foundation by IS code method	
	2.3	Geotechnical design of shallow foundation on rock and weathered rock	
	2.4	Geotechnical design of raft foundation.	
	2.5	Improvement in the bearing capacity of footings using geocells	
III	**Pile Foundation**		07
	3.1	Introduction, necessity of piles, types of pile foundations.	
	3.2	Load carrying capacity of single and group piles	
	3.3	Pile load test as per IS 2911 (Part I & Part II)	
	3.4	Geotechnical Design of single pile and pile cap as per IS 2911 and IRC 78	
IV	**Floating Foundation and Well Foundation**		06
	4.1	Introduction to floating foundation, floatation, bottom elastic heave	
	4.2	Design of floating foundation on piles	
	4.3	Introduction to well foundation, forces acting on well foundation.	
V	**Sheet piles and Braced cuts**		08
	5.1	Cantilever sheet piles including anchored sheet piles in cohesionless and cohesive soils, lateral earth pressure diagram, computation of embedment depth	
	5.2	Difference in open cut and retaining wall theories, apparent earth pressure diagram	
	5.3	Design of reinforced soil retaining walls	
	5.4	Estimation of strut loads in braced cuts placed in cohesionless and cohesive soils.	
VI	**Machine Foundations**		08
	6.1	Introduction, Dynamic soil properties as per IS 5249	
	6.2	Types of machine vibrations	
	6.3	Basic principles of machines foundation	
		Total	**39**

Contribution to Outcome

On completion of this course, the students will be able to:

1. Analyze vertical stress condition in soils.
2. Design a suitable foundation system.
3. Evaluate the safe allowable bearing capacity of shallow foundation and load carrying capacity of pile foundation under different soil conditions.
4. Explain concept of floating foundation.
5. Design different types of sheet piles.
6. Explain basic principles of machines foundation.

Internal Assessment 20 marks.

Consisting of Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Average of marks will be considered for IA.

End Semester Examination 80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

Recommended Books:

1. Terzaghi K. and Peck R. B., "Soil Mechanics in Engineering Practice", Wiley and Sons, 1996.
2. Alamsingh, "Soil Mechanics and Foundation Engineering", Vol I & Vol II, Standard book House, 2013.
3. Holtz, R.D. & Kovacs, W.D., "An introduction to geotechnical engineering", Prentice Hall, 1981.
4. Taylor D.W., "Fundamentals of soil mechanics, Asia publications Bombay, 1967.
5. Das B. M., "Shallow Foundation- Bearing Capacity & Settlement" Taylor & Francis, 2009.
6. Das B. M., "Principles of Foundation engineering", PWS Publishing Company, 2012.
7. Winterkorn H. and Fang F. Y., "Foundation Engineering Handbook", CBS Publishers & Distributors, New Delhi, 1990.
8. Robert M. Koerner, "Design with Geosynthetics", Pearson Prentice Hall, 2005.
9. G.V. Rao & G.V.S.S. Raju, "Engineering With Geosynthetics", Tata McGraw-Hill Pub Co Ltd, 1990.

Reference Books:

1. Bowles J. E., Foundation Analysis and Design, McGraw-Hill Book Co, 2001.
2. Shamsher P. and Sharma H., Pile Foundations in Engineering Practice, Wiley and Sons, 1990.
3. Ranjan, Gopal & Rao, A.S.R., "Basic and applied soil mechanics", New Age International Pvt. Ltd., 2004
4. Kramer S. L. Geotechnical Earthquake Engineering, Prentice Hall, 1996
5. Swami Saran, Soil Dynamics and Machine Foundation (2nd Ed,), Galgotia Publication Pvt Ltd.
6. Duncan C. Wyllie, "Foundations on Rock" CRC Press; 2nd edition 2019.
7. N.V. Nayak, "Foundation Design Manual" Dhanpat Rai Publications, 2018.

Semester VII

Course Code	Course Name	Credits
CEDLO7022	Department Optional Course-4 Solid and Hazardous Waste Management	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Rationale

Management of solid and Hazardous waste is a challenge for all developed and developing nations. Measures like proper collection, segregation, treatment, and solid waste disposal needs more attention in today's world. To achieve sustainable development proper solid waste management should be subjected to various types of waste treatments for obtaining value added products. Robust implementation of planned facilities for reuse, recycling, maximum resource recovery from various waste facilities, combined with safe residual waste disposal through sanitary landfills, incineration and novel methods of composting is initiated.

