Item No.-6.16

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	:	B.E (Civil Engineering)
Eligibility for Admission	:	After Passing Third Year Engineering as per the Ordinance 6244
Passing Marks	:	40%
Ordinances / Regulations (if any)	:	Ordinance: O.6244
No. of Years / Semesters	:	4 years / 8 semesters
Level	:	UG
Pattern	:	Semester
Status	:	Revised 2019
To be implemented from Academic Year	:	With effect from Academic Year: 2022-2023

Dr. S. K. Ukarande

Dr. Anuradha Muzumdar

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

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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	Course Name	Teachi (Conta	ng Sche act Hou	eme rs)	Credit Assigned				
Code		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	Course Name	I As	nterna sessm	ıl ent	End	Exam Duration (Hrs.)	Term	Pract.	Tatal	
Code		Test - I	Test – II	Avg.	Exam		Work	/Oral	Total	
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	-	-	-	-	-	25	25	50	
	Total		100		400	-	200	125	825	

\$ indicates work load of Learner (Not Faculty), for Mini Project. Faculty Load: 1 hour per week per four groups.

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

Course	Course Name	Teachi (Cont	ing Sche act Hou	eme rs)	Credit Assigned				
Code		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	Course Name	II Ass	nterna sessme	l ent	End	Exam Duration (Hrs.)	Term	Pract.	Total	
Code		Test - I	Test – II	Avg.	Exam		Work	/Oral	Total	
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.

Faculty Load: 1 hour per week per four groups.

Undergraduate Program Structure for Third year Civil Engineering University of Mumbai

(With Effect from A.Y. 2021-2022) Semester - V

Course Code	Course Name			Teach (Cont	ing S tact H	chei lour	me ·s)	Credit Assigned			
Course Coue	Course Maine		Т	Theor	Prac	t.	Tut.	Theory	Pract	. Tut.	Total
				у							
CEC501	Structures	te		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 C	Course-	1	03	-		-	03	-	-	03
CEL501	Theory of Reinforced Concre Structures	te		-	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-II			-	02*+	-2	-	-	02	-	02
CEM501	Mini Project – 2A			-	04	5	-	-	02	_	02
Total				16	16		-	16	08	-	24
	Ex	kamina	ation	Scher	ne						
Course	Course Name	As	Interr ssessr	nal nent	E	em	E	xam ration	Term	Pract	Total
Code	Course Maine	Test - I	Test – II	Avg	g. Ez	kam	n (1	Hrs.)	Work	/Oral	1000
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
CEDLO501 X	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-II	-	-	-		-		_	25	25	50
CEM501	Mini Project – 2A	-	-	-		-		_	25	25	50
	Total		100)	4	00		-	150	150	800

* Theory class to be conducted for full class

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

Faculty Load: 1 hour per week per four groups.

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		'eachi Conta	ng Sche act Hou	me rs)	Credit Assigned				
		Theo	ory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
CEC601	Design & Drawing of Steel Structures	0	3	-	-	03	-	-	03	
CEC602	Water Resources Engineering	0	3	-	-	03	-	-	03	
CEC603	Geotechnical Engineering-II	0	3	-	-	03	-	-	03	
CEC604	Environmental Engineering	0	4	-	-	04	-	-	04	
CEDLO601X	Department Level Optional Course -2	0	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	
	1	6	14	-	16	07	-	23		
	Exa	aminat	tion S	cheme						
Course Code	Course Name		Intern Assessn		End	Exam	Term	Pract	. Total	
Course Coue			Test - II	Avg.	Exam	(Hrs.)	Work	/Oral	Total	
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

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

Faculty Load: 1 hour per week per four groups.

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 University of Mumbai (With Effect from A.Y. 2022-2023) Semester VII

Course	Course Name	Teachi (Conta	ng Sche act Hou	eme rs)	Credit Assigned			
Code		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

	Ех	amina	tion Sc	heme					
Course		Intern	al Asses	sment	End Sem Exam	Exam	Term	Pract	
Code	Course Name	Test - I	Test – II	Avg.		Duration (Hrs.)	Work	/Oral	Total
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
CEDLO701 X	Department Level Optional Course – 3	20	20	20	80	03	-	-	100
CEDLO702 X	Department Level Optional Course – 4	20	20	20	80	03	-	-	100
CEILO701 X	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	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
Code		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	LO801X Institute Level Optional Course – II		-	-	03	-	-	03
CEL801	Construction Management	-	02	-	-	01	-	01
CEP801	Major Project – Part II	-	12\$	-	-	06	-	06
	12	14	-	12	07	-	19	

	Examination Scheme								
Course	Course Nome	Internal Assessment			End	Exam	Term	Pract.	T
Code	Course Manie	Test - I	Test – II	Avg.	Exam	(Hrs.)	Work	/Oral	Total
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 Hydraulic 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 practical 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				Credi	ts Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3			3			3

Theory					Term W			
Inte	rnal Asses	sment	End Sem	Duration of	Term	Dract	Oral	Total
Test-I	Test-II	Average	Exam	End Sem Exam	Work	T Tact.	Ulai	
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					
	Comp	orehensive Design of Building					
	1.1	Analysis and design of residential/commercial/industrial (G+ 3) RCC framed building.					
Т	1.2	Load transfer mechanism, arrangement of beams, slabs and columns.	11				
	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).					
	Desig	n of Retaining Wall					
II	2.1	Design of Cantilever retaining wall	06				
	2.2	Design of Counterfort retaining wall					
	Desig	n of Water Tank					
III	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.	07				
	3.2	Introduction to design of elevated water tank, frame and shaft type of staging.					
	Introduction to Structural Dynamics						
	4.1	Definition of basic terms used in structural dynamics. Static and dynamic loads, types of dynamic load.					
IV	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.	06				
	Earth	equake Resistant Design of Structures					
V	5.1	Earthquake motion and response of structure.	06				
v	5.2	Design load calculation by seismic coefficient method.	UU				
	5.3	Ductile design and detailing as per IS: 13920.					
	Intro	duction to Pre-stressed Concrete					
VI	6.1	Prestressed Concrete: basic principles of prestressed concrete, materials used, systems of prestressing.	03				
	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

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

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

- Use of relevant IS codes shall be allowed in the examination. 1.
- 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.
- Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi 6.
- 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.

80 Marks

20 Marks

- 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				edits Assigne	d	
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03			03			03

	Evaluation Scheme							
Theory						Term Work/ Practical/Oral		
Inter	nal Asse	ssment	End	Duration	116			Total
Test 1	Test 2	Average	Sem Exam	of End Sem	TW	PR	OR	
				Exam				
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 of various 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.		
	Intro	oduction			
	1.1	Importance of Course	l		
I.	1.2	Measurement systems for specific items of civil engineering structures	l		
	1.3	Units of measurement of various items of works	03		
	1.4	IS1200: - Introduction, deduction rules for Masonry & Plastering work	l		
	Spec	ifications & Rate Analysis	 I		
	2.1	Types & importance of specifications, rules to be followed for drafting	l		
		the specifications of important items of work etc.	06		
II.		Rate analysis, its importance & necessity, Factors affecting rate	VO		
	2.2	analysis, Task work, sources of materials, Study of IS 7272 regarding	1		
		labor output, District Schedule of Rates (DSR)	l		
		Rate analysis of important items of construction works.	l		
	Estii	nates			
		Approximate Estimate	1		
		Definition & Purposes of approximate estimates, Methods for preparing	l		
	3.1	approximate estimates & numerical based on methods, Various terms such	12		
		as administrative approval, technical sanction, Contingencies,	14		
		Work charged establishments etc.	l		
III.		Detailed Estimate	l		
		Definition & purposes of detailed estimate, Data required for preparation	l		
	3.2	of detailed estimate. Introduction of detailed estimate of load bearing	l		
		structure. Methods of taking out quantities such as long wall & short wall	l		
		method, Centre line method for R.C.C. framed structure, Bar Bending	l		
		Schedule & its necessity, preparation of bar bending schedule of various	l		
		structuralelements as per code IS2502.	1		
	Esti	nation of Earthwork for Roads & Canals			
		Methods of computation of volume of earthwork such as mean area	04		
IV.	4.1	method, mid-sectional area method, Prismoidal formula, Trapezoidal	l		
		formula etc. & numerical based on methods. Introduction of Mass Haul	l		
		diagram, Terms like lead & lift etc.	l		
	Tene	lers & Contracts			
		Tenders	0.0		
	~ 1	Definition & types of tenders, Tender notice & its inclusions,	VO		
	5.1	Pre-qualification of contractors, Pre-bid meeting, Procedure for	1		
		submission & opening of tender, acceptance & rejection of tender, Tender	1		
		validity period, E-Tendering	1		
V.		Contracts	1		
	5.2	Definition, basic forms such as Valid, void & voidable contract. General	1		
		types of contracts with their suitability, conditions of contract	1		

	Val	uation	
VI.	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	08
	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

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:

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.

20 Marks

80 Marks

- 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:	3
	Pre-stressed Concrete	

Cont		Credits .	Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3			3			3

Theory					Term W			
Internal	Assessme	nt	End Sem	Duration of Terr		Term Proof Oral		Total
Test-I	Test-II	Average	Exam	End Sem Exam	Work	I lact.	Orai	
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.

Module	Sub-Modules/ Contents			
	Introductio	n of Pre-stressed Concrete		
	1.1	Basic concept and general principle		
Ι	1.2	Materials used and their properties, need of high strength concrete and steel	02	
	1.3	Techniques and systems of prestressing		
	1.4	Advantages of Prestressed Concrete		

Detailed Syllabus

	Analysis of Pre-stressed Concrete Beams					
Π	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,				
	Losses in Pres	stress				
III	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	06			
	Analysis of Pre-stressed Concrete Beams in Limit State of Serviceability Deflection					
IV	4.1	Deflection at transfer, short time and longtime deflection of uncracked beams, permissible limits	04			
	Analysis and Collapse	Design of Pre-stressed Concrete Beams in Limit State of				
v	5.1	Shear - Principal tension, permissible limit, analysis and design of beams in shear (sections uncracked in flexure)	10			
	5.2	Flexure - General philosophy of design, assumptions, analysis and design of beams in flexure				
	Design of Pre	e-stressed Concrete Beams in Limit State of Serviceability,				
	Maximum Compression and Cracking					
VI	6.1	Suitability of section modulus	07			
	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.
- 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:

- 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
- Prestressed Concrete Structures: *P. Dayaratnam*, Oxford and IBH Publishing Co. Pvt. Ltd.
 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:	03
	Applied Hydrology & Flood Control	

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

Theory					Term Wo			
Inter	rnal Asse	essment	End Sem	Duration of	TW	PR	OR	Total
Test 1	Test 2	Average	Exam	End Sem Exam				
20	20	20	80	3 hrs	-	-	-	100

Rationale

This course 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.

Module	Sub-Modules/ Contents	Hrs.
	1.1 Introduction:	
	Hydrological cycle, scope of hydrology, water budget equation, data sources.	
	1.2 Precipitation:	
Ι	Measurement of precipitation, network of rain gauges and their adequacy in a	
	catchment, methods of computing average rainfall, hyetograph and mass curve	8
	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.	
	2.1 Abstractions from Precipitation:	
	Evaporation and transpiration, evapo-transpiration, interception, depression	
	storage, infiltration and infiltration indices, determination of water losses.	(
11	2.2 Stream Flow Measurement:	0
	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.	
	3.1 Kunon:	(
111	Catchment, watersned and drainage basins, Factors affecting runoff,	0
	rainiali-runoli relationship, runoli estimation, droughts 4.1 Hadrograph Analysia	
	4.1 Hydrograph Analysis:	
IV	hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous	7
	5.1 Floods:	
	Estimation, envelope curves, flood frequency studies, probability and stochastic	
V	methods, estimation of design flood, flood control methods, Limitations, risk-	6
	reliability and safety factor. Flood routing: Hydrologic and hydraulic routings.	
	6.1 Ground Water Hydrology:	
VI	Yield, transmissibility, Darcy's law, Dupuitt's theory of unconfined flow, steady	6
	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.	
<u> </u>	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

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

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:

- 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

80 Marks

20 Marks

- 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							
C	Credits Assigned						
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total	
03			03			03	

Evaluation Scheme								
Theory					TW/ Pract/Oral			Total
Internal Assessment			End Sem	Duration of End	TW	DD	OB	
Test 1	Test 2	Average	Exam	Sem Exam	1 VV	PK	UK	
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
	Cons	truction Projects and Report Preparation	
I.	1.1	Classification of construction projects. Project Formulation and phases involved in it.	03
	1.2	Feasibility studies, SWOT analysis. Preparation of Project report.	
	Proje	ect Appraisal	
II.	2.1	Importance and phases in a project development cycle for major infrastructure projects.	06
	2.2	Importance of Appraisal, its need and steps involved in it.	
	Mark	xet Appraisal	09
III.	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.	
	Tech	nical and Managerial Appraisal	
	4.1	Method to study the technical appraisal/viability of a project in terms of its	06
IV		location, type of land and intended use of building, technology requirements	
1		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.	
	Finar	ncial analysis and Economic Appraisal	
	5.1	Various costs related to a project, Methods to determine the profitability of	00
V.		a project, Break even analysis.	07
	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.	
	Proje	ect Financing and Implementation	
VI.	6.1	Turnes and Sources of finance in local National and International context	
	0.1	I ypes and Sources of Inflance in local, National and International context.	
	62	Agancies involved in the implementation of a project Methods of	06
	0.2	implementation like Built operate and Transfer and its other variants like	
		B.O.O. B.O.O.T. B.L.T. EPC etc.	
		Total	20
		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).
- 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:	03
	Analysis of Offshore Structures	

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

Theory				Term Wo				
Inte	Internal Assessment		ernal Assessment End Sem Duration of End		TW	PR	OR	Total
Test-I	Test-II	Average	Exam	Sem. Exam				
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
п	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
ш	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
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:

- Subrata K. Chakrabarti (2005): Handbook of offshore engineering Volume–I & II, Elsevier, The Boulevard Langford Lane, Kidlington, Oxford OX51GB, UK.
- 2. Deo M C (2013): Waves and Structures, <u>http://www.civil.iitb.ac.in/~mcdeo/waves.html</u>
- 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.
- Sarpakaya T. and Isaacson M., "Mechanics of Wave Forces on Offshore Structures", Van Nostrand Rainhold, NewYork, 1981.