Objectives

1. To describe functional elements of solid waste management and its need.
2. To explain the segregation and transportation of municipal solid waste.
3. To recognize waste disposal methods and energy recovery techniques.
4. To comprehend the necessary knowledge and concepts of landfill for disposal.
5. To demonstrate hazardous waste management through its safe handling and disposal.
6. To identify assorted types of solid waste.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Municipal Solid Waste Management**		06
	1.1	Sources, Types, Quantities, Composition, sampling of wastes, Properties of wastes, Numericals related to moisture content, density and Energy content, Problems and issues of solid waste management - Need for solid waste management- Awareness programme, Legal issues related to solid waste disposal	
	1.2	Functional Elements of SWM- waste generation (factors affecting), storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.7R concept	
II	**Waste Segregation, Storage, Collection and Transport**		06
	2.1	Segregation - wet and dry method, Volume reduction at source, Recycling and Reuse of waste, Methods of collection - House to House collection, On site storage of municipal solid waste, Hauled container and stationary container system, Collection routes; Optimization of transportation routes, Numericals on container and collection systems.	
	2.2	Transfer station -Significance, Site selection, Types, Material Recovery facility	
III	**Waste processing techniques and Energy Recovery**		06
	3.1	Waste transformation- Biological and Thermal Biological Conversion Technologies – Composting, Factors affecting for composting, Various Composting Methods as Indore and Bangalore, Vermi, Mechanical and In vessel composting, Numericals on aerobic and anaerobic composting	
	3.2	Thermal conversion technologies – Incineration, Pyrolysis, Gasification, Refuse derived fuel	
IV	**Landfills for Disposal of Waste**		07
	4.1	Landfill Classification-Sanitary, Secure and Bioreactor, Design criteria for landfill site selection, operation and maintenance, Landfill methods -Trench, Area, Slope	
	4.2	Leachate generation, Characteristics and it's control methods. Landfill gas management and landfill closure	
	4.3	IoT in solid waste management	
V	**Hazardous Waste Management**		07
	5.1	Sources, Characteristics and classification of hazardous wastes, Storage, Handling, Collection, Transportation and Minimization, Need for Hazardous Waste Management	
	5.2	Treatment and Disposal	

		Hazardous Site remediation – onsite and offsite Techniques. Hazardous waste management using secure landfill, Disposal practices in Indian Industries, Hazardous Waste Management Rules 2016.	
VI	**Assorted Solid Wastes**		
	6.1	**Biomedical waste** Need for Biomedical Waste Management, Sources, Classification, Storage and Segregation- Color coding, Collection and Transportation, Treatment and Disposal. Latest Biomedical waste management rules. **Electronic Waste** Types, Component separation, Collection, Recycling and Recovery, E-waste management techniques and Latest E- waste management rules	07
	6.2	**Plastic Waste** Problems related to plastic wastes, Plastic waste management- Recycling & recovery, Energy production, Plastic waste management- Rules and Regulation **Construction and Demolition waste** Composition, Recycling and reduction, Proper Management	

Contribution to Outcome

After the completion of the course the learner should be able to:

1. Acquire the knowledge of functional elements of solid waste management.
2. Illustrate solid waste collection system, route optimization techniques, transfer station and processing of solid waste.
3. Develop the ability to plan waste minimization and processing of solid waste.
4. Explain approaches to treat the solid waste in the most effective manner for sustainable development.
5. Discuss safe methods of handling, management and disposal of hazardous waste.
6. Summarize waste management techniques used for assorted solid waste

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Average of marks will be considered for IA.

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

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
7. Advances in Construction and Demolition Waste Recycling Management, Processing and Environmental Assessment, Fernando Pacheco-Torgal, Yining Ding, Francesco Colangelo, Rabin Tuladhar, Alexander Koutamanis.
8. Plastics Waste Management, Disposal Recycling and reuse, Marcel Dekker, Inc. New York, 1993- Nabil Mustafa.
9. CPHEEO, "Manual on Municipal Solid Waste Management" Central Public Health and Environmental Engineering Organization, Government of India, New Delhi , 2000.
10. MSW Rules 2016," Swachh Bharat Mission and Smart Cities Program of India.
11. Hazardous and other Wastes Management Rules,2016

Semester VII

Course Code	Course Name	Credits
CEDLO7023	Department Level Optional Course-4: Ground Improvement Techniques	03

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

Theory					Term Work/ Practical/Oral			
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	Total
Test 1	Test 2	Average						
20	20	20	80	3 Hrs.	--	--	--	100

Rationale

A geotechnical engineer often needs to design new structures or repair the structures on or in problematic soils in engineering practices. The types of soil at construction sites are not always totally favorable for supporting civil engineering structure such as buildings, bridges, highways, tunnels, retaining walls, dams, offshore structures and many more. Soil needs to be treated using ground improvement techniques to enhance the soil strength. Specific types of soil improvement techniques are required for different problematic soils and situations, such as expansive and collapsible soils, liquefiable soils, karst deposits, foundation on dumps and sanitary landfills, earthquake prone areas, etc. This course will deal with different ground improvement techniques, their principles, effectiveness, design issues and areas of applications.

Objectives

- To enable students to identify problematic soils, associated issues and need for ground improvement.
- To make the students understand shallow and deep compaction techniques, importance of pre-compression and vertical drains.
- To make the students understand different soil stabilization techniques.
- To make the students learn the concepts, purpose and effects of grouting.
- To make the students understand application of stone column technique.
- To provide students the concept of reinforced earth, soil nailing and ground anchors.

Detailed Syllabus

Module	Course Module/ Contents	Periods
I	**Introduction**	07
	Different types of problematic soils and concerns (inadequate mechanical properties, swelling and shrinkage - expansive soils, collapsible soils, marshy and soft soils, organic/ peaty soils, loose sandy or gravelly deposits, liquefiable soils, karst deposits, foundation on dumps and sanitary landfills, old mine pits, etc.); Need for ground improvement; Control of ground improvement works; Ground improvement techniques for different soil types (principles, applicability to various soil conditions, material requirements, equipments required, results likely to be achieved and limitations); Grain size ranges for different treatment methods; Classification of ground modification techniques; Factors affecting the selection of ground improvement techniques; Benefits/objectives of ground improvement techniques, Emerging trends in ground improvement techniques (Types and brief discussion on constructive use of waste materials, low cost technologies with soil and additives, Geosynthetics, biotechnical stabilization, etc.) **Note:** Refer IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"	
II	**Compaction and Consolidation**	07
	Shallow compaction: laboratory and field methods of compaction, compaction curve, advantages of compaction, effect of compaction; Deep compaction: objectives, brief discussion on dynamic compaction (types of dynamic compaction, evaluation of improvement), dynamic consolidation, dynamic replacement, Vibro-compaction or, Vibro-floatation, Vibro replacement, blasting; Precompression and vertical drains: Precompression or preloading (principle, settlement without and with Precompression), accelerated consolidation by sand drains, free strain and equal strain cases, design of sand drain layout; Brief discussion on prefabricated vertical drains (PVDs), advantages of PVDs over sand drains	
III	**Stabilization of Soil**	05
	Methods of stabilization; mechanical stabilization; lime, cement, fly-ash, bitumen, chemicals and polymer stabilization; Electrokinetic stabilization	

IV	**Grouting**	**06**
	Grouting technology, grout materials, choice of a grout material, classification, general relationship between permeability and groutability; Particulate grouts: characteristics of grout materials, characteristics of grout slurries; Non-particulate grouts: types of chemical grouts, salient features of chemical grouts, grout properties (mechanical properties, chemical properties, economic factors), penetrability and performance aspect of coarse and fine grouts, limits of groutability based on grain size distribution; Various applications of grouting. **Note:** Refer IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"	
V	**Stone Columns**	**07**
	Some important features of stone column treatment: influence of soil type, influence of construction methodology, treatment depth, area of treatment; Basic design parameters: stone column diameter, pattern, spacing, equivalent diameter, replacement ratio, stress concentration factor; Failure mechanisms; Design considerations; Estimation of load capacity of a stone column (unit cell concept); Settlement analysis by the reduced stress method; Granular blanket; Field loading tests; Installation techniques of stone columns: non-displacement method, displacement method, vibro-replacement method; Vibrofloat and rammed stone columns; Methods of improving the effectiveness of stone column **Note:** Refer IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"	
VI	**Reinforced Earth and Anchors**	**07**
	Theory of reinforced earth concept; Design principles of reinforced earth through Mohr circle analysis; Necessity of reinforced earth; Materials; Introduction to Geosynthetics: scope and definitions, multiple functions of Geosynthetics (Separation, Filtration, Drainage, Reinforcement, Protection (Cushion), Barrier/Containment/Waterproofing, Erosion Control), areas of applications; Introduction to soil nailing and ground anchors; Capacity of shallow horizontal strip anchor by using Mononobe-Okabe method.	
Total		**39**

Contribution to Outcome

After successful completion of the course, students will be able to:

1. Identify the problems associated with the existing ground conditions and recognize the need for ground improvement.
2. Explain shallow and deep compaction techniques, pre-compression and vertical drains as well as estimate maximum dry density and consolidation settlement.
3. Evaluate soil stabilization and select the effective soil stabilization technique.
4. Apply knowledge of grouting as per IS 14343:1996.
5. Design stone column as per IS 15284-1 (2003).
6. Describe reinforced earth mechanism, multiple functions of Geosynthetics and evaluate capacity of anchors.

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.

Recommended Books:

1. P. P. Raj (2016). "Ground Improvement Techniques", Second edition, Laxmi Publications (P) LTD.
2. M. R. Hausmann (1990). "Engineering Principles of Ground Modification", McGraw-Hill Inc.,US.
3. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards, New Delhi, (2003).
4. Nihar Ranjan Patra (2012). "Ground Improvement Techniques", Vikas Publishing.
5. S. L. Kramer (2013). "Geotechnical Earthquake Engineering", Pearson.
6. B. M. Das (1990). "Earth Anchors", Elsevier.

Reference Books and IS Codes:

1. IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"
2. IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"
3. IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"
4. R.M. Koerner (1984). "Constructional and Geotechnical Methods in Foundation Engineering (McGraw-Hill series in construction engineering and project management), McGraw-Hill Inc.,US.
5. FHWA Report No. Rd 83/026, (1983) Design and Construction of Stone Columns, Vol I.
6. B. M. Das (2011). "Principles of Foundation Engineering", 7th edition, Cengage Learning.
7. R.M.Koerner (1999). "Designing with Geosynthetics", 4th Edition, Prentice Hall, Jersey.

Semester – VII							
Course Code	**Course Name**						**Credits**
CEDLO7024	**Department Level Optional Course-4: Green Building Constructions**						**03**
Contact Hours			**Credits Assigned**				
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**		**Total**
03	--	--	03	--	--		03
Theory				**Term Work/Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**
Test–I	**Test–II**	**Average**					
20	20	20	80	3 hours	--	--	--	100

Rationale

Globally, buildings are responsible for a huge share of energy, electricity, water and materials consumption. As of 2018, buildings account for 28% of global emissions or 9.7 billion tonnes of CO_2. The United Nations' 2020 global status report and other sources detail that around 35 - 40% of globally generated energy was used by buildings; which also contributed to 33% of worldwide emissions. If new technologies in construction are not adopted during this time of rapid growth, emissions could double by 2050, according to the United Nations Environment Program. Green building construction practices aim to reduce the environmental impact of building as the building sector has the greatest potential to deliver significant cuts in emissions at little or no cost. As civil engineering graduates, it is of utmost importance to have a deep understanding of the concepts and technologies involved in the sustainable development with respect to the construction industry. It is also further desirable for the graduates to have an in-depth knowledge of the green rating systems as well as green auditing & green retrofitting – which will have tremendous scope in the future.