- 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.
- 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.
- 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
CEDI 07015	Department Level Optional Course-3	03
CEDLO/015	Advanced Construction Technology	03

Contact Hours				Credit	s Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

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

- 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		Sub-Modules/ Contents	Hrs.		
	Sub	Structure Construction			
	1.1	Box jacking, Pipe jacking, Underwater drilling, blasting, and concreting. Underwater construction of diaphragm walls and basement			
Ι	1.2	Driving well and caisson, sinking cofferdam, cable anchoring, and grouting. Driving diaphragm walls, sheet piles	06		
	1.3	Laying operations for built-up offshore system, Shoring for deep cutting, large reservoir construction, and well points. Dewatering for underground open excavation.			
	Supe	er Structure Construction for building			
	2.1	Vacuum dewatering of concrete flooring, Concrete paving technology			
Π	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	06		
III	Con	struction of Special Structures			
	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.			
	Adva	ancement in Construction techniques			
	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.			
IV	4.2	Coastal construction techniques: Sound Proofing walls, water-resistant roofs, high-performance doors and windows, air and moisture barriers.	08		
	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.			
	Dred	lging			
V	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.	06		

	5.2	Advantages & Disadvantages of Various Dredging Systems, Production	
		Cycle for Dredgers, Application, Capacity of dredgers, & its economical use,	
		dredging economics	
	Reh	abilitation and Strengthening Techniques	
VI	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	07
	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

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

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

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.
- 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.

20 Marks

80 Marks

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:

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	
CEDI 07016	Department Level Optional Course-3:	03	
CEDL07010	Pavement Materials, Construction and Maintenance	03	

Contact Hours				Cre	dits Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

Theory					Term W	ork/Pract		
Internal Assessment		End Sem	End Sem Duration of		Breat Oral		Total	
Test-I	Test-II	Average	Exam	End Sem Exam	Work	Flact.	Orai	
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.

- 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		Sub-Modules/ Contents	Hrs.			
	Soil					
	1.1	Soil-Classification methods				
Ι	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.	05			
	1.3	Soil classification as per HRB.				
	Stresses in Soil					
н	2.1	Theories of elastic and plastic behavior of soils, Cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus.	00			
Ш	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)	08			
	Aggre	egates				
III	3.1	Classification, requirements, Blending of aggregates, Importance of aggregate shape factor in mix design	04			
	3.2	Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials),				
	Bitun	nen, Tar and Bituminous Mix Design				
IV	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.	09			
	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.				
	Evalu	ation and strengthening				
	5.1	Flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkelman beam deflections, skid resistance and measurement				
V	5.2	Highway construction: Construction of WBM roads, Bituminous pavements, cement concrete roads, Reinforced concrete pavements construction.	09			
	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.				

	Introduction to Super pave Technology				
VI	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.	04		
	6.2	Use of super pave perform and grade binder specifications. Comparison between Marshal Mix method and Super pave method.			

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

- Explain the soil classification in accordance with various soil classify the system and evaluate the 1 ability of the soil as a subgrade material in terms of standard engineering parameters.
- Describe the stress distribution in subgrade soil and the various ground improvement methods. 2
- 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 paying (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
- Apply basic principles of mix design of cement concrete and bituminous mixes. 6

Internal Assessment

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

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.
- Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then 3 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)
- Principles and Practices of Highway Engineering; Dr. L. R. Kadiyali and Dr. N. B.Lal, Khanna 2 Publishers, New Delhi.
- Highway Engineering, Sharma, S.K., S. Chand Technical Publishers, New Delhi (3rd 3 Revised Edition, 2013).
- 4 Principles of Transportation and Highway Engineering: Rao, G.V., Tata Mc-Graw Hill Publications, New Delhi

80 Marks

20 Marks

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	03	
	Foundation Analysis and Design		

Contact Hours				Cr	edits Assigned	
Theory Practical		Tutorial	Theory	Practical	Tutorial	Total
03			03			03

Theory					Term W	ork/Practio		
Int	ernal Asse	ssment	End Som	Duration of	Term Described Oral		Total	
Test-I	Test-II	Average	Exam	End Sem Exam	Work	Tacucai	Orai	
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.

- 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		Sub-Modules/ Contents	Hrs.				
	Esti	mation of Stresses in Soils					
т	1.1	Boussinesque and Westergaard's theories	04				
1	1.2	Newmark Chart	04				
	1.3	Practical applications.					
	Sha	llow Foundation					
	2.1	Determination of bearing capacity of shallow foundation by IS Code method					
II	2.2	Settlement analysis of shallow foundation by IS code method	06				
11	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					
	Pile	Foundation					
	3.1	Introduction, necessity of piles, types of pile foundations.					
III	3.2	Load carrying capacity of single and group piles	07				
	3.3	Pile load test as per IS 2911 (Part I & Part II)	07				
	3.4	Geotechnical Design of single pile and pile cap as per IS 2911 and IRC 78					
	Floating Foundation and Well Foundation						
137	4.1	Introduction to floating foundation, floatation, bottom elastic heave	0.6				
1V	4.2	Design of floating foundation on piles	00				
	4.3	Introduction to well foundation, forces acting on well foundation.					
	She	et piles and Braced cuts					
	5.1	Cantilever sheet piles including anchored sheet piles in cohesionless and cohesive soils, lateral earth pressure diagram, computation of embedment depth					
V	5.2	Difference in open cut and retaining wall theories, apparent earth pressure diagram	08				
	5.3	Design of reinforced soil retaining walls					
	5.4	Estimation of strut loads in braced cuts placed in cohesionless and cohesive soils.					
	Machine Foundations						
1 71	6.1 Introduction, Dynamic soil properties as per IS 5249		00				
VI	6.2	Types of machine vibrations	08				
	6.3	Basic principles of machines foundation					
	1	Total	39				

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

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

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

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

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.

80 Marks

20 marks.

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	03
	Solid and Hazardous Waste Management	

(Contact Hour	Ś	Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

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

- 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		Sub-Modules/ Contents	Hrs.		
	Munio	cipal Solid Waste Management			
Ι	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			
	Waste	e Segregation, Storage, Collection and Transport			
Π	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.	06		
	2.2	Transfer station -Significance, Site selection, Types, Material Recovery facility			
	Waste processing techniques and Energy Recovery				
III	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	06		
	3.2	Thermal conversion technologies – Incineration, Pyrolysis, Gasification, Refuse derived fuel			
	Landf	ills for Disposal of Waste			
IV	4.1	Landfill Classification-Sanitary, Secure and Bioreactor, Design criteria for landfill site selection, operation and maintenance, Landfill methods -Trench, Area, Slope	07		
	4.2	Leachate generation, Characteristics and it's control methods. Landfill gas management and landfill closure			
	4.3	IoT in solid waste management			
	Hazar	dous Waste Management			
v	5.1	Sources, Characteristics and classification of hazardous wastes, Storage, Handling, Collection, Transportation and Minimization, Need for Hazardous Waste Management	07		

	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	Assor	ted 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 				
	6.2	Plastic WasteProblems related to plastic wastes, Plastic waste management- Recycling & recovery, Energy production, Plastic waste management- Rules and RegulationConstruction and Demolition waste Composition, Recycling and reduction, Proper Management				

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

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

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.
- 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

80 Marks

20 Marks

Semester VII

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

	Contac	t Hours	Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03			03			03

Theory					Term We			
Inter Test 1	rnal Asse Test 2	ssment Average	End Sem Exam	Duration of End Sem Exam	TW	PR	OR	Total
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.

- 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 precompression 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	Sub-Modules/ Contents	Hrs.
Ι	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

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.
- 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:

- P. P. Raj (2016). "Ground Improvement Techniques", Second edition, Laxmi Publications (P) LTD.
- 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.
- 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								
Cours	se Code			Course Na	ame			Credits
CEDI	LO7024	Departn	nent Lev	el Optional Co	ourse-4: G	reen Bu	ilding	03
				Constructi	ions			
	Contact Hou	rs			Credits A	ssigned		
Theory	Practical	Tutorial	ſ	Theory	Practica	1 T	utorial	Total
03				03				03
		Theory		Term				
		Ľ		Work/Practical/Oral				
Int	ernal Assess	ment	End	Duration		DD	0.0	Total
Test–I	Test–II	Average	Sem Exam	of End Sem Exam	TW	РК	OK	
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.

- 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		Sub-Modules/ Contents	Hrs.			
	Intro 1.1.	duction Environmental impact of buildings, concept of sustainable				
Ι	1.2.	buildings, benefits of green buildings Overview of features of green building – design and construction	3			
		efficiency, water efficiency, energy efficiency, materials efficiency, indoor environmental quality, waste reduction, operations and maintenance				
	1.3.	Examples of green buildings				
	Site S	Selection, Planning and Design				
	2.1.	Site preservation				
	2.2.	Passive architecture				
	2.3.	Soil erosion control				
II	2.4.	Natural topography and on-site vegetation	8			
	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				
	Wate	r Conservation and Energy Efficiency				
	3.1.	Rainwater harvesting				
	3.2.	Water efficient plumbing fixtures				
	3.3.	Irrigation systems				
	3.4.	Wastewater treatment and reuse				
III	3.5.	Water metering	10			
	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				
	Gree	n building materials and indoor environmental quality				
	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				
	11	Fresh air ventilation				
IV	4.5.	CO ₂ monitoring	10			
	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				
	Green building rating systems					
	5.1. Introduction to green building rating systems					
V	5.2.	Overview of various green building rating systems	4			
	5.3.	Indian Green Building Council (IGBC) rating system – overview, benefits of new green buildings, overview of certification process and project checklist				
	Gree	n audit and green retrofitting				
	6.1.	Green audit: pre-audit, on-site audit and post-audit report				
VI	6.2.	Case study of any one green building audit	4			
	6.3.	Green retrofit – overview, components of green retrofit: integrated design, occupant behaviour, lighting retrofits, HVAC retrofits,				
		window retrofits, green roof retrofits				

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
CEDI 07025	Department Level Optional Course- 4:	03
CEDLO7025	Legal Aspects in Construction	05

(Contact Hour	S		Credits	Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03						03

Theory					Term W			
Internal Assessment		End	End Duration of		Deve etterni	01	Total	
Test-I	Test-II	Average	Sem Exam	End Sem Exam	Work	Fractical	Ural	
20	20	20	80	3 Hours	-	-	-	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 intends to help students understand various aspects of contracts, tenders and roles & responsibilities of various involved individual and parties.

- 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	Sub-Modules/ Contents						
	Introduction to Legal Aspects in Construction Industry						
	1.1Need of laws in the construction industry. Role of Builders, Engineers, Architects and Contractors.Need for legislation Important Laws related to construction						
1	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.	6				
	Cont	racting in Construction					
Π	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.	8				
	2.2	Contract Management: Indian Contract Act- 1872, Breach of Contract and Professional ethics to be followed by Contracting Parties.					
	Tend	lering in Construction					
III	3.1	Tender: Definitions. Requisites of a Valid Tender Types of Tendering: Open Tendering, Selective Tendering and Negotiated Tendering.	6				
	3.2	Tender Documents, Scrutinization process, Award, acceptance, Bidding models & bidding strategies. E-Tendering process of PWD.					
	Arbi	tration and Dispute Resolution					
	4.1	Claims & disputes, Standard methods of resolving disputes.					
IV	4.2	Dispute Resolution Board (DRB) – Necessity, formation, Functioning, Advantages etc	6				
	4.3	Arbitration & conciliation Act -1996 – Arbitration agreement, Arbitration process, duties & powers of an arbitrator, rules of preparing evidence, Publication of an award.					
	Heal	th, Safety and Labour Laws					
	5.1	Safety rules on construction sites. Roles and responsibilities of owner, contractor and engineers on site.					
V	5.2	Important laws: BOWC Act 1996	6				
	5.3	Minimum Wage Act, 1948					
	5.4	GST Tax Act 2017					
	Envi	ronmental Protection and Ethics					
VI	6.1	Impact of construction industry in global warning and climate change. Environmental impact assessment report and case study of any recent infrastructure project.	7				

62	Paris agreement 2020 and Indian's Climate target as per Paris	
0.2	agreement.	
63	Ethical responsibilities of Civil Engineers, contractors and	
0.5	other parties in construction.	

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

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

20 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.
- 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 Hour	S		Credits	Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

		The	eory	Term W				
Inte	rnal Asses	ssment	End Sem	Duration of	Term	Pro et Orel		Total
Test-I	Test-II	Average	Exam	End Sem Exam	Work	Pract.	Orai	
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	Sub-Modules/ Contents	Hrs.		
	Environmental impact assessment			
Ι	What is it, Environmental attitudes, Brief history of EIA, Significance of EIA, Role of EIA in planning and decision-making process, objectives of EIA.	5		

Π	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				
IV	Rapid EIA Rapid EIA, when it is carried out, advantages and disadvantages				
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			

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

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.
- 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.

80 Marks

20 Marks

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		Credits				
CEDLO7027	CEDLO7027 Department Level Optional Course-4:					
Teaching Scheme						
Con	tact Hours	Credits Assign	ed			

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

Evaluation Scheme

Theory				Term Work/ Practical/Oral			Total	
Inte Test	ernal Asse Test	ssment Average	End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
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.

- 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	Hrs.			
I	Introduction to Steel Structure and Moment Resistant Beam End Connections:				
	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:				
	Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.				
III	Round Tubular Structural Members:				
	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:				
	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:				
	Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower,	06			
	Steel Chimney:	06			
VI	Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.				

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

- 1. Analyze and design Moment Connection.
- 2. Analyze 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
- 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 | 03 | | | |
| | Management | | | | |

Teaching Scheme								
Contact Hours Credits Assigned								
Theory	Theory Practical		neory Practical Tutorial Theory		Theory	Practical	Tutorial	Total
03			03			03		

Evaluation Scheme

		Theory	Term v	vork / Pract	ical / Oral			
Internal Assessment			End	Duration of				Total
Tost 1	Tost 2	Avorago	Sem	End Sem	TW	PR	OR	Marks
1051 1	1651 2	Average	Exam	Exam				
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ Contents	Hrs.		
	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			
т	and Application, A PLM Project, Starting the PLM Initiative, PLM			
1	Applications			
	PLM Strategies:	10		
	Industrial strategies, Strategy elements, its identification, selection and	10		
	implementation, Developing PLM Vision and PLM Strategy, Change			
	management for PLM			
	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			
II	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,	00		
	Concurrent Engineering and Life Cycle Approach, New Product Development	09		
	(NPD) and Strategies, Product Configuration and Variant Management, The			

	Design for X System, Objective Properties and Design for X Tools, Choice of	
	Design for X Tools and Their Use in the Design Process	
	Product Data Management (PDM):	
III	Product and Product Data, PDM systems and importance, Components of	05
	PDM, Reason for implementing a PDM system, financial justification of	
	PDM, barriers to PDM implementation	
	Virtual Product Development Tools:	
TX 7	For components, machines, and manufacturing plants, 3D CAD systems and	05
IV	realistic rendering techniques, Digital mock-up, Model building, Model	05
	analysis, Modeling and simulations in Product Design, Examples/Case studies	
	Integration of Environmental Aspects in Product Design:	
	Sustainable Development, Design for Environment, Need for Life Cycle	
V	Environmental Strategies, Useful Life Extension Strategies, End-of-Life	05
	Strategies, Introduction of Environmental Strategies into the Design Process,	
	Life Cycle Environmental Strategies and Considerations for Product Design	
	Life Cycle Assessment and Life Cycle Cost Analysis:	
	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO	
VI	Standards, Fields of Application and Limitations of Life Cycle Assessment,	05
	Cost Analysis and the Life Cycle Approach, General Framework for LCCA,	
	Evolution of Models for Product Life Cycle Cost Analysis	

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

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 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)

- 1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
- 2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "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								
		Credit	s Assigned					
Theory	Theory Practical		Theory	Practical	Tutorial	Total		
03			03			03		

Evaluation Scheme

		Theory	Term work / Practical / Oral					
Internal Assessment			End	Duration of				Total
Test 1	Test 2	A	Sem	End Sem	TW	PR	OR	Marks
Test I	est i lest 2 Avera	Average	Exam	Exam				
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ 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
ш	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.			
	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis,			
VI	severity/criticality analysis, FMECA examples. Fault tree construction, basic	05		
	symbols, development of functional reliability block diagram, Fau1t tree analysis			
	and Event tree Analysis			

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)

- 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	03			
	Information System				

Teaching Scheme Contact Hours Contact Hours							
Theory	Theory	Practical	Tutorial	Total			
03			03			03	

Evaluation Scheme

Theory						work / Prace		
Internal Assessment			End Com	Duration of				Total Manlia
Test 1	Test 2	Average	End Sem Exam	End Sem Exam	TW	PR	OR	
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ 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			
п	Data and Knowledge Management:Database Approach, Big Data, Datawarehouse and Data Marts, Knowledge Management.Business intelligence (BI):Managers and Decision Making, BI for Data analysis andPresenting Results	7			
ш	Ethical issues and Privacy : Information Security. Threat to IS, and Security Controls				
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.				
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)

- 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

Semester VII									
Course Code			С	ourse Nai	ne		Credits		
ILOC7014 Institute Level Optional				Course –	03				
	Teaching Scheme								
	Contact Hours Credits Assigned								
Theory	Practical		Tutorial	Theory	Practical	Tutorial	Total		
03			03				03		
	Evaluation Scheme								

		Theor	ry	Term v				
Internal Assessment			E. 10	Duration of				Total
Test 1	Test 2	Average	End Sem Exam	End Sem Exam	TW	PR	OR	Marks
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ Contents	Hrs.
Ι	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 Models2.1 Linear Regression Models2.2 Estimation of the Parameters in Linear Regression Models2.3 Hypothesis Testing in Multiple Regression2.4 Confidence Intervals in Multiple Regression2.5 Prediction of new response observation2.6 Regression model diagnostics2.7 Testing for lack of fit	08
III	Two-Level Factorial Designs3.1 The 2² Design3.2 The 2³ Design3.3 The General2k Design3.4 A Single Replicate of the 2k Design3.5 The Addition of Center Points to the 2k Design,3.6 Blocking in the 2k Factorial Design3.7 Split-Plot Designs	07

	Two-Level Fractional Factorial Designs			
	4.1 The One-Half Fraction of the 2 ^k Design			
	4.2 The One-Quarter Fraction of the 2 ^k Design			
IV	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			
	Response Surface Methods and Designs			
	5.1 Introduction to Response Surface Methodology			
\mathbf{V}	5.2 The Method of Steepest Ascent	07		
	5.3 Analysis of a Second-Order Response Surface			
	5.4 Experimental Designs for Fitting Response Surfaces			
	Taguchi Approach			
VI	6.1 Crossed Array Designs and Signal-to-Noise Ratios	04		
V I	6.2 Analysis Methods			
	6.3 Robust design examples			

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)

- 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 Code Course Name								
ILOC7015	Institute L	evel Optional Co	ourse – I :	Operations		03			
		Research							
	Teaching Scheme								
Co	ontact Hours		Credits Assigned						
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total			
03			03			03			
	Evaluation Scheme								

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

- 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	Sub-Modules/ 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
ш	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)

- 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	ILOC7016 Institute Level Optional Course – I : Cyber Security and					
	Laws					

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

2

Theory Term work / Practical / Oral								
Internal Assessment			End	Duration of				Total
Test 1	Tost 2	Avorago	Sem	End Sem	TW	PR	OR	Marks
Test I	1051 2	Average	Exam	Exam				
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ 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
п	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
ш	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					
VI	Information Security Standard compliances	6				
	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	0				

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)

- 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	03				
	and Mitigation Measures					

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

Evaluation	Scheme
------------	--------

Theory						vork / Pra			
Internal Assessment		End	Duration of				Total Manka		
Test 1	Test 2	Tost 2	Test 2	Average	Sem	End Sem	TW PR	OR	I Utal Walks
1051 1	1651 2	Average	Exam	Exam					
20	20	20	80	03 Hrs.				100	

- 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	Sub-Modules/ 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
п	 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
ш	 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 coordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process. 	06

VInstitutional 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.064.2 Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.90VFinancing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and 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 post-disaster measures in some events in general 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.06								
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6.4 Do's and Don'ts in case of disasters and effective implementation of relief aids.		contingency plans.						
		6.4 Do's and Don'ts in case of disasters and effective implementation of relief aids.						

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	03				
	Management					

Teaching Scheme								
	Contact Hou	rs	Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total		
03			03			03		

Evaluation Scheme

		The	eory		Term work / Practical / Oral			
Inter	nal Asses	sment	End	d Duration of				Total Marka
Test 1	Test 2	Ava	Sem	End Sem	TW	PR	PR OR	I Utal Walks
Test I		Avg	Avg Exam Exam					
20	20	20	80	03 Hrs.				100

- 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	Sub-Modules/ Contents	Hrs.
Ι	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
П	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
ш	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.					
	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.					
IV	General fuel economy measures in Boilers and furnaces, Waste heat recovery, use	10				
	of insulation- types and application. HVAC system: Coefficient of performance,					
	Capacity, factors affecting Refrigeration and Air Conditioning system					
	performance and savings opportunities.					
	Energy Performance Assessment:					
	On site Performance evaluation techniques. Case studies based on: Motors and					
V	variable speed drive, pumps, HVAC system calculations: Lighting System:	04				
	Installed Load Efficacy Ratio (ILER) method, Financial Analysis.					
	Energy conservation in Buildings:					
VI	Energy Conservation Building Codes (ECBC): Green Building, LEED rating,	03				
	Application of Non-Conventional and Renewable Energy Sources					
	Outcomes:					
Students v	vill be able to:					
• To iden	tify 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 util						
• To describe the energy performance evaluation of some common electrical installations and identif						
the ener	rgy saving opportunities.	-				
• To describe the energy performance evaluation of some common thermal installations and identify						

- 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)

- 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				

		Tea	ching Sche	eme		
	Contact Hours	5		Cred	its Assigned	
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

Evaluation Scheme

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

- 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
- 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	08
	for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya	
	Raj - beginning of planning and community development; National extension services.	
П	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 weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	06

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
- 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

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

Col	Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
		2			1	1

	Work/P							
Interi	nal Assessm	ent	End Sem	Duration	Term	erm Proof Orel		Total
Test-I	Test-II	Average	Exam	Sem Exam	Work	TTACI.	Ulai	
					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				
1 st Week	Project – I – Design of G+3 RCC Framed Building.	02				
(Tutorial)	(Drawing of structural plan on Sheet no. 1)	02				
2 nd Week	Project – I – Design of G+3 RCC Framed Building.	02				
(Tutorial)	(Design of Staircase)	02				
3 rd 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				
4 th 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				
5 th 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				
6 th 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				
7 th Week	Assignment no. 1					
(Assignme	Introduction to Structural Dynamics	02				
nt)	(Maximum 5 Questions)					
8 th Week. (Assignme nt)	Assignment no. 2 Earthquake resistant design of structures (Maximum 5 Questions)	02				
9 th Week (Tutorial)	Project – II – Design of Counterfort retaining wall Design of the elements of counterfort retaining wall using LSM	02				
10 th Week (Tutorial)	Project – II – Design of Counterfort retaining wall (Detailing of reinforcement of counterfort retaining wall on sheet no. 6)	02				
11 th Week (Assignme nt)	Assignment no. 3 Design of water tanks using WSM (Maximum 5 Questions)	02				
12 th Week (Assignme nt)	Assignment no. 4 Introduction to prestressed concrete Maximum 5 Questions	02				
13 th 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

С	Credits Assigned					
Theory	Practical	Tutorial	Theory Practical		Tutorial	Total
		2			1	1

Theory					Work/F			
Interna	al Assessm	nent	End Sem	Duration of End Sem	Term Pract Oral		Total	
Test-I	Test-II	Average	Exam Exam	Work	11400	Ulai		
					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	Tutorial	Tutorial			
No.	Tutonai	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	02			
	RCC structure • Road work Cross drainage work				
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											
Cours	se Code		Course Name								
CE	P701		Major Project Part-I						Major Project Part-I		03
(Contact Hou	irs	Credits Assigned								
Theory	Practical	Tutorial	Г	heory	Practical Tutorial			Total			
-	6	-		-	3 -			3			
		Theory			Term Work/Practical/Oral						
Inte	ernal Assess	sment	End	Duration							
Test–I	Test-II	Average	Sem	of End	TW	PR	OR	Total			
			Exam	Sem Exam							
-	-	-	-	-	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

Semester-VIII

Semester VIII

Course Code	Course Name	Credits
CEC801	Construction Management	03

	Contact Hour	`S	Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-		03	-		03

Theory				Term V				
Inter	rnal Asse	ssment	End	Duration of	Term		Oral	Total
Test-I	Test- II	Average	Sem Exam	End Sem Exam	Work	Practical.		
20	20	20	80	3	-	-	-	100

Rationale

This course is intended to teach students the management skills to be applied during all the stages of Civil Engineering Project. The professional construction engineering practice will be rendered meaningless if service is not offered with a scientific approach and managerial practices. This course deals with the techniques to be applied for planning and scheduling projects, optimizing time-cost and other resources in construction, monitoring & ensuring quality and safety aspects in projects.

Objectives

- 1 To understand the basic functions and construction management.
- 2 To apply scheduling techniques such as CPM & PERT
- 3 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.
- 4 To understand allocating the resources and project monitoring
- 5 To know about safety and quality aspect of construction works.

Detailed Syllabus

Module	Sub-Modules/ Contents	Hrs.
I 1.	Atroduction to Construction ManagementConcept and Principles of Management, contribution by eminent personalities like F.W.Taylor, Henry Fayol and Elton Mayo towards growth of management thoughts.	03

	1.2	Significance, objectives & functions of construction management					
	Cor	nstruction Projects:					
п	2.1	Role and unique features of Construction industry in economic development of country	03				
	2.2	Construction projects- Classification, Characteristics, Project life cycle	00				
	2.3	Roles and responsibilities of various agencies associated with a Construction project					
	Cor	struction project planning & Scheduling:					
	3.1	Stages of planning in the view of owner / department as well as contractor.					
	3.2	W.B.S, Bar Charts its limitations and its uses, Milestone charts					
III	3.3 Network-Terminology, Network Rules, Fulkerson's rule, Precedence network.						
	3.4 C.P.M- Activity & event with their types, activity times, even Critical path, forward pass, backward pass, float & its types.						
	3.5	P.E.R.T- Assumption underlying PERT analysis time estimates, slack& its types, probability of completing the project.					
	Resources Management & Allocation :						
IV	4.1	Material Management- Importance, objectives and functions of material management. Inventory control, A-B-C analysis and E.O.Q.	08				
	4.2	.2 Human Resource Management- Importance, objectives and functions					
	4.3	Resources Allocation Methods- Resource levelling and Smoothening					
	Pro	ject Monitoring & Cost Control :					
	5.1	Network Updating- Purpose and frequency of updating.					
V	5.2	Time and cost optimization in construction projects - Compression & decompression of network.	08				
	5.3	Common causes of time over run & cost overrun & Corrective measures.					
	Cor	nstruction Safety, Quality Control & Labour Acts:					
VI	6.1	Common causes of accidents on construction sites, costs of accident and precautionary measures to avoid accidents.					
	6.2	Introduction to O.S.H.A. Occupational health hazards & Health Campaign in construction industry.	05				
	6.3	Concept of Quality and quality control.					
	6.4	Importance of labour acts as applicable to Indian construction labour such as Payment of wages act, Minimum wages act, Workmen's compensation act.					

Contribution to Outcome

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

- 1 Explain & apply the knowledge of management functions like planning, scheduling, Executing & controlling the construction projects.
- 2 Prepare feasible project schedule by using various scheduling techniques.
- 3 Gain knowledge of managing various resources & recommend best method of allocating resources to the project
- 4 Develop optimum relationship between time & cost for construction project
- 5 Implement quality & safety measures on construction sites during execution of Civil Engineering projects.
- 6 Describe the importance of labour acts.

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.
- 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 needs to be solved.

Recommended Books:

- 1 Construction Engineering and Management: S. Seetharaman.
- 2 Construction Planning & Management Dr. U. K. Shrivastava.
- 3 Construction Projects planning and Management: P. S. Gahlot and Dhir New Age International (p) Publishers
- 4 Construction Project Management: Chitkara K. K. Tata McGraw Hill
- 5 Handbook of Construction Management: P K Joy, Macmillan, India
- 6 Critical Path Methods in Construction Practice: Antill J M & Woodhead R W, Wiley

Reference Books:

- 1 Construction Hazard and Safety Handbook: King &Hudson, Butterworth
- 2 Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill
- 3 NPTEL: Civil Engineering-NOC: Principles of construction https://nptel.ac.in/courses/105/104/105104161/

Semester VIII

Course Code	Course Name	Credits
CEDLO8011	Department Level Optional Course-5: Bridge Engineering	03

	Credits Assigned						
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total	
03			03			03	

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

Rationale

In the age of increase in traffic load and rapid transportation, bridges are very important part of nation's transportation infrastructure associated with the economic growth. Bridges allow for roads and railways to cross over obstacles such as rivers, valleys or other roads etc. Bridges are being built mainly with reinforced concrete, pre-stressed concrete or structural steel depending on various factors such as environment, site conditions, nature of loads and spans etc. The civil engineering profession is much concerned with proper planning, design, construction, maintenance, repairs and rehabilitation of bridges which are of utmost importance.