Objectives

1. To outline the environmental impact of buildings
2. To explain the concepts of sustainable development and green building
3. To summarize the features of green buildings
4. To explain green building rating systems
5. To describe green audit
6. To explain green retrofitting

Detailed Syllabus			
Module	**Course Modules / Contents**		**Duration**
I	**Introduction**		**3**
	1.1.	Environmental impact of buildings, concept of sustainable development, concept of green buildings, necessity of green buildings, benefits of green buildings	
	1.2.	Overview of features of green building – design and construction efficiency, water efficiency, energy efficiency, materials efficiency, indoor environmental quality, waste reduction, operations and maintenance	
	1.3.	Examples of green buildings	
II	**Site Selection, Planning and Design**		**8**
	2.1.	Site preservation	
	2.2.	Passive architecture	
	2.3.	Soil erosion control	
	2.4.	Natural topography and on-site vegetation	
	2.5.	Preservation of transportation of trees on-site	
	2.6.	Heat island reduction	
	2.7.	Optimization in structural design	
	2.8.	Innovation in design process	
III	**Water Conservation and Energy Efficiency**		**10**
	3.1.	Rainwater harvesting	
	3.2.	Water efficient plumbing fixtures	
	3.3.	Irrigation systems	
	3.4.	Wastewater treatment and reuse	
	3.5.	Water metering	
	3.6.	Wastewater reuse during construction	
	3.7.	Minimum and enhanced energy efficiency	
	3.8.	Commissioning plan for building equipment and systems and post-installation	
	3.9.	On-site and off-site renewable energy	
	3.10	Energy Metering and Management	
IV	**Green building materials and indoor environmental quality**		**10**
	4.1.	Sustainable building materials	
	4.2.	Use of certified green building materials, products & equipment	
	4.3.	Segregation of waste, organic waste management and handling of waste materials	
	4.4.	Fresh air ventilation	
	4.5.	CO_2 monitoring	
	4.6.	Day lighting	
	4.7.	Minimizing of indoor and outdoor pollutants	
	4.8.	Low-emitting materials	
	4.9.	Occupant well-being facilities	
	4.10	Indoor air quality testing, after construction and before	

		occupancy	
	4.11	Indoor air quality management	
V	**Green building rating systems**		**4**
	5.1.	Introduction to green building rating systems	
	5.2.	Overview of various green building rating systems	
	5.3.	Indian Green Building Council (IGBC) rating system – overview, benefits of new green buildings, overview of certification process and project checklist	
VI	**Green audit and green retrofitting**		**4**
	6.1.	Green audit: pre-audit, on-site audit and post-audit report	
	6.2.	Case study of any one green building audit	
	6.3.	Green retrofit – overview, components of green retrofit: integrated design, occupant behaviour, lighting retrofits, HVAC retrofits, window retrofits, green roof retrofits	

Contribution to Outcomes

On completion of this course, students will be able to:
1. Explain environmental impact of buildings, discuss the concepts of sustainable development & green buildings and overview the features of green buildings
2. Describe site selection, planning and designing of green buildings
3. Explain water conservation and energy efficiency in green buildings
4. Identify green building materials and indoor environmental quality
5. Apply green building rating systems
6. Describe green audit and green retrofitting

Internal Assessment (20 Marks):
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination (80 Marks):
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.
1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only four questions need to be solved.

Recommended Books:
1. Green Building: Principles and Practices by Dr. Adv. Harshul Savla (Notion Press)
2. The Idea of Green Building by A. K. Jain (Khanna Publishers)
3. Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination by Karthik Karuppu (Notion Press)

4. Green Building Materials & Implementation by Dr. V. Murugesh (Notion Press)
5. Green Building Fundamentals by G. Harihara Iyer (Notion Press)

Reference Books/Links:

1. Indian Green Building Council (IGBC) web-site: https://igbc.in/igbc/
2. Leadership in Energy & Environmental Design (LEED) web-site: https://www.usgbc.org/leed
3. Green Building: Principles & Practices in Residential Construction by Abe Kruger and Carl Seville (Delmar Cengage Learning)
4. Green Building through Integrated Design by Jerry Yudelson (McGraw Hill)
5. Green Building Handbook: Volume 1: A Gude to Building Products and their Impact on the Environment by Tom Wooley, Sam Kimmins, Rob Harrison and Paul Harrison (Routledge Publishers)

Semester VII

Course Code	Course Name	Credits
CEDLO7025	Department Level Optional Course- 4: Legal Aspects in Construction	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Practical	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hours	-	-	20	100

Rationale

Construction industry is one of the most regulated industries in the World and subjected to various laws, rules, and regulation and ethical standards. A civil Engineering graduate must be able to understand and interpret these laws and navigate through these environments with utmost certainty and responsibilities.

The syllabus of this course has been designed to give preliminary introduction to Civil Engineering about legal aspects in construction industry. Along with this, the course intend to help students understand various aspects of contracts, tenders and roles & responsibilities of various involved individual and parties.

Objectives

1 To explain needs of various laws and legislation related to Construction Industry.

2 To summarize application of various Contracts and their forms (Documents)

3 To describe application of various Tenders and their forms (Documents)

4 To understand needs & Methods of arbitration and dispute resolution mechanism

5 To explain needs health, safety and labour laws associated with Construction Industry

6 To describe needs of Environmental protection and ethics in Construction Industry

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Introduction to Legal Aspects in Construction Industry**		6
	1.1	Need of laws in the construction industry. Role of Builders, Engineers, Architects and Contractors.	
	1.2	Need for legislation. Important Laws related to construction industry: Indian Contract Act 1872, Labour laws, The Building and Other Construction Workers Act, 1996, The Environment (Protection) Act, 1986.	
II	**Contracting in Construction**		8
	2.1	Contract: Definition, Purpose and Sanctity of Contract, Classification of Construction Contracts and their advantages and disadvantages: Lump-Sum Contract, Unit Price Contract, Cost-Plus Contract and Target Contract. Types of Documents (Forms) in a Construction Contract.	
	2.2	Contract Management: Indian Contract Act- 1872, Breach of Contract and Professional ethics to be followed by Contracting Parties.	
III	**Tendering in Construction**		6
	3.1	Tender: Definitions. Requisites of a Valid Tender Types of Tendering: Open Tendering, Selective Tendering and Negotiated Tendering.	
	3.2	Tender Documents, Scrutinization process, Award, acceptance, Bidding models & bidding strategies. E-Tendering process of PWD.	
IV	**Arbitration and Dispute Resolution**		6
	4.1	Claims & disputes, Standard methods of resolving disputes.	
	4.2	Dispute Resolution Board (DRB) – Necessity, formation, Functioning, Advantages etc	
	4.3	Arbitration & conciliation Act -1996 – Arbitration agreement, Arbitration process, duties & powers of an arbitrator, rules of preparing evidence, Publication of an award.	
V	**Health, Safety and Labour Laws**		6
	5.1	Safety rules on construction sites. Roles and responsibilities of owner, contractor and engineers on site.	
	5.2	Important laws: BOWC Act 1996	
	5.3	Minimum Wage Act, 1948	
	5.4	GST Tax Act 2017	
VI	**Environmental Protection and Ethics**		7
	6.1	Impact of construction industry in global warning and climate change. Environmental impact assessment report and case study of any recent infrastructure project.	

	6.2	Paris agreement 2020 and Indian's Climate target as per Paris agreement.	
	6.3	Ethical responsibilities of Civil Engineers, contractors and other parties in construction.	

Contribution to Outcome

On completion of this course, the students will be able to:

1 Explain needs of various laws and legislation related to Construction Industry.

2 Describe application of various Contracts and their forms (Documents)

3 Describe application of various Tenders and their forms (Documents)

4 Evaluate needs & Methods of arbitration and dispute resolution mechanism

5 Explain health, safety and labour laws associated with Construction Industry

6 Apply needs of Environmental protection and ethics in Construction Industry

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

Recommended Books:

1 Manual for Procurement of Works 2019 GoI, Ministry of Finance

2 PWD manual for E-tendering 2018 PWD, India

3 Construction contracts and claims - Simon M.S., McGraw Hill, New York

4 Construction contracts Management- NICMAR Publication India

5 Estimation and contracts B.S. Patil

Reference Books:

1 Construction contracts and claims - Simon M.S., McGraw Hill, New York

2 Construction contracts Management- NICMAR Publication India

Semester VII

Course Code	Course Name	Credits
CEDLO7026	Department Level Optional Course-4: Environmental Impact Assessment	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 hours	--	--	--	100

Rationale

Environmental impact assessment is the formal process used to predict the environmental consequences (positive or negative) of a plan, policy, program, or project prior to the decision to move forward with the proposed action. An impact assessment may propose measures to adjust impacts to acceptable levels or to investigate new technological solutions. This subject covers the study of environmental assessment process, environmental auditing and provisions of various environmental acts of India.

Objectives

1 Students will learn about sustainable development

2 Students will learn different steps within environmental impact assessment

3 Students will learn how to use of EIA for various projects

4 Students will learn the need to assess and evaluate the impact on environment.

5 Students will learn about Environmental Audit

6 Students will learn Major principles of environmental impact assessment

Detailed Syllabus

Module	Course Module / Contents	Periods
I	**Environmental impact assessment**	5
	What is it, Environmental attitudes, Brief history of EIA, Significance of EIA, Role of EIA in planning and decision making process, objectives of EIA.	

II	**Environmental assessment process** Assessment methodology, Socioeconomic impact assessment, Air quality impact analysis, Noise impact analysis, Energy impact analysis, Water quality impact analysis, Vegetation and wild life impact analysis, Cumulative impact assessment, Ecological impact assessment, Risk assessment.	8
III	**Environmental Impact Assessment Process** Basic concept behind EIS, Stages in EIS production: Screening, scoping, prediction, evaluation, reducing impact, monitoring, conclusions, typical EIS outline	5
IV	**Rapid EIA** Rapid EIA, when it is carried out, advantages and disadvantages	6
V	**Environmental Auditing** Definition, aims and objectives, audit principles, incentives to undertake audit, partial environmental audits, stages of implementing environmental audits, scope of audit	7
VI	**Provisions of various environmental acts of India** various environmental acts of India, Case studies	8

Contribution to Outcome

On completion of this course, the students will be able to:

1 Demonstrate the understanding of concept of Sustainable Development and justify the methods of achieving Sustainable Development.