- 1 Learner will be able to take the appropriate decision in respect of selection of site, type of bridge superstructure, sub structure, bearing, foundation, launching method of girder and construction methods as per conditions.
- 2 Learner will be able to analyze and design reinforced concrete culverts and pre-stressed concrete bridges using relevant IRCs.
- 3 Learner will be able to analyze and design lattice girder steel bridge for railway loading using relevant Bridge Rules and IRS code.
- 4 Learner will be able inspect the bridge and understand general aspects of repairs and rehabilitation.
| Module | | Sub-Modules/ Contents | Hrs. |
|--------|-------|--|------|
| | Intro | oduction of Bridge Engineering | |
| т | 1.1 | Types of bridges and their classification, components of a bridge | 02 |
| I | 1.2 | Selection of suitable site (data required and investigations) | 02 |
| | 1.3 | Economic span | |
| | IRC | loads, their distribution and design of superstructure for roadway | |
| | brid | ges using limit state method | |
| | 2.1 | IRC loads: IRC-Class AA and 70R tracked vehicle, Class-A and Class-B train of vehicles | |
| II | 2.2 | Design of RC culvert | 20 |
| | 2.3 | Preliminary design of balanced cantilever bridge | |
| | 2.4 | Design of PSC deck slab bridge | |
| | 2.5 | Design of PSC I- girder bridge. | |
| | IRS | loads, analysis and design of steel lattice girder bridge for broad gauge | |
| | railv | vay | |
| Ш | 3.1 | Various IRS loadings, analysis of steel lattice girder bridge for broad gauge loading | 8 |
| | 3.2 | Design guidelines for main components (top chord, bottom chord, diagonal member, end post) of steel lattice girder bridge [Numerical not expected] | |
| | Subs | structure | |
| 13.7 | 4.1 | Types of foundations and their choices, well foundation, pile foundation | 4 |
| IV | 4.2 | Types of piers & abutments and their shapes, wing walls | 4 |
| | 4.3 | Need of bearing, types and suitability | |
| | Erec | tion of girder and construction methods | |
| V | 5.1 | Various methods of erection of bridge girders | 2 |
| | 5.2 | Cantilever method of construction of bridge | |
| | Insp | ection and repairs of bridges | |
| VI | 6.1 | Categories of bridge inspection and instruments | 3 |
| | 6.2 | General aspects of repairs, retrofitting and rehabilitation | |

Contribution to Outcome

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

- 1 Choose the suitable type of bridge according to site condition.
- 2 Design RC Culvert and RC balanced cantilever bridge using relevant IRCs.
- 3 Design prestressed concrete deck slab bridge and I-girder bridge using relevant IRCs.

- 4 Design steel lattice girder bridge using IRS loading.
- 5 Choose different bearings, foundations, piers and abutments based on their suitability.
- 6 Choose method of erection of bridge superstructure and repair techniques of existing bridges.

Site Visit/ Field Visit:

The learner shall visit an under construction prestressed concrete bridge or steel lattice girder bridge site and prepare a detailed report on the same.

Internal Assessment Examination

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)

End Semester Examination

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

80 Marks

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.
5	IRC: 6, IRC: 112 and IS: 1343 are allowed in the examination.
Recommende	d Books:
1	Design of Bridges: Raju N. K., Oxford and IBH

- 2 Bridge Engineering: *Ponnuswamy S.*, Tata Mc Graw Hill
- 3 Design of Bridge Superstructures: *T.R. Jagdeesh* and *M.A. Jayaram*, Prentice Hall India Private Ltd., New Delhi
- 4 Comprehensive Design of Steel Structures: Dr. B C Punmia, Ashok Kumar Jain and Arun Kumar Jain; Laxmi Publications (P) Limited

IRC Codes:

IRC: 5- 2015, IRC: 6- 2017, IRC: 78-2014, IRC: 83-(Part-I)-2015, IRC: 83-(Part-II)-2018, IRC: 83-(Part – III)-2018, IRC: 112-2020, IRC:123-2017, IRC SOR17-1996, IRC SOR18-1996, IRC SP13-2004, IRC SP37-2010, IRC SP40-1993, IRC SP54-2000, IRC: SP105-2015

IRS Codes:

Bridge Rules: Rules specifying the loads for design of super-structure and sub-structure of bridges and for assessment of the strength of existing bridges -2014

Indian railway standard code of practice for the design of steel or wrought iron bridges carrying rail, road or pedestrian traffic (steel bridge code) -2017

Reference Books:

- 1 Concrete Bridge Practice: *Raina V. K.*, Tata Mc Graw Hill
- 2 Essentials of Bridge Engineering: *Victor D.J*, Oxford and IBH
- 3 Bridge Engineering Handbook: Chen W. F. and Duan L., CRC Press, 2000
- 4 Bridge Bearings and Expansion Joints: *David Lee*, E & FN Spon

20 Marks

Course Code	Course Name	Credits
CEDLO8012	Department Level Optional Course-5: Design of Hydraulic Structures	03

C	Contact Hours	8		Credits	Assigned		
Theory	Practical	Tutorial	Theory Practical Tutorial Tot				
03			03			03	

Theory Term Work/Practical/Oral								
Inter	nal Asses	sment	End Sem	Duration of End Sem	Term	Pract.	Oral	Total
Test-I	Test-II	Average	Exam	Exam (Hours)	WORK			
20	20	20	80	3				100

Rationale

Hydraulic structures are the structures designed to retain, convey, control, regulate, mix and dissipate the energy of water. Such structures are constructed in all domains of water engineering; primary domains being water quantity management (water supply, irrigation, hydro power, flood control, drainage, navigation, socio-economic and recreational use), water-quality management and various transportation aspects. While the course emphasizes the "WHY" aspect; e.g., design of multi-purpose reservoirs and canal works, it also examines the "HOW" aspect of hydraulic structures. It is only through this mindful approach that the engineer can determine the advantages of a proposed design for a specific application.

	Objectives						
1	To understand the reservoir and planning of reservoir, different zones, capacity and						
2	To convey the knowledge on the various types of Dams, utility and adaptability of						
	various dams.						
3	To develop understanding of the various causes of failure, design criteria and stability						
5	analysis of Gravity & Embankment dam.						
4	To understand Spillways and Energy dissipators, their applicability.						
5	To impart knowledge of canal headworks, canal regulation works and cross drainage						
	works						

Module	Sub-Modules/ Contents	Hrs.					
	Reservoir Planning and Management:						
	Purpose of reservoir, classification of Reservoir, site selection,						
	Investigation works for reservoir, storage zones storage capacity of						
Ι	reservoir, Yield and capacity of reservoir, mass inflow curve and demand						
	curve, Determination of reservoir capacity, determination of safe yield,						
	reservoir losses, reservoir sedimentation, sediment control,						
	Multipurpose reservoirs, Flood Routing and its methods.						
	Gravity Dams:						
	Various forces acting on gravity dam, Load combinations for design,						
	Stability requirements& modes of failure, principal and shear stress,						
II	Profile of dam- elementary and practical profile, low and high gravity	10					
	dam, Limiting height of gravity dam, High and Low gravity dam, Design						
	of gravity dams, Galleries, Joints, Keys, Water seals, crack control in						
	concrete dams.						
	Arch and Buttress Dams:						
III	Types of arch dams, forces acting on arch darn, design of arch dams,	4					
	types of buttress dams.						
	Earth and Rock Fill Dams:						
	Types of earth dams, causes of failures of earth dams, design criteria,						
	section of earth dam, downstream drainage system, seepage analysis,						
	phreatic line, Stability analysis, stability of d/s slope during steady						
IV	seepage, stability of u/s slope during sudden drawdown, stability of u/s						
	and d/s slopes during construction, slope protection, seepage control	9					
	measures, design considerations in earthquake regions, types of rock fill						
	dams.						
V	Spillways and Flood Control Works:						
	Introduction, Necessity of spillways, location of spillway, design						
	consideration of main spillway, Classification of spillways, straight drop	6					
	spillway, design principles of ogee spillway, Chute spillway, Side	0					
	channel spillway, conduit spillway, Siphon spillway and shaft spillway,						
	energy dissipation below spillways, location of hydraulic jump and its						

	share staristics, design of hyperstart type, an every dissinctor, and stilling	
	characteristics, design of bucket type energy dissipator and stilling	
	basin,. Crest gates, types, advantages, design of radial gate, outlet works.	
VI	Miscellaneous Topics:	
	Diversion head works-Component parts, functions, weirs and barrages,	
	Bligh's Creep theory, Lane's weighed theory, Khosla's Theory.	
	Canal regulation works - classification, Sarda type fall, Head regulators	5
	and Cross regulators, Canal escape.	
	Cross Drainage Works-Types, classification of aqueducts and syphon	
	aqueducts	

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

- 1 Explain the Reservoir planning, storage capacity, Sedimentation & Reservoir losses.
- 2 Carry out the stability analysis of Gravity & Earth Dam.
- 3 Explain the causes of failure of various dams & their design criteria.
- 4 Design an ogee spillway.
- 5 Suggest suitable energy dissipation measures.
- 6 Describe the various minor irrigation structures such as Weirs & barrages, Canal Regulators and Cross-drainage works.

Internal Assessment_20 Marks

Consisting Two Compulsory Class Tests - First test of 20 marks based on approximately 40% of contents and second test of 20 marks based on remaining contents (approximately 40% but excluding contents covered in Test I). Average marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

End Semester Examination_80 Marks

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

- 1) Question paper will comprise of a 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:

- Irrigation and Water Power Engineering: B.C. Punmia, PandeB.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi.
- Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-9789383656899.
- Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
- 4. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.
- 5. Design of Irrigation Structures: S. K. Sharma, S. Chand and Co.

Reference Books:

- 1. Theory and Design of Irrigation Structures: R. S. Varshney and R, C. Gupta, Nem Chand
- 2. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
- 3. Design of Small Dams: USBR.
- 4. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
- 5. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.

Semester VIII										
	Course Code CEDLO8013		Course NameCreditsDepartment Level Optional Course-5: Construction Safety3					its		
								Ļ		
	Cont	act Hours Practica	al 🗌	Tutorial	Theory	Practical	its Assig	<u>gned</u> utori	al	Total
	3	-		-	3	-		-		3
		The)rt/			Torm W	ork/Pra	ctica	l/Oral	
	Internal Asse	ssment	лу	End	Duration of	Torm		iciica	l'Oran	- Total
Test- I	Test-II	Ave	erage	Sem Exam	End Sem Exam	Work	Pract	ical	Oral	Total
20	20		20	80	3 Hrs	-	-		-	100
develo manag Studen that ar sites, n enviro laws. Studen invest	The primary goal of this course is to have students learn that a "culture" of safety needs to be developed within companies for a safety program to be effective. This course is more about managing the safety process than the details involved in the specific construction activities. Students in this course will be provided an understanding of safe working practices, various training that are required to be undergone by employees to ensure safe working environment on construction sites, record keeping and maintenance of records, compliance with OSHA worker safety, codes and environmental safety laws, inspection procedures, and penalties for lack of conformance to safety laws. Students will also learn procedures for recognizing hazards, CPR, site safety meetings and accident									
	-			Obj	jectives					
1	Plan to comp	y with sat	fety do	cumentati	on/procedure	s and legal	require	ment	S	
2	Differentiate (OSHA req	uireme	ents for dif	ferent work a	ctivities				
3	3 Design Safety and Emergency response plans									
4	Analyse the cost of Accidents									
5	Design an effective company safety culture manual									
6	Prepare comp analysis of act	lete corpo ual constr	orate s	safety plan projects.	n and site-sp	ecific safe	ety plan	con	itaining	hazard

Detailed Syllabus							
Module		Sub-Modules/ Contents	Hrs.				
	Construction Safety Management:						
	1.1	Role of top management, Duties & responsibilities of various					
Ι		officers on site, Responsibilities of general employees	04				
	1.2	Safety committee. Role of safety officer					
	1.3	General OSHA Requirements, Safety training, Safety campaign					

	Safety in co	onstruction operations and emergency response		
	2.1	Safety on various construction sites viz. buildings, dams,		
	2.1	Tunnels, bridges, roads	06	
II	2.2	Safety at various stages of construction. CPR, site safety meetings		
		Prevention of accidents. Safety measures. (preferably, site visit		
	2.3	shall be arranged to understand the actual safety measures		
		undertaken on construction sites)		
	Safety in us	se of construction equipment		
	3.1	Safety while operating construction equipment.		
III		vehicles, cranes, hoists and lifts	07	
	3.2	Safety of scaffolding and working platforms		
	3.3	Safety while using electrical appliances and explosives used.		
	Accident pr	evention mechanisms		
	4.1	Hazard Recognition, Evaluation, and Control.		
	4.2	Fall Hazards & Fall Arrest- Ladders, Stairs, & Scaffolds		
	13	Electrical Safety Guidelines & Lockout, Tag-out.		
	т.5	Struck-By and Caught-in-Between Hazards		
IV	4.4	Personal Protective gear, first aid on construction sites	12	
	4.5	Job-Site Exposure Hazards, Occupational Hazards		
	4.6	Environmental Extremes - extreme hot and extreme cold		
		weather hazards		
	17	Fire Hazards and Fire fighting - Use of fire extinguishers and		
	4.7	other fire control measures. Occupational Health Hazards		
	Labor Laws	s and legal requirements		
	5.2	Study of various existing national and state laws for worker		
V	5.2	safety and well-being	04	
	5.2	Accident Analysis, computation of costs of accidents for various		
	5.2	scenarios, Worker's compensation insurance		
	Study of Sa	afety Policies		
		Study of safety policies, methods, equipment and training		
	6.1	provided on any ISO approved construction company. Safety		
		Standards and codes		
VI	62	Safety in office, working on sites of high rise construction,	06	
	0.2	prevention of workplace violence		
		Observance of safety week, zero accident period, awards to best		
	6.3	employee (for safety adherence), reprimands to habitual		
		defaulters, etc.		

	Contribution to Outcome				
On compl	On completion of this course, the students will be able to:				
1	Apply safety mechanisms and concepts for improving overall safety of construction sites				
2	Demonstrate the various safety requirements				
3	Explain the various techniques to prevent accidents.				
4	Examine construction safety management.				
5	Implement safety policies, methods and training on construction sites.				
6	Practice safety in construction operations.				