2 Overview of assessing risks posing threats to the environment

3 List and evaluate different risks associated with given project

4 Conduct Environmental Audit

5 Explain the importance of stakeholders in the EIA process

6 Conduct different case studies/examples of EIA in practice

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks.

2 Question 1 will be compulsory and should cover maximum contents of the curriculum.

3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).

4 Only Four questions need to be solved.

Recommended Books:

1 Corporate Environmental Management: Welford R, University Press

2 Environmental Assessment: *Jain R K*, Mc-Graw Hill

3 Environmental Impact Assessment: *Harry W Conter*, Mc-Graw Hill

4 Environmental Impact Assessment – Handbook: *John G Rau* and *D C Wooren*, Mc-GrawHill.

5 Introduction to Environmental Impact Assessment, A Chadwick, Taylor & Francis , 2007

6 Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

7 Environmental Impact Assessment, Larry Canter, McGraw-Hill Publications

Reference Books:

1 Strategic Environmental Assessment,R.Therirvel, E. Wilson, S. Hompson, D. Heaney, D.Pritchard, Earthscan, London , 1992

2 A Practical Guide to Environmental Impact Assessment, Paul, A Erickson,Academic Press , 1994

3 Handbook of Environment Impact Assessment by Judith Petts; McGraw Hill publications

4 Environmental Impact Assessment: Theory & Practice, Wathern, P, Publishers-Rutledge, London, 1992.

Subject Code	Subject Name	Credits
CEDLO7027	Department Level Optional Course-4: Advanced Design of Steel Structures	03

Teaching Scheme

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

Evaluation Scheme

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test	Test	Average						
20	20	20	80	--	--	--	--	100

Rationale

The civil engineering structures are subjected to different types of loading and their combination. Many of the structure are made of steel , these structure are design by working stress method and limit state method . The design method of different component are given in the syllabus are based on limit state method and working state method.

Objectives

- To understand the design philosophies of Working stress and Limit state methods and
- design of moment resistant connections.
- To explain the design concept of gantry girder
- To understand the analysis and design concept of round tubular structures
- To describe the design concept of different type of steel water tank
- To explain the design concept of lattice tower
- To describe the design concept of steel chimney.

Detailed Syllabus

Module	Sub – Modules / Contents	Periods
I	**Introduction to Steel Structure and Moment Resistant Beam End Connections:**	07
	Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM) , Limit state method and design of simple riveted connection. Design of moment resistant bolted and welded beam end connections by limit state method	
II	**Gantry Girder :**	06
	Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.	
III	**Round Tubular Structural Members :**	06
	Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports	
IV	**Elevated Steel Tanks and Stacks :**	08
	Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation,	
V	**Lattice Tower:**	06
	Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower,	
VI	**Steel Chimney :**	06
	Forces acting on chimney, design of self supporting welded and bolted chimney and components including design of foundation.	

Contribution to Outcomes

On completion of this course, the students will be able to

1. Analyze and design Moment Connection.
2. Analyse and design gantry girder by limit state method.
3. Analysis and design of tubular truss using IS code.
4. Analysis and design of Elevated water tank using IS code.

5. Analyze and design Lattice Tower using IS code.
6. Analyze and design Steel Chimney using IS code.

1 Theory Examination:-

1. Question paper will comprise of six question; each carrying 20 marks.
2. The first question will be compulsory.
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

Internal Assessment **20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Average of marks will be considered for IA.

Term Work (this may be included in content beyond syllabus / optional)

The Term work shall consist of a Design report and detailed drawings on any two projects as indicated below:

1. Roofing system including details of supports using tubular section
2. Design of elevated circular tank with conical bottom steel tank.
3. Design of lattice tower or steel chimney.

The drawing should be drawn in pencil only on minimum of A-1 (imperial) size drawing sheets.

Recommended Books:

1 Design of Steel Structures : N Subramanian, Oxford- University Press
2 Design of Steel Structures: Punamia, A. K. Jain & Arun Kumar Jain . Laxmi Publication
3 Design of Steel Structures: Dayaratnam, Wheeler Publication, New Delhi.
4 Design of steel structures: Krishnamachar B.S, & Ajitha Sinha D.

Reference Books:

1. Design of Steel Structures: Mac. Ginely T.
2. Design of Steel Structures: Kazimi S. M. & Jindal R. S., Prentice Hall of India.
3. Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York.

4. Design of Steel Structures: Arya and Ajmani, New chand & Bros.
5. Relevant IS codes, BIS Publication, New Delhi
6. Steel structures, Controlling behavior through design: R. Englekirk, Wiley
7. LRFD Steel Design : William T. Segui, PWS Publishing
8. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord and James. Stallmeyer, McGraw-Hill

Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7011	**Institute Level Optional Course – I : 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 Life-cycle Management (PLM):** Product Life-cycle 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	09

	Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
III	**Product Data Management (PDM):** 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	05
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 to

- 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. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Life-cycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7012	**Institute Level Optional Course – I : 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, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
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…

- Explain 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 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**
ILOC7013	**Institute Level Optional Course – I : 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
- Evaluate 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

Teaching Scheme

Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7014	**Institute Level Optional Course – I: Design of Experiments**	**03**

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**	07

	4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 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

Internal Assessment:

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

Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7015	**Institute Level Optional Course – I : Operations 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	14

	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
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

- Explain 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.
- Describe 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 question carrying 20 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**
ILOC7016	**Institute Level Optional Course – I : 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 cyber crime 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 Cyber crime:** Cyber crime definition and origins of the world, Cyber crime and information security, Classifications of cyber crime, Cyber crime and the Indian ITA 2000, A global Perspective on cyber crimes.	4
II	**Cyber offenses & Cyber crime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cyber crimes, 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 for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
III	**Tools and Methods Used in Cyber line** Phishing, Password Cracking, Key loggers and Spy-wares, 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:

- Explain 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**
ILOC7017	**Institute Level Optional Course – I : 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 describe role of individual and various organization during and after disaster
- To explain 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: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and	06

	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 software 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

Contribution to Outcome

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**
ILOC7018	**Institute Level Optional Course – I : 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.	10

	Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. 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

Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7019	**Institute Level Optional Course – I : Development 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			
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	**Total Marks**
Test 1	Test 2	Avg						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

Module	Detailed Contents	Hrs.
I	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	**08**
II	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee- linkage between Panchayati Raj, participation and rural development.	**04**
III	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the	**06**

	weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
IV	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
V	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	**10**
VI	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Outcomes: Learner will be able to…

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part

(a) from module 3 then part (b) will be from any module other than module 3)

4. **<u>Only Four questions need to be solved</u>**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District

Planning, 2006, Planning Commission New Delhi

6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 40

Semester-VII

Course Code	Course Name	Credits
CEL701	Design and Drawing of Reinforced Concrete Structures	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	--	2	--	--	1	1

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
--	--	--	--	--	25	--	25	50

Course Objective:

1. To explain the LSM design procedure of G+ 3 RCC framed Building by application of IS code clauses including loading calculation, analysis and design of individual elements with detailing of reinforcements.
2. To explain the concept in the design of water tanks.
3. To explain the concept in the design of retaining walls.
4. To introduce the basics of structural dynamics, structural behavior under the dynamic load and the effect of damping.
5. To introduce earthquake resistant design approach.
6. To develop the practice of design using charts and tables from SP:16 published by BIS.
7. To introduce concept of Pre-stressed Concrete.

Course Outcomes:

At the end of the course, learner will be able to:

1. Design G+3 RCC framed building using IS code recommendations.
2. Design different types of water tanks with detailing of reinforcement.
3. Design different types of retaining walls with detailing of reinforcement
4. Apply the basic concepts of structural dynamics
5. Explain response of structure during an earthquake and calculate design forces.
6. Explain principles of Prestressed Concrete and its losses.

List of Tutorials and Assignments		
Week (Activity)	**Detailed Content**	**Hours**
1st Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Drawing of structural plan on Sheet no. 1)	**02**
2nd Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Design of Staircase)	**02**
3rd Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Design of simply supported and continuous one way and two-way slabs and detailing of reinforcement for slabs including staircase on sheet no. 2)	**02**
4th Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Design of simply supported and continuous Beams and Detailing of reinforcement for beams on sheet no. 3)	**02**
5th Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Design of Columns and Detailing of reinforcement for columns on sheet no. 4)	**02**
6th Week (Tutorial)	Project – I – Design of G+3 RCC Framed Building. (Design of isolated & combined footing and Detailing of reinforcement for footing on sheet no. 5)	**02**
7th Week (Assignment)	Assignment no. 1 Introduction to Structural Dynamics (Maximum 5 Questions)	**02**
8th Week. (Assignment)	Assignment no. 2 Earthquake resistant design of structures (Maximum 5 Questions)	**02**
9th Week (Tutorial)	Project – II – Design of Counterfort retaining wall Design of the elements of counterfort retaining wall using LSM	**02**
10th Week (Tutorial)	Project – II – Design of Counterfort retaining wall (Detailing of reinforcement of counterfort retaining wall on sheet no. 6)	**02**
11th Week (Assignment)	Assignment no. 3 Design of water tanks using WSM (Maximum 5 Questions)	**02**
12th Week (Assignment)	Assignment no. 4 Introduction to prestressed concrete Maximum 5 Questions	**02**
13th Week	Viva – Voce Examination	**02**

Assessment:

- **Term Work**

The Term work shall consist of neatly written design report on Project – I & II & reinforcement detailing on A2 size sheets of paper, detailed drawings using AutoCAD and Assignments 1 to 4. A visit to be conducted at RCC or Prestressed concrete construction site and a detailed report to be submitted by the groups of students. Students may be asked to check manual calculations with available structural design software.

Distribution of marks for Term Work shall be as follows:

Tutorial Work	:	15 Marks
Assignments & Site Visit Report	:	05 Marks
Attendance	:	05 Marks

- **End Semester Oral and Sketching Examination**

  Oral examination will be based on entire syllabus and sketching examination will be conducted for 60 minutes duration before oral examination.

Recommended Books:

1. Design of Reinforced Concrete Structures*: Dayaratnam, P;* Oxford and IBH.
2. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand& bro.
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi
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.

Reference Books:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.
2. Reinforced Concrete: Syal and Goel; Wheeler Publishers.
3. Reinforced Concrete Design: Pillai, S.U. and Menon, Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.
4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.
5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.
6. Prestressed concrete : N. Rajgopalan, Narosa Publishers.
7. Earthquake resistant design of structures: Pankaj Agarwal, Manish Shrikhande, PHI, New Delhi.
8. Relevant IS Codes: BIS Publications, New Delhi.