Internal A	Assessment	20 Marks				
Consisting	g 2 Compulsory Class Tests - 1 st test based on approximately	y 40% of contents and 2 nd test				
based on r	remaining contents (approximately 40% but excluding contents	nts covered in Test I)				
End Sem	ester Examination	80 Marks				
Weightage	e of each module in end semester examination will be propor	rtional to number of respective				
lecture ho	urs mentioned in the curriculum.					
1	Question paper will comprise of total six questions, each ca	rrying 20 marks.				
2	Question 1 will be compulsory and should cover maximum contents of the curriculum.					
2	Remaining questions will be mixed in nature (for example i	f Q.2 has part (a) from module				
5	3 then part (b) will be from any module other than module 3	3).				
4	Only Four questions need to be solved.					
Recomme	ended Books:					
1	Construction Safety and Health (2nd ed), David L. Goetsch, Publish by Pearson					
1	ISBN-13: 978-0-13-237469-9, ISBN-10: 0-13-237469-2					
2	Safety Management, Girmaldi and Simonds, AITBS Publishers, New Delhi					
3	Construction Safety, Jimmy W. Hinze, Prentice Hall Inc.,					
Construction Safety and Health Management, Richard J. Coble, Jimmie Hinze and 7						
4	C. Haupt, , Prentice Hall Inc., 2001.					
5	Construction Safety, R.K. Mishra, AITBS Publishers, New	Delhi				
6	Safety Management in Construction (Principles and Pr	actice), S.K. Bhattacharjee,				
0	Khanna Publishers, New Delhi					
7	Safety, Occupational Health And Environmental Manage	ement In Construction, S. C.				
1	Sharma and Vineet Kumar,					
8	Construction Safety (English), by D.S.S.Ganguly and C.S.Cl	hangeriya, Chetan Publication;				
0	2017 th edition, ISBN-10 : 9386953293, ISBN-13 : 978-93	86953292				
9	Construction Safety Handbook - Davis V.S Thomasin K, Th	nomas Telford, London				
Reference	e Books:					
1	Construction Safety Manual published by National Safety G	Commission of India				
2	Safety Management in Construction Industry"- A manual fo	r project managers- NICMAR,				
2	Pune					
3	Construction Safety Handbook - Davis V.S Thomasin K, Th	nomas Telford, London				
4	IS standards for safety in construction - Bureau of Indian S	tandards				
5	OSHA Standards (CFR 1926) at www.osha.gov/readingrood	m.html				

Semester VIII

Course Code	Course Name	Credits
CEDLO8014	Department Level Optional Course-5: Pavement Design	03

(Contact Hour	'S		Credits	Assigned	
Theory	Practical	Tutorial	Theory	Theory Practical Tutor		Total
03	-	-	03	-	-	03

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

Rationale

The pavements are classified according to mode of transportation (highway and airways) and structural behaviour (flexible and rigid). The design of any pavement warrants the proper analysis thereof. The course deals with the various methods of the analyses and design of pavements.

Objectives

- 1 To study the different types of pavements depending upon the mode of transportation, factors affecting pavement design, and methods.
- 2 To understand the concept of analysis of stress, strain and deflection in pavement.
- 3 To enable the students to understand and analyse the mechanics related to flexible pavements as applicable for highways.

4 To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations. To enable the students to understand and analyses the concrete pavements as applicable for highways.

- 5 To enable the students to understand and analyse the mechanics related to flexible and concrete pavements as applicable for airports.
- 6 Evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements and introduce pavement management system

Module		Sub-Modules/ Contents					
	Intro	duction					
Ι	1.1	Classification of Pavement, Pavement structure and functional attributes, factors affecting pavement design.	04				
	1.2	Types of wheel loads for highways and airports, development of design method for highway and airport pavements					
	Stres	sses in Pavement					
Π	2.1	Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF,ESWL	06				
	2.2	Stresses in Rigid pavement: load and temperature stresses, combined stresses.					
	Flex	ible Pavement Design					
III	3.1	Empirical methods using no soil strength criteria, empirical method based no soil strength criteria: CBR method as specified by IRC-37 -1970, 1984, 2001, 2012, 2018.	08				
	3.2	Road note 29 methods, AASHTO method, Asphalt institute method.					
	5.2	Fatigue and rutting as a failure criterion.					
	3.3	Introduction to use of software for flexible pavement design.					
	Rigi	d Pavement Design					
	4.1	Load and temperature stresses in rigid pavements Westergaard's, Bradburry's and Picket's concepts					
IV	4.2	Design steps as per IRC-58-2012,2015 method	08				
	4.3	Design of joints in rigid pavements					
	4.4	Introduction to use of software for rigid pavement design					
	Desi	gn of Airport Pavements					
	5.1	Factors affecting, types of wheel loads, aircraft loading, gear					
V		Design Methods: Corps of Engineer's method, FAA method CDOT	08				
	5.2	method, Asphalt institute method. PCA methods					
	5.3	Joints and reinforcement requirement.					
	Desi	gn of Overlay					
VI	6.1	Design aspects of flexible and rigid overlays design of overlays (IRC-81- 1997)	05				
	6.2	Introduction to pavement management systems: Components of pavement management systems					

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

- 1 Explain the structural actions involved in the pavement due to different types of load acting thereon and the various methods of analysis of pavements.
- 2 Describe the applications of the analysis in the design of pavements using different methods of pavement design.
- 3 Explain of the design of flexible pavement.
- 4 Describe the design of Rigid pavement.
- 5 Explain the design of airfield pavements and apply this knowledge in the field
- 6 Evaluate the different types of distresses occurring in the existing pavements and carry out the structural and functional evaluation of the pavements. Understand the pavement management system.

Internal Assessment

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 marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

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.
- 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 Principles and Practice of Highway Engineering: *L.R.Kadiyali*, Khanna publications.
- 2 Highway Engineering: *Khanna S.K. and Justo* C.E.G. Nem Chand (Revised 10th Edition, 2014)
- ³ Principles, Practice and Design of Highway Engineering (Including Airport Pavements): *Sharma, S.K.*, S. Chand Technical Publications (3rd Revised Edition, 2013)
- 4 Pavement Design: *Yoder* and *Witzech*, McGraw-Hill, 1982.

Reference Books:

- 1 Rajib Mallick & Tahar El-Korchi, *Pavement Engineering: Principles and Practice*, CRC Press, 2nd Edition, 2013
- 2 A. T. Papagiannakis, Eyad A Masad, *Pavement Design and Materials*, John Willey and Sons, 1st Edition 2008
- 3 Relevant Latest IRC, ASTM, AASHTO and other Codes, Manuals and Specifications
- 4 R Srinivasa Kumar, Pavement Design, University Press.
- 5 Pavement Analysis and Design: *Yang H. Huang*, Prentice Hall, New Jersey, 1993
- 6 The Design and Performance of Road Pavements: *Croney, David et al*, McGraw Hill.

80 Marks

20 Marks

Semester VIII

Course Code	Course Name		
CEDI 08015	Department Optional Course 5:	03	
CEDLO8015	Industrial Waste Treatment	03	

(Contact Hours			Credits A	ssigned	
Theory	Theory Practical Tutorial		Theory	Practical	Tutorial	Total
03			03			03

Theory					Work	Term :/Practical/	'Oral	
Inte	ernal Assess	ment	End Sem	Duration of	Term	Droot	Oral	Total
Test-I	Test-II	Average	Exam	End Sem	Work	T Tacı.	Ulai	
20	20	20	80	3 Hrs.				100

Rationale

Industrial wastewater is much more polluted than the domestic wastewater and hence has to be treated with the efficient choice of treatment units by preventing pollution of natural streams and rivers Wastewater treatments may not suffice only with primary treatments until they are modified and supplemented by additional techniques because of toxic chemicals. Industries are therefore generally prevented by legal aspects, from discharging their untreated effluents. It becomes mandatory fo industries to treat their wastewater in their individual treatment plant or common effluent treatment plan before discharging their waste on land, lake, river, municipal sewer, streams as the case may be.

Objectives

- 1. To enable the students to understand quality, characteristics, toxicity of industrial wastewater and its effects on streams.
- 2. To enable the students to understand the impact of industrial wastewater on natural streams.
- 3. To enable the students to understand waste minimization techniques for industrial wastewater.
- 4. To enable the students to understand the necessary knowledge and concepts of biological treatment and advanced/emerging techniques.
- 5. To enable the students to understand various industrial manufacturing process, effluents and treatments.
- 6. To enable the students to understand legislative framework for the remediation of industrial wastewater through environmental audit, environmental impact assessment and common effluent treatment plant.

Module	Sub-Modules/ Contents					
	Introduction to industrial waste and treatments: Sources and types of					
	industrial waste-water, Effects of industrial waste-water on streams and	06				
Ι	waste-water treatment plants. Population equivalence, generation rates,					
	characterization, important contaminants of concern from industries. Toxicity					
	and Bioassay tests. Regulation for protection of streams. BOD Numericals.					
	Stream Protection Measures: Stream and effluent standards, stream					
Π	sampling, stream sanitation, Procedures for improving stream water quality,	06				
	zones of pollution, oxygen sag curve, Streeter Phelps Equation and numerical.					
	Waste minimization:					
	Minimizing effects of industrial waste water: Volume reduction and					
III	Strength reduction	06				
	Equalization, Neutralization, Proportioning, Precipitation, Coagulation	00				
	^{3.2} and flocculation. Flotation - Oil separation and Emulsion breaking.					
	Waste-water treatments for industries					
	Biological treatments: Aerobic and Anaerobic biological treatment					
	methods (Ponds, lagoons, UASB, RBC). Sludge dewatering techniques-					
	4.1 Filter Press, Vacuum Filtration, Sludge thickening, Membrane filtration					
IV	and Centrifuge.					
	Advanced treatments: Need for advance technologies,					
	Automated Chemostat Treatment (ACT)	06				
	4.2 Soil Biotechnology (SBT)					
	Qzonation					
	Industries and waste-water management:					
	Raw material, Manufacturing process and flow-sheets, sources of effluents,					
V	characteristics, ETP, byproduct recovery for following industries:					
	• Sugar	10				
	• Distillery	10				
	• Tannery					
	Dairy Paper and Pulp					
	 Metal Processing Industry (Electroplating) 					
	G					

	Lega Trea	al Aspects, Environment Management Tools and Common Atment Facility for industries	
	6.1	Environmental Impact Assessment, Case Study.	05
VI	6.2	Environmental Audit for industries.	05
	6.3	Common Effluent Treatment Plants (CETPs): Flow chart, Location, Need, Operation & Maintenance Problems and Economical aspects. Case study.	

Having completed this course, the students shall acquire the knowledge of biological treatment and will be able to decide and select precise treatment for particular waste. The students shall be able to determine and design the treatment facilities and assess the guidelines for disposing of waste. They shall be able to formulate approaches to treat waste water in the most effective manner for contamination removal.

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

- 1. Explain the impact of industrial wastewater characteristics on natural streams.
- 2. Analyze various stream protections measures to protect the natural streams.
- 3. Summarize waste minimization techniques for industrial wastewater.
- 4. Relate biological treatment concept and summarize various treatments along with advance technologies.
- 5. Describe waste water generated during manufacturing process and decide the suitable treatment for effluents.
- 6. Evaluate legislative framework for the remediation of industrial wastewater through environmental audit, environmental impact assessment and common effluent treatment plant.

Internal Assessment:

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 marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

End Semester Examination:

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

- 1 Question paper will comprise of a 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
- 4 Only Four questions need to be solved.

20 Marks

80 Marks

Recommended Books:

- 1. Industrial Pollution Control by Eckenfedlar W.W, 2017
- 2. Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, T.M.H. Edition, New Delhi, 1995.
- 3. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi.
- 4. Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
- 5. Wastewater Treatment for Pollution Control and Reuse Hardcover 1 July 2017, Soli. J Arceivala , Shyam. R Asolekar.
- 6. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
- 7. Water Supply and Sewerage: E.W. Steel.
- 8. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
- 9. Introduction to Environmental Engineering: P. Aarne Vesilind, Susan M. Morgan, Thompson.
- 10. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
- 11. Basic Principles of Wastewater Treatment Book ,Marcos Von Sperling
- 12. Industrial Waste Water Treatment Book, A. D. Patwardhan
- 13. Waste Water Treatment , M.N. Rao and Dutta

Reference Books:

- Manual on Wastewater Treatment 3rd Ed. Pub: CPH and Env. Engg. Organization, Ministry of Urban Development, Govt. of India, New Delhi, 1991.
- 2) CPHEEO Manual on Sewage and Treatment.
- 3) Relevant Indian standard specifications and BIS publications.
- Handbook of Water and Wastewater Treatment Plant Operations Book, y Frank R. Spellman

Semester VIII					
Subject Code	Subject Code Subject Name Credits				
CEDLO8016	Department Level Optional Course-5:	03			
	Soil Dynamics				

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

Evaluation Scheme									
Theory				Term Work/ Practical/Oral					
In	ternal Ass	essment	End	Duration				Total	
Toot 1	Test 2	Avorago	Sem	of	TW	PR	OR		
Test I		Test 2 Average		Exam	End Sem				
				Exam					
20	20	20	80	03 Hrs.				100	

Rat	iona	ale

In basic geotechnical engineering course normally various static loads are considered in the theories and analysis of soil. But practically many geotechnical applications require the knowledge of the behavior. properties and response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings. Some of the structures which are subjected to dynamic loadings are machine foundations, shallow and deep foundations, retaining structures, slopes, subgrade soil below railway, pavement, runway etc. This course provides the fundamental theoretical and computational aspects of dynamics for some important geotechnical problems and structures.

Objectives

- 1. To study fundamental concepts of vibrations, degrees of freedom and damping systems.
- 2. To study phenomena like liquefaction and their effects.
- 3. To study principals of machine foundation design and dynamic earth pressure theories on Retaining wall.
- 4. To learn test methods of evaluating dynamic properties of soil.
- 5. To know the earth pressure on retaining walls.

	Detailed Syllabus	
Module	Sub- Modules/Contents	Hrs
I.	Introduction to Soil Dynamics	04
	 Introduction to vibration (simple harmonic motion), Types of waves Introduction to the concept of degree of freedom Introduction to dynamic soil properties (IS4249) Scope and objective, Nature and types of dynamic loading, Importance of soil dynamics. 	
II.	Dynamic approach in different components	05
	 2.1 Wave propagation in elastic rods, in an elastic finite medium and in semi-elastic half space 2.2 Wave generated by surface footing 	
III.	Liquefaction of Soil	08
	 3.1Introduction to liquefaction of soils and its basic terminologies, criterion and factors affecting liquefaction of soil. 3.2 Liquefaction studies in triaxial shear, field studies on liquefaction 3.3 Evaluation of liquefaction potential using analytical method and SPT. 	
IV.	Machine Foundation	06
	 4.1Principles of machine foundation design, criteria for satisfactory machine foundation, degree of freedom of a block foundation, analysis of vertical and sliding vibration of a machine foundation 4.2 Practical design considerations and codal provisions. 	
V.	Dynamic behavior of Machine Foundation	05
	5.1 Mass of soil participating in vibration.5.2 Vibration isolation and screening methods, improvement of distressed machine foundation.	
VI.	Dynamic behavior of Retaining Wall	
	 6.1 Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils. 6.2 Basics of dynamic earth pressure on retaining walls conventional gravity type, reinforced soils, distribution of pressure, and point of application of the resultant, simple examples. 	11
	Total teaching Hours	39
	Course Outcome	

On successful completion of the course, the students are expected to:

- 1. Demonstrate the knowledge of concepts, principles, and applications of soil response under dynamic loading.
- 2. Develop an ability to design with reference to code provisions and solve the practical soil problems subjected to vibrations.
- 3. Able to explain the concept of Liquefaction Potential of different types of soil
- 4. Provide an impetus to new developments in related dynamic topics.
- 5. Carryout field tests on soil to know the dynamic properties of soil.
- 6. Calculate the dynamic earth pressure on retaining walls.

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 marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

Theory Examination:-

- Question paper will comprise of **six** questions: each carrying 20marks.
- The **first** question will be **compulsory** which will have the short questions covering the entire syllabus.
- The remaining five questions will be based on all the modules of Entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub- module and contents thereof.
- There can be an internal choice in various sub-questions / questions 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. Soil Dynamics: Shamsher Prakash, McGraw-Hill book company
- 2. Principles of Soil Dynamics: *Braja, M.Das*, PWS-Kent Publishing Company
- 3. Dynamics of Bases and Foundations: *Barkan, D.D.*, McGraw- Hill Book

company

- 4. Geotechnical Earthquake Engineering", StevenL.Kramer ,PrenticeHallInc.
- 5. Vibrations of Soils and Foundations", E.E.Richartetal ,PrenticeHallInc.
- 6. Relevant IS codes

Semester VIII

Course Code	Course Name	Credits
CEDLO8021	Department Optional Course 6: Repairs, Rehabilitation and Retrofitting of Structures	03

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

Theory					Work			
Inte Test-I	rnal Asse Test-II	ssment Average	End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	Total
20	20	20	80	3 Hrs.				100

Rationale

Structures need strengthening and repairs due to variety of reasons. Now a days different materials, techniques and machineries are used to improve the structures and prolong their serviceable life. A structure needs regular maintenance to perform satisfactorily during its lifetime. This subject deals with damage assessment, preparing a strengthening strategy of RCC, steel structures, Seismic Retrofitting and maintenance of heritage structures.

Objectives

- 1. To understand the concept of Repair of repair and its need.
- 2. To understand various causes of deterioration of concrete structure and Distresses monitoring techniques.
- 3. To understand various materials of repairs and their properties.
- 4. To understand various methods of repairs of concrete structure.
- 5. To understand various methods of repairs of steel structure.
- 6. To understand seismic retrofitting and maintenance of heritage structures.

Module		Sub- Modules/Contents	Hrs
	Intro	duction	
1	11	Need for repair, rehabilitation and maintenance of structure.	
	1.1	Repair Management. Sustainable development.	03
	1.2	Maintenance and it's importance, life cycle cost of structure	
	1.3	Heritage structure and need for their Rehabilitation	
	Dama	age Assessment	
	2.1	Causes of deterioration of concrete: Physical , Chemical and Mechanical causes.	
2	2.2	Distresses monitoring, Visual inspection, Non Destructive Testing using Rebound hammer, Ultra sonic pulse velocity, Semi destructive testing, Probe test, Pull out test, Chloride penetration test, Carbonation, Carbonation depth testing, Corrosion activity measurement	
	2.3	Types of cracks: Diagonal Cracks, Horizontal Cracks, Splitting Cracks, Corrosion Cracks, Plastic shrinkage cracks, thermal cracks	00
	2.4	Crack Measurement techniques: Steel Ruler, Magnified Graticule, Plastic Tell Tale Glass Tell Tale Brass Screws and Caliper Displacement Transducer	
	Repa	ir of Concrete Structures	
	3.1	Methods of crack repairs: Epoxy injection, Routing and Sealing of Cracks, Stitching Prestressing steel Drilling and Plugging Method Gravity Filling Method	
3	3.2	Repair Materials: Essential parameters for repair materials Materials for repair: Materials for Surface Preparation, Chemical Rust removers for corroded reinforcement, Passivators for reinforcement protection, Bonding Agents, Structural Repair Materials, Non-structural Repair Materials, Injection grouts, Joint sealants,Surface coatings for protection of RCC. Premixed Cement concrete/mortars, Polymers/latex modified cement mortars, Epoxy resins	06
	3.3	Corrosion repair methods: Cathodic Protection, Chloride Removal	
	Reha	bilitation and Retrofitting Methods	
Λ	4.1	Repair Stages: Concrete Removal and Surface Preparation, Fixing formwork, Bonding / passivating coat and repair application.	10
4	4.2	Repair Methods: Repairs using mortars/modified mortars, Epoxy based material repairs, Shotcrete, Ferro-cement, Plate bonding, RCC Jacketing Propping and Supporting, Fibre Wrap Technique.	10

	4.3	Foundation Rehabilitation Methods: Shoring, Raking shores, Flying shores, Dead shores, Underpinning, Slab jacking	
		Tying biores, Deau shores, Chaerphinning, Shao Jaching,	
	Repa	ir of steel structures	
		Types and causes for deterioration - Preventive measures -	
	5.1	Repair procedure - Brittle fracture - Lamellar tearing -	
5		Defects in welded joints -	06
-	5.2	Design and fabrication errors - Distress during erection -	
		Causes and remedies	
	5.3	Repair methods for structures.	
	Seisn	nic Retrofitting and Maintenance of Heritage Structures	
	6.1	Earthquake damages of buildings, their retrofitting and	
6	0.1	restoration. Effects of earthquakes.	06
	60	Methods of seismic retrofitting, restoration of buildings	
	6.2	Special care in repair and rehabilitation of heritage structures.	
		Total	39

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

- 1. Describe the concept of repair and its need.
- 2. Classify various causes of deterioration of concrete structure and Distresses monitoring techniques.
- Classify various materials of repairs and their properties. 3.
- Explain various methods of repairs of concrete structure. 4.
- 5. Describe various methods of repairs of steel structure.
- 6. Explain seismic retrofitting and maintenance of heritage structures.

Internal Assessment:

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 marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

End Semester Examination

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

- Question paper will comprise of six questions: each carrying 20marks.
- The first question will be compulsory which will have the short questions covering the entire syllabus.

20 Marks

80 Marks

- The remaining five questions will be based on all the modules of Entire syllabus. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub- module and contents thereof.
- There can be an internal choice in various sub-questions / questions 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. CPWD Handbook on Repair and Rehabilitation of RCC buildings, Govt of India Press, New Delhi
- 2. Santhakumar A.R., "Concrete Technology" Oxford University Press, 2007, New Delhi
- Bhattacharjee J, Concrete Structures Repair Rehabilitation and Retrofitting- 2019, CBS Publishers & Distributors Pvt. Ltd.

Reference Books:

- 1. Raikar, R.N., "Learning from failures Deficiencies in Design, Construction and Service" R and D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
- 2. Maintenance, Repair & Rehabilitation and Minor Works of Buildings P.C.Varghese, PHI Publications
- 3. P.K.Guha , Maintenance & Repairs of Buildings, New Central Book Agency (P) Limited,
- 4. R.Dodge, Concrete structures Concrete Structures Protection Repair and Rehabilitation, woodson

Semester VIII

Course Code	Course Name	Credits
CEDLO8022	Department Optional Course 6: Physico - Chemical Treatment of Water and Waste Water	03

С	Contact Hours		Credits Assigned				
Theory	Practical	Tutorial	ial Theory Practical Tutorial		Total		
03			03			03	

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

Rationale

This course introduces the principles and physico-chemical methods to control water and wastewater pollution. The aim of the course is to give a more fundamental and theoretical understanding of the specific unit processes, providing a better understanding of the principles of how they function and the degree of treatment that can be achieved. Students should be conversant with the sedimentation, coagulation, filtration, disinfection, advanced physico-chemical processes of water and wastewater. They should be conversant with de-watering and disposal of sludge.

Objectives

- 1. To study the impact of water and waste-water treatment on the environment.
- 2. To develop the rational approach towards the design of preliminary treatments.
- 3. To design primary treatment units.
- 4. To Explain and apply chemical unit techniques.
- 5. To impart knowledge about the advanced treatment for water and waste-water.
- 6. To study sludge de-watering & disposal techniques.

Module	Sub- Modules/Contents	Hrs.
Ι	Quality, Quantity of Water and Waste-water Characteristics of water and waste-water, conventional water and waste-water treatment, Sampling and analysis, Health and environmental concerns, Components of waste water flows, sources, strategies for reducing interior	6
II	Water use and waste water flow rates, waste water reclamation and reuse Preliminary Treatment of Water and Waste-water Screens: significance, Classification of screens, Design for head loss, Grit chambers: Gravity settling, stoke's law, Classification and Design Skimming Tank design and flotation	6
III	Primary Treatment of Water and Waste-waterSedimentation: Significance, Types of sedimentation tanks, Zones of settling, Design parameters, Design of sedimentation tank, Tube settlersFiltration: Mechanisms of filtration, hydraulics of filtration, different types of filters, filter clogging, filter washing, Design criteria of Rapid sand filter	8
IV	Chemical units-Techniques: Role of chemical unit processes in water and waste water treatment, Coagulation: Fundamentals, coagulant aids, polyelectrolytes, Design of flash mixer, power requirement Flocculation: Types of flocculation and flocculators, Design of flocculator, power requirement	6
V	Advanced Physico-chemical Processes: Softening, methods of softening, Chemical precipitation, Desalination, solar distillation, Reverse osmosis, Electrolysis Disinfection, Disinfection using chlorine and UV. Estimation of Chorine doses, Use of various forms of chlorine Removal of heavy metals, neutralization, Chemical oxidation of BOD and COD, Removal of colour, Gas stripping, Adsorption and Ion Exchange, Reverse osmosis, Membrane filtration, Activated carbon treatment	08
VI	Sludge De-watering and Disposal Sources of sludge, Estimation of bulk density of sludge, Principles of dewatering, Methods and suitability, thickening of sludge, Chemical conditioning, Elutriation of sludge, Vacuum and pressure filtration, sludge drying beds, Design of sludge drying beds	05

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

- 1. Explain the quality, quantity and treatment of water and waste-water.
- 2. Design preliminary units for treatment of water and waste-water
- 3. Evaluate the removal efficiencies of physico-chemical treatment units.
- 4. Identify optimized dose of chemical coagulation as well as disinfecting agents.
- 5. Apply advanced physico-chemical processes to water and waste-water.
- 6. Administer sludge de-watering and disposal process

Internal Assessment:

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 marks scored in the above two tests will be considered for final assignment of marks which will be out of 20.

End Semester Examination

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

- 1 Question paper will comprise of a 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
- 4 Only Four questions need to be solved.

Recommended Books:

- 1. Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, T.M.H. Edition
- 2. Water Supply Engineering: S. K. Garg, Khanna Publication.
- 3. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers.
- 4. Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
- 5. Industrial Pollution Control by Eckenfedlar W.W
- 6. Wastewater Treatment for Pollution Control and Reuse Hardcover by Soli. J Arceivala (Author), Shyam. R Asolekar (Author)
- 7. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
- 8. Water Supply and Sewerage: E.W. Steel.
- 9. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
- 10. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
- 11. Basic Principles of Wastewater Treatment Book by Marcos Von Sperling
- 12. Industrial Waste Water Treatment Book by A. D. Patwardhan
- 13. Environmental Engineering: Peavy, H.S., RoweD.R.,
- 14. CPHEEO Manual on Water Supply and Treatment.
- 15. CPHEEO Manual on Sewage and Treatment

20 Marks

80

Marks

Semester VIII

Course Code	Course Name	Credits
CEDLO8023	Department Level Optional Course-6: Transportation System Engineering	03

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

Theory					Term Work/Practical/Oral			
Inte	rnal Asses	ssment	End Sem	Duration of	Term	Dreat	Oral	Total
Test-I	Test-II	Average	Exam	End Sem Exam We	Work	Pract. Or		
20	20	20	80	03 Hrs				100

Rationale

Transportation contributes to the economical, industrial, social cultural development of any country. The adequacy of Transportation system of a country indicates its economic social development. Three basic modes of transportation include land, water and air. The land mode further includes highways and railways. This course is developed so as to impart the basic principles behind Railway Engineering, Airport Engineering, Water Transportation Engineering, Public Transportation system in respect of various types of materials used, function of component parts and planning principles.

	Objectives					
1	To enable the students to study the various elements of Transportation system in the					
	country, NUTP and its Environmental consideration.					
2	To study, plan and design different elements of airports and understand aircraft movement controls.					
3	To explain and design various geometric elements of railways and study the elements of modern rails.					
4	To Explain different components of water transport such as Ports, Harbors and Docks.					
5	To study and Explain planning elements of public transport systems.					
6	To Explain different components of bridges, planning of bridges and analyzing different hydrological elements of bridge.					

Module		Sub- Modules/Contents	Hrs					
	Intro	luction to Transportation System						
Ι	1.1	 Role of transportation system in development of country, Different modes of transportation; their merits and demerits, 1.1 present scenario of each mode in India. Different modes of Public Transportation modes available in Mumbai and Suburban areas with advantages and disadvantages of each. 						
	1.2	Urban Transport: National Urban Transport Policy, Sustainable Transportation, Transit Oriented Development.						
	1.3	Environmental Guidelines for Transportation Infrastructure Projects: Environmental Impact Assessment, Identification of Impacts, Measures for offsetting adverse impacts.						
	Air T	ransportation System						
Π	2.1	Introduction: Aircraft: Types and components Airport: Site selection, classification, obstruction, zones and zoning laws, Environmental impacts and guidelines for Airport projects						
	2.2	Airport components: Requirements and functions of each Terminal building: Layout and planning, gate positions and gate capacity, blast consideration Apron and holding apron Taxiway: Design Runway: Configuration, orientation, wind rose diagram, basic runway length and corrections to runway length, Aircraft parking and hangars Airport drainage: Requirements and types	10					
	2.3	Aircraft movement control: Lighting and marking of runway, taxiway and other areas Air traffic control aids, en-route aids and landing aids						
	2.4	Planning of Heliports: Characteristics of Helicopter, Selection of site, Size of landing area, Obstruction clearance requirements, Marking and Lighting of Heliports.						
	Rail 7	Transportation System						
	3.1	Introduction: Alignment of Railway lines, Engineering Surveys for new railway lines. Introduction to Railway Track Components: Requirements and functions of each	08					
	3.2	Geometrics- Gradient: Types Curves: Widening on curves, cant and cant deficiency Turnout: Components and design	00					
	3.3	Yards: Types and functions, Signaling- classifications,						

		interlocking of signals and points				
		Modern Rails: Characteristics of MAGLEV, Metro rails and				
	3.4	mono rails, modernization of track and railway station, high				
		speed trains (Bullet trains) and high-speed tracks				
	Water	r Transportation System				
		Harbour: Classification, functions and requirements				
	4.1	Harbour Infrastructures: Types of breakwaters, jetty, dock				
IV		fenders, piers, wharves, dolphin, mooring accessories	04			
	42	Docks: Repair facilities, wet docks, lift docks, dry docks, gates	-			
	7.2	for graving docks, floating docks				
	4.3	Port facility: Transit shed, warehouses, cargo handling,				
	1.5	container handling				
	Public Transportation System					
	5.1	Introduction: Para Transit system, Street Transit system, Rapid				
		Transit System.				
V	5.2	Route and Schedule: Properties of good route set, stopping	06			
		policy and Stop location, Properties of good schedule.				
	53	Capacity of Transit system: Capacity of Rapid Transit system,				
	5.5	Capacity of Street Transit system.	<u> </u>			
	Bridg	e Engineering				
		Introduction: History and classification of bridge, Components				
	6.1	of bridge, Requirement of Ideal bridge, Site selection and				
		selection of alignment of bridges, Various loads on bridges				
	62	Low-cost Bridges: Introduction to Causeways, Culverts,				
VI	0.2	Floating bridges etc.	06			
		Bridge superstructure and its types, Bearings and Joints on				
	63	bridges				
	0.5	Piers, abutments, Wing walls and approaches, Types of bridge				
		foundations				
	6.4	Bridge Hydrology: Flood Discharge, Waterway, Economic				
	0.4	span, Scour depth, Afflux.				