Semester VII

Course Code	Course Name	Credits
CEL702	Quantity Survey, Estimation & Valuation	1

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	--	2	--	--	1	1

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
--	--	--	--	--	25	--	25	50

Course Objective:

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand measurement systems for various items of civil engineering structures
2. To draft the specifications for various items of work & determine unit rates of items of works by preparing rate analysis
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork by using various methods.
5. 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.
6. To understand the concept of valuation & to determine the present fair value of any constructed building at stated time.

Course Outcomes:

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

1. **Identify** current unit rates of various construction materials through market survey & also study District Schedule of Rates (DSR)
2. **Prepare** rate analysis of few important Items of work
3. **Estimate** approximate cost of the structures by using various methods & **prepare** detailed estimates of various civil engineering structures, including bar bending schedule, by referring drawings.
4. **Assess** the quantities of earthwork & **construct** mass haul diagrams.
5. **Draft** tender notice & **demonstrate** the significance of the tender as well as contract process.
6. **Evaluate** present fair value of any constructed building at stated time.

Activity Based Tutorials		
Tutorial No.	Tutorial	Tutorial Hours
1	Market Survey for rates of materials & items	02
2	Study of District Schedule of Rates & Prepare rate analysis of few important Items of work	02
3	Prepare approximate estimate of residential building	02
4	Prepare detailed estimate (Measurement sheet & Abstract Sheet) of any **two** of the following • RCC structure • Road work • Cross drainage work	02
5	Work out Steel quantity by using BBS	02
6	Work out earthwork volume in banking & cutting for a Road section	02
7	Draft Tender Notice for proposed construction Project & study tender documents & Conditions of contract	02
8	Prepare Valuation Report of any Civil Engineering Structure	02

Internal Assessment

Term work: - **25 Marks**

The term work shall consist of all tutorials enlisted in the syllabus
The use of quantity survey software and the use of worksheets/databases while solving some of the afore-mentioned tutorial is desirable.

Distribution of marks for Term Work shall be as follows:

Tutorials: 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

End Semester Oral Examination: - **25 Marks**

Oral examination will be based on Term-work & entire syllabus

Reference Books: -

1) Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
2) Estimating and costing: Datta, B. N., UBS Publications
3) Building and Engineering Contracts: Patil, B. S., University Press, Hyderabad.
4) Professional Practice: Dr. Roshan H. Namavati

Semester - VII								
Course Code		**Course Name**						**Credits**
CEP701		**Major Project Part-I**						**03**
Contact Hours			**Credits Assigned**					
Theory	**Practical**	**Tutorial**	**Theory**		**Practical**	**Tutorial**		**Total**
-	**6**	**-**	**-**		**3**	**-**		**3**
Theory					**Term Work/Practical/Oral**			
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	**Total**
Test–I	**Test–II**	**Average**						
-	**-**	**-**	**-**	**-**	**25**	**-**	**25**	**50**

Rationale

In the field of Civil Engineering, new problems arise every now and then; but a professional Civil Engineer must know how to precisely identify & state those problems, define the scope & objectives of the probable solution(s), carry out effective review of available literature in the domain of the problem and formulate a systematic methodology to solve the problem. Modern tools and multidisciplinary knowledge are vastly used nowadays for the effective solution of Civil Engineering problem. It is also important to work effectively & ethically as a team and communicate the work done in the form of written reports. The aim of this course is to acquaint the learners with all of the above-mentioned aspects of the Civil Engineering field by inculcating the process of research.

Objectives

1. To acquaint the learners to identify problems
2. To accustom the learners to formulate the scope and objectives
3. To familiarize the learners with the process of review of literature
4. To advice the learners to formulate a methodology
5. To accustom the learners to work as a team
6. To appraise the learners on proper documentation of work

Detailed Syllabus

1. A project group should consist of minimum 3 and maximum of 4 students.
2. The problem statement of the project should preferably be (but not limited to) from the domains of civil engineering.
3. The solutions to the problem may be multidisciplinary i.e., incorporating concepts, tools, techniques etc. of disciplines apart from Civil Engineering.
4. The project work may include:
    a) Experimental Analysis
    b) Design of Structures
    C) Preparation of Working Drawing
    D) Research on Novel Materials
    E) Development of Working Models

F) Studies on Technical and Economic Feasibility
G) Application of Internet of things (IOT) and Software in field of Civil Engineering.
H) Application of any other innovative tools and techniques.

Guidelines for Project

- Students should do literature survey/visit industry/analyse current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor
- Students should use multiple literatures and understand the problem.
- Students should attempt solution to the problem by experimental/simulation methods.
- The solution to be validated with proper justification and report to be compiled in standard format.

Guidelines for Assessment of Project I

Project I should be assessed based on following points

1. Quality of problem selected
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization
4. Clarity of objective and scope
5. Breadth and depth of literature survey

Project I should be assessed through a presentation by the student project group to a panel of internal and external examiners appointed by the Head of the Department/Institute of respective Programme.

Contribution to Outcomes

On completion of this course, the students will be able to:

1. Review & comprehend literature in the selected domain
2. Articulate problem statement & identify the objectives
3. Identify existing methods or solutions to solve identified problem
4. Identify modern engineering tools & other resources to solve the problem
5. Formulate methodology to solve the identified problem
6. Effectively communicate their project work by writing reports & presentations