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

- 1 Compare different modes of transportation and describe National Urban Transport Policies.
- 2 Plan and design different elements of Airports, movements of aircrafts and helicopters.
- 3 Plan and design geometric elements of railway system and explain the elements of modern trains.
- 4 Explain different components of water transport.
- 5 Plan different public transport system, routing, scheduling and estimating transit capacity of the system.
- 6 Explain different elements of bridge and analyse various hydrological elements of bridge.

Internal Assessment

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.
- 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 Khanna S.K., Arora M.G., Jain S.S., Airport Planning & Design, Nemchand Bros., Roorkee
- 2 Saxena S.C., Railway Engineering, Dhanpat Rai & Sons, 1995
- 3 Srinivasan R., Harbours, Docks & Tunnel Engineering, Charotar Publishing House, Anand
- 4 Partha Chakroborty, Animesh Das, Principles of Transportation Engineering
- 5 Bindra S.P., Bridge Engineering, Dhanpat Rai & Sons

Reference Books:

- 1 Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book Co.
- 2 Indian Railway Track: Agarwal, M. M., Suchdeva Press New Delhi.
- ³ Planning Design of Airport: *Horonjeff Mckelrey*, Tata Mc-Graw Hill India Publishing House, New Delhi.
- 4 Docks & Harbour Engineering, Bindra S.P., Dhanpat Rai Publications,
- 5 Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House
- 6 Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi
- 7 Transportation Engineering: *Khisty, C.J. and Lall, Kent, B.;* Prentice Hall India Learning Pvt. Ltd., New Delhi

20 Marks

80 Marks

Semester	- VIII
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Course Code	Course Name	Credits
CEDLO8024	Department Level Optional Course-5: Smart Building Materials	03

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

Theory				Term Wor	·k/Pract	ical/Oral		
Inte	rnal Asses	sment	End Sem	Duration of End			Total	
Test-I	Test-II	Average	Exam	Sem Exam	1 ***		Ŭ K	
20	20	20	80	03 Hrs				100

Rationale

A safe, comfortable, and sustainable built environment is highly desirable, as we spent most of our time in offices, factories, or homes. So smart building materials can play a vital role. Smart materials that are able to respond to an external stimulus have received great attention, especially in last two decades. These materials can change their dimensions, solubility, color, and shape, etc., upon a specific trigger. A wide range of smart materials including alloys, composites, gels, and polymers have been investigated for various applications from aerospace industry to medical technologies and now a days in the buildings and infrastructures. Smart materials can be designed with various responses and actuation mechanism based on the requirements of applications. Study of the importance and working principles of the smart materials is todays need. The concept of "smart" or "intelligent" materials, systems, and structures has been around for many years. A great deal of progress has been made recently in the development of structures that continuously and actively monitor and optimize themselves and their performance through emulating biological systems with their adaptive capabilities and integrated designs. The field of smart materials is multidisciplinary and interdisciplinary, and there are a number of enabling technologies-materials, control, information processing, sensing, actuation, and damping and system integration across a wide range of industrial applications.

Objectives

- 1. To study the importance of smart materials and technology
- 2. To Explain the types, properties of smart materials and learn to select appropriate materials.
- 3. To develop smart technology using smart materials
- 4. To Describe requirements of structural health monitoring
- 5. To understand the smart concrete
- 6. To learn applications of smart materials and technology via case studies.

Module	Sub- Modules/Contents	Hrs
т	Introduction to Smart Building Materials & Technology	02
1	History, importance and need, merits and demerits of smart building materials.	
	Smart Structure system, Components, Importance of smart structures.	
	Fundamentals of Smart Materials	09
	Types and characteristics of smart materials:-	
	Property-changing materials: Thermo-chromics, Photochromics,	
	Mechanochromics, Chemochromics, Electrochromics, Liquid crystals,	
	Suspended particle, Electrorheological, Magnetorheological	
п	Energy-exchanging materials: Electroluminescents, Photoluminescents,	
	Chemoluminescents, Thermoluminescents, Light-emitting diodes,	
	Photovoltaics,	
	Energy-exchanging (reversible) materials: Piezoelectric, Pyroelectric,	
	Thermoelectric, Electrorestrictive, Magnetorestrictive.	
	Miscellaneous Materials: Shape Memory alloy, optical fiber, Construction	
	chemicals, Sealants etc. Review of material, effect, working principle,	
	advantages and disadvantages, application in Smart Structures, Use of alternative	
	materials for structural steels and rebars.	
	Energy Efficient Materials, Durability and Technology	06
	Use of solar energy, wind energy, Smart window, Smart paints, Smart	
	Wall skin, Smart roof. Green buildings and Green Material, Intelligent	
III	buildings. FRP rebars and its properties, smart lighting.	
	Service life. Life cycle concept for structures and selection of materials	
	for durability and sustainability. Use of Thermal and Sound Insulation	
	systems and materials	
	systems and materials.	

	Smart Structural Health Monitoring	09					
IV	Important structural sensing parameters, Basic sensing system, Different						
	types of sensors for monitoring stress, strain, temperature, moisture,						
	displacements, vibration, corrosion etc. Active and passive structural						
	health monitoring system. Specifically for buildings and bridges.						
	Smart Concrete: Transparent concrete, Polymer modified concrete and	08					
	mortars, self-healing concrete, self-compacting concrete, light weight						
	concrete, pervious concrete, fiber reinforced concrete, temperature						
V	controlled concrete, coloured concrete- Constituents, Proportions,						
	material properties, Importance and its application,						
	Electrically conductive concrete, fire/ heat resistant concrete, acid						
	resistant concrete, Ultra high performance concrete and its application in						
	bridge engineering.						
	Applications of Smart Materials and Technology:	05					
	Structural health monitoring of buildings, bridges geotechnical and						
VI	transportation structures, Different types of sensors their working and						
	principles, Repairs and Rehabilitations, Modern Construction, Energy efficient						
	Buildings- A case study.						
		39					

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

- 1. Explain the importance of the smart materials in Civil Engineering structures.
- 2. Describe the working principles of the smart materials.
- 3. Learn to select appropriate sensors.
- 4. Explain the smart concrete and its use in bridges
- 5. Explain the use of smart materials in the structural health monitoring.
- 6. Describe the sensing technology and select appropriate sensors for structural health monitoring.

Recommended Books:

- 1. D. Michelle Addington, Daniel L. Schodek, "Smart Materials and New Technologies For the architecture and design professions", Harvard University. ISBN0750662255.
- 2. Vinod K. Wadhawan, "Smart Structures: Blurring the Distinction between the Living and the Nonliving", Oxford University place, ISBN 978–0–19–922917–8.
- Nilesh Y. Jadhav, Green and Smart Buildings Advanced Technology Options, Springer Nature, ISBN 978-981-10-1002-6.

- Mel Schwartz, Encyclopaedia of Smart Materials, Vol. 1 and Vol. 2, John Wiley & Sons, Inc.
- James Sinopoli, Advanced Technology for Smart Buildings, ARTECH HOUSE, Boston, London.
- Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
- 7. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.
- 8. D. Patranabis Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003.
- Structural health monitoring of civil infrastructure Systems, Edited by Vistasp M. Karbhari and Farhad Ansari, CRC Press Boca Raton Boston New York Washington, DC, Woodhead Publishing Limited, New Delhi.
- HuaPeng Chen and Yi-Qing Ni Structural Health Monitoring of Large Civil Engineering Structures, John Wiley & Sons Ltd, 2018.
- 11. SP-7 (National Building Code of India), Bureau of Indian Standards.

Semester-VIII				
Subject Code	Subject Name	Credits		
CEDLO8025	Department Level Optional Course 6:	3		
	Structural Dynamics			

	Contact Hour	S	Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	TW/Tutorials	Total
3			3			3

Evaluation Scheme								
Theory			Termwork/Practical/			Total		
			Oral/Tutorials					
Internal Assessments		ESE	Durationof	TW/TU	PR	OR		
IA-I	IA-II	Avg.		ESE				
20	20	20	80	3 Hr				100

Course	Objective
COULTE	ONICCUIVE

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

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

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

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

- Summarize the difference between static and dynamic loads and analysis.
- Evaluate the response of SDOF systems for different types of dynamic loadsincluding ground motions.
- Describe Distributed mass system idealized as SDOF system
- Evaluate the response of MDOF systems to different types of dynamic loadsincluding ground motions.
- Explain the basics of Concepts of Earthquake analysis.
- Describe the I.S code provisions for seismic analysis of buildings.

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

- 1. Craig R.R.: 'Structural Dynamics-An Introduction to Computer Methods', *John Wiley and Sons*.
- 2. Anil K. Chopra: 'Dynamics of Structures', Prentice Hall India Pvt. Ltd.
- 3. Cloguhand Penzein: 'Dynamics of Structures' TataMc-Graw Hill Pvt. Ltd.
- 4. John M. Biggs: 'Structural Dynamics', Tata Mc-Graw Hill.
- 5. Mario Paz: 'Structural Dynamics Theory and Computation', CBS Publisher.

Semester VIII

Course Code	Course Name	Credits
CEDLO8026	Department Level Optional Course 6: Ground water Engineering	03

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

Theory						Term Work/Practical/Oral			
Inter	rnal Asse	essment	End	Duration of	Term	Term		Total	
Test-I	Test- II	Average	Sem Exam	Sem End Sem Exam Exam		Pract.	Oral		
20	20	20	80	3 hours	-	-	-	100	

Rationale

This subject deals with the various processes involved in ground water Engineering which provides in depth understanding of the theories and concepts of hydrological parameters, well hydraulics, ground water quality etc. It also explains the concept of basin water management concept and its evaluation.

Objectives

- 1 To introduce the student to the principles of hydrological parameters
- 2 To Explain to the students the principles of Well Hydraulics.
- 3 To introduce the student the concept of ground water quality and conservation.
- 4 To introduce the student the concept of basin management

Detailed Syllabus

Module	Sub- Modules/Contents						
	Hyd	rogeological Parameters					
	1 1	Introduction – Water bearing Properties of Rock – Type of aquifers -					
	1.1	Aquifer properties					
_	1.2	permeability, specific yield, transmissivity and storage coefficient –					
Ι	1.2	Methods of Estimation	6				
	1 2	GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity					
	1.3	– Dupuit Forchheimer assumption					
	1 /	Steady Radial Flow into a Well					
	1.4						

	Well Hydraulics								
II	2.1	Unsteady state flow - Theis method - Jacob method							
	2.2	Chow's method – Law of Times – Theis Recovery							
	2.3	Bailer method – Slug method - tests - Image well theory	8						
	2.4	Partial penetrations of wells – Well losses							
	2.5	Specific Capacity and Safe yield							
	2.6	Collector well and Infiltration gallery							
	Groundwater Management								
	3.1	Need for Management Model – Database for Groundwater Management – Groundwater							
III	3.2	Balance study – Introduction to Mathematical model – Model Conceptualization	6						
	3.3	Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity							
	3.4	Analysis – Uncertainty – Development of a model							
	Groundwater Quality								
	4.1	Ground water chemistry - Origin, movement and quality - Water quality standards							
IV	4.2	Drinking water – Industrial water – Irrigation water	7						
	4.3	Ground water Pollution and legislation							
	4.4	Environmental Regulatory requirements							
	Gro	undwater Conservation							
	5.1	Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT)	5						
V	5.2	Aquifer Storage and Recovery (ASR)Seawater Intrusion and Remediation							
	5.3	Ground water Basin management and Conjunctive use							
	5.4	Protection zone delineation, Contamination source inventory and remediation schemes Name of Module 6 Management of Groundwater							
	6.1	Concept of basin management							
X7T	6.2	Ground water basin investigations	7						
V I	6.3	Basin management and conjunctive use	/						
	6.4	Basin yields							

Contribution to Outcome

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

- 1 Apply the principals of hydrological parameters for design of wells.
- 2 Calculate the specific yield and yield of well under different ground water conditions.
- 3 Develop a model for groundwater management.
- 4 Explain the concept of ground water quality models

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.
- 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 Numerical Ground Water Hydrology: A.K. Rastogi, Penram International Publishing, Mumbai,2007
- 2 Ground Wter Hydrology: D.K.Todd, John Wiley &Sons, New York, USA, 1980
- 3 Ground water Hydrology by A. K. Rastogi
- 4 Hydrology- Principles, Analysis, Design: H.M.Raghunath, New Age International Publishers.
- 5 Engineering Hydrology: C.S.P.Ojha, R.Berndtsson, &P.Bhunya:, Oxford University Press

Reference Books:

- 1 Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
- 2 Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998

Semester VIII							
Subject Code	Subject Name	Credits					
ILOC8011	Institute Level Optional Course – II : Project	03					
	Management						

Teaching Scheme									
	Contact Hour	S		Credits	Assigned				
Theory	Practical	Tutorial	Theory	Total					
03			03			03			
Evaluation Scheme									

				Evaluation Sch	eme			
		Theo	Term w	Tatal				
Internal Assessment			End Som	Duration of				10tai Morka
Test 1	Test 2	Avg	Avg End Sem End S Exam Exa		TW	PR	OR	wiai KS
20	20	20	80	03 Hrs.				100

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Module	Sub- Modules/Contents	Hrs
Ι	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
п	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
Ш	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
IV	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan.	6

R ic a p	Risk Management in projects: Risk management planning, Risk dentification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
V 5 P re T 5 E c s 6 5 P	 5.1 Executing Projects: Planning monitoring and controlling cycle. Information needs and eporting, engaging with all stakeholders of the projects. Feam management, communication and project meetings. 5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and ecope creep. Project audit. 5.3 Project Contracting Project procurement management, contracting and outsourcing, 	8
VI 6 II N 6 C P P Id n A	 b.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. b.2 Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons earned analysis; acknowledging successes and failures; Project nanagement templates and other resources; Managing without authority; 	6

Outcomes

Students will be able to :

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

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. Attempt any 3 from remaining 5 questions

- 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)

- Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
- 2. A Guide to the Project Management Body of Knowledge (PMBOK[®] Guide), 5th Ed, Project Management Institute PA, USA
- 3. Gido Clements, Project Management, Cengage Learning.
- 4. Gopalan, Project Management, , Wiley India
- 5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

				Semest	er V	III					
Course	e Code			(Cour	se Name)				Credits
ILOC	C8012		Institute	Level O	ptio	nal Cour	se –	II : Fina	ance		03
				Ι	Man	agement	,				
	Teaching Scheme										
Contact Hours Credits Assigned											
Theor	y F	Practica	l Tu	l Tutorial		Theory		Practical		ıtorial	Total
03						03					03
			E	valuatior	ı Sch	eme					
		Theor	y			Term	worł	x / Practi	ical /	' Oral	
Interna	l Assessm	ent	End	Durati	ion						Tatal
Test 1	Test 2	Avg	Sem Exam	of En Sem	d i	TW		PR		OR	l otal Marks

Exam 03 Hrs.

• Overview of Indian financial system, instruments and market

80

20

20

20

• Basic concepts of value of money, returns and risks, corporate finance, working capital and its management

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100

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• Knowledge about sources of finance, capital structure, dividend policy

Module	Sub- Modules/Contents	Hrs
Ι	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System.	
	 Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges 	06
II	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
III	 Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; 	09

	Profitability Ratios; Capital Structure Ratios; Stock Market Ratios;								
	Limitations of Ratio Analysis.								
IV	 Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. 	10							
V	 Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value: Concept of Optimal Capital Structure 	05							
VI	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03							

Outcomes

Students will be able to...

- Describe Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

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. Attempt any 3 from remaining 5 question
- 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)

- 1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
- 2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
- Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

Semester VIII								
Course Code				Course Na	ame		Credits	
ILOC80	ILOC8013 Institute Level Optional Course – II :						03	
	Entrepreneurship Development and Management							
	Teaching Scheme							
Contact H	Contact Hours Credits Assigned							
Theory Practical		Tutorial	Theory	Practical	Tutoria	al Total		
03				03			03	

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

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Module	Sub- Modules/Contents	Hrs
Ι	 Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship 	04
Π	 Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations 	09
III	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	05
IV	Indian Environment for Entrepreneurship: key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships,	08

	National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
V	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
VI	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Outcomes:

Students will be able to...

- Explain the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Describe government policies for entrepreneurs

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.

- 1. Question paper will comprise of total six questioncarrying20 marks
- 2. Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- 3. Remaining question (Q.2 to Q.6) will be selected from all the modules.
- 4. 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)

- 1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
- 2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
- 3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
- 4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
- 5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
- 6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
- 7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
- 8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
- 9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
- 10. Laghu Udyog Samachar
- 11. www.msme.gov.in
- 12. www.dcmesme.gov.in
- 13. www.msmetraining.gov.in

Semester VIII								
Course Code Course Name							Credits	
ILOC8014		Institute	Level Opt	ional Course – II :	: Human Reso	ource	03	
				Management				
Teaching Scheme								
Co	ontac	t Hours		(Credits Assign	ed		
Theory Practical Tutorial Theory Practical Tutorial					l Total			
03				03			03	
Evaluation Scheme								

		The	eory	Term work / Practical / Oral				
Internal Assessment			End Com	Duration of				Total
Toot 1	Tost 2	Averag	End Sem	End Sem	TW	PR	OR	Marks
Test I	Test 2	e	Exam	Exam				
20	20	20	80	03 Hrs.				100

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Module	Sub- Modules/Contents	Hrs
Ι	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
II	Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision- making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	7
III	Organizational Structure &Design Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	6

	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
IV	 Human resource Planning Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods 	5
V	Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
VI	 HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labour Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act 	10

Contribution to Outcomes:

Students will be able to:

- Explain the concepts, aspects, techniques and practices of the human resource management.
- Describe the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

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.

1. Question paper will comprise of total six questioncarrying20 marks

- 2. Question no. 1 is compulsory. Attempt any 3 from remaining 5 question
- 3. Remaining question (Q.2 to Q.6) will be selected from all the modules.
- 4. 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)

- 1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
- 2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
- 3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
- 4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
- 5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
- 6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Semester VIII					
Course Code	Course Name	Credits			
ILOC8015	Institute Level Optional Course – II : Professional	03			
	Ethics and CSR				
	Teaching Scheme	•			

Cor		Credit	s Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

Evaluation Scheme

Theory					Term wo			
Internal Assessment			End Com	Duration of				Total
Test 1	Test 2	Average	End Sem Exam	End Sem Exam	TW	PR	OR	Marks
20	20	20	80	03 Hrs.				100

- To understand professional ethics in business
 To recognized corporate social responsibility

Module	Sub- Modules/Contents	Hrs
I	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
II	 Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources 	08
ш	 Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs. 	06
IV	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
V	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP)	08
VI	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Contribution to outcomes

Students will be able to...

- Summarize rights and duties of business
- Distinguish different aspects of corporate social responsibility
- Demonstrate professional ethics
- Explain legal aspects of corporate social responsibility

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
- 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)

- 1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
- 2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
- 3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
- 4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Semester VIII					
Course Code	Course Name	Credits			
ILOC8016	Institute Level Optional Course – II : Research	03			
	Methodology				
Teaching Scheme					

(Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03			03			03

Evaluation Scheme

Theory						Term work / Practical / Oral			
Intern	Internal Assessment		End Sem	Duration of	TW	DD	OD	l otal Marks	
Test 1	Test 2	Average	e Exam	End Sem Exam	1 vv	PK	UK		
20	20	20	80	03 Hrs.				100	

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Module	Sub- Modules/Contents	Hrs
I	 Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical 	09
п	Types of Research2.1. Basic Research2.2. Applied Research2.3. Descriptive Research2.4. Analytical Research2.5. Empirical Research2.6 Qualitative and Quantitative Approaches	07
ш	 Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors 	07
IV	 Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem 	08

	c. Review of Literature		
	d. Formulation of Hypothesis		
	e. Formulation of research Design		
	f. Sample Design		
	g. Data Collection		
	h. Data Analysis		
	i. Hypothesis testing and Interpretation of Data		
	j. Preparation of Research Report		
	Formulating Research Problem		
V	5.1 Considerations: Relevance, Interest, Data Availability, Choice of data,	04	
	Analysis of data, Generalization and Interpretation of analysis		
	Outcome of Research		
VI	6.1 Preparation of the report on conclusion reached	04	
V I	6.2 Validity Testing & Ethical Issues		
	6.3 Suggestions and Recommendation		

Course Outcomes

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

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. Attempt any 3 from remaining 5 question
- 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)

- 1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
- 2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
- 3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Semester VIII								
Course Code			(Course	Name			Credits
ILOC8017		Institute	e Level Option	nal Cou	ırse – II :	IPR & Pater	nting	03
			Tea	ching S	cheme			
С	ontact	Hours		Credits Assigned				
Theory	P	ractical	Tutorial	Tł	neory	Practical	Tutorial	l Total
03	03				03			03
Evaluation Scheme								
Theory Term						ork / Practica	1 / Oral	

THEOLY						VOIK / FIAC	lical / Olal	
Internal Assessment			Duration of					Total
Test 1	Test 2	Avg	End Sem Exam	End Sem Exam	TW	PR	OR	Marks
20	20	20	80	03 Hrs.				100

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Module	Sub- Modules/Contents	Hrs
Ι	 Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development 	05
П	 Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc. 	07
III	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
IV	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07

	Patent Rules: Indian patent act, European scenario, US scenario, Australia				
\mathbf{V}	scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is	08			
	a member (TRIPS agreement, Paris convention etc.)				
	Procedure for Filing a Patent (National and International): Legislation and				
	Salient Features, Patent Search, Drafting and Filing Patent Applications,				
VI	Processing of patent, Patent Litigation, Patent Publication etc, Time frame and	07			
	cost, Patent Licensing, Patent Infringement				
	Patent databases: Important websites, Searching international databases				

Outcomes:

Students will be able to...

- Explain Intellectual Property assets
- assist individuals and organizations in capacity building
- work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

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. Attempt any 3 from remaining 5 question
- 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)

Reference Books:

- 1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
- 2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
- 3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
- 4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
- Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
- LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
- 7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
- 8. R Radha Krishnan & S Balasubramanian,2012,Intellectual Property Rights, 1st Edition,Excel Books
- 9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial

Publications

- Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
- 11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
- 12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
- 13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency
- 14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
- 15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Semester VIII					
Course Code	Course Name	Credits			
ILOC8018	Institute Level Optional Course – II : Digital	03			
	Business Management				

Teaching Scheme

	Credits Assigned							
Theory	Theory Practical Tuto		Theory	Practical	Tutorial	Total		
03	03		03			03		
Evaluation Scheme								

Theory					Term w	ork / Pra			
Internal	Assessm	ent	End	Duration	1		Total Manlea		
Test 1	Test 2AvgSemCExamSemSem	Test 2	Aug	Sem	of End	TW	PR	OR	
		Sem Exam							
20	20	20	80	03 Hrs.				100	

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Module	Sub- Modules/Contents	Hrs
Ι	 Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts iference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business, 	09
Π	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
III	Digital Business Support services : ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
IV	Managing E-Business-Managing Knowledge, Management skills for e- business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce	06

	Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security Prominent Cryptographic Applications						
V	E-Business Strategy -E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04					
VI	Caterializing e-business: From Idea to Realization-Business plan preparation Case Studies and presentations	08					

Outcomes:

Students will be able to:

- Identify drivers of digital business
- Illustrate various approaches and techniques for E-business and management
- Prepare E-business plan

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
- 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)

- 1. A textbook on E-commerce, Er. Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
- 2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
- 3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
- 4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
- 5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
- 6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
- 7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
- 8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
- 9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
- 10. Measuring Digital Economy-A new perspective -DOI:<u>10.1787/9789264221796-en</u>OECD Publishing

					Semest	er VI	I				
Cours	Course Code Course Name							Credits			
ILOO	C8019		Insti	tute Level	Optiona	al Cou	ırse – II:	: Environm	ental	03	
					Ma	inagei	ment				
					Teac	hing S	cheme				
	(Cont	act Ho	urs				Credits As	signed		-
Theor	Theory Practical			l Tuto	Tutorial The		eory	Practical Tutori		ıl	Total
03				-	-	(03				03
	•				Evalu	ation	Scheme				•
			Theo	ry			Term w	vork / Practio	cal / Oral		
Intern	al Asse	essm	ent	E 1 C	Dura	tion					Total
Test 1	Test 2	2	Avg	End Sem Exam	of E Sem E	nd Exam	TW	PR	OR]	Marks
20	20		20	80	03 H	Irs.					100

Understand and identify environmental issues relevant to India and global concerns •

• Learn concepts of ecology

• Familiarise environment related legislations

Module	Sub- Modules/Contents	Hrs
I	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
п	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
III	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
IV	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
V	Total Quality Environmental Management, ISO-14000, EMS certification.	05
VI	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Contribution to Outcomes

Students will be able to...

- Describe the concept of environmental management •
- Evaluate ecosystem and interdependence, food chain etc. •
- Compare and interpret environment related legislations •

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. Attempt any 3 from remaining 5 question
- 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)

- 1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
- 2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
- 3. Environmental Management, T V Ramachandra and Vijay Kulkarni, TERI Press
- 4. Indian Standard Environmental Management Systems Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
- 5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
- 6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
- 7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Semester-VIII

Course Code	Credits	
CEL801	Construction Management	01

(Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	-	02	-		01	01

Theory					Term Wo			
Internal Assessment		End Sem	Duration of	Term	Dreat	Orrol	Total	
Test-I	Test-II	Average	Exam	End Sem Exam	Work	Fract.	Orai	
-	-	-	-	-	25		25	50

Course Objective:

- 1 To understand the basic functions and construction management.
- 2 To apply scheduling techniques such as CPM & PERT
- 3 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.
- 4 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.
- 5 To know about safety and quality aspect of construction works.

Course Outcomes:

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

- 1 Summarize & apply the knowledge of management functions like planning, scheduling, Executing & controlling the construction projects.
- 2 Prepare feasible project schedule by using various scheduling techniques.
- 3 Gain knowledge of managing various resources & recommend best method of allocating resources to the project.
- 4 Develop optimum relationship between time & cost for construction project.
- 5 Implement quality & safety measures on construction sites during execution of Civil Engineering projects.
- 6 Explain the importance of labour acts.

List of Assignments						
Module No.	Assignment	Tutorial Hr.				
1	Assignment No. 1: Principles, Functions, and contribution eminent personalities towards Management	02				
2	Assignment No.2 : Project classifications, Unique features of construction, Various agencies involved in construction industry	02				
3	Assignment No.3 : Bar Charts its limitations and its uses Numerical on development of networks and calculation of floats using CPM technique.	02				
4	Assignment No.4: Assumption underlying PERT analysis time estimates, slack& its types, probability of completing the project.	02				
5	Assignment No.5: Numerical on Resources Allocation Methods- Resource levelling and Smoothening	02				
6	Assignment No.6: Procedure and Numerical on Time and cost optimization in construction projects - Compression & decompression of network.	02				
7	Assignment No.7 : Network Updating- Purpose and frequency of updating. Numerical on Project Updating	02				
8	Assignment No.8: Construction Safety, Quality Control & Labour Acts	02				

Term Work

Comprises of Assignments, which has to be submitted by each student individually.

Distribution of marks for Term Work shall be as follows:

Assignments: 20 Marks Attendance : 05 Marks

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

Attendance	Marks awarded
75%- 80%	03 Marks
81%-90%	04 Marks
91% onwards	05 Marks

End Semester Oral Examination: The oral examination shall be based on the entire syllabus & the Term-work prepared by the students including assignments.

Reference Books:

- 1 Construction Engineering and Management: S. Seetharaman.
- 2 Construction Planning & Management Dr. U. K. Shrivastava.
- 3 Construction Project Management: Chitkara K. K. Tata McGraw Hill.
- 4 Construction Projects planning and Management: P. S. Gahlot and Dhir New Age International (p) Publishers
- 5 Critical Path Methods in Construction Practice: Antill J M & Woodhead R W, Wiley
- 6 Construction Hazard and Safety Handbook: King & Hudson, Butterworth

Semester - VIII								
Cours	Course Code Course Na				ame			Credits
CE	P801		Ν	Iajor Project	- Part II			06
(Contact Ho	urs		C	redits Ass	igned		
Theory	Practical	Tutorial	Theory		Practical	l Tu	ıtorial	Total
-	12\$	-	-		6		-	6
Theory								
			1		Work/P	ractica	u/Oral	
Inte	ernal Assess	sment	End	Duration				Total
Test–I	Test–II	Average	Sem	of End	TW	PR	OR	
			Exam Sem Exam					
-	-	-	-	-	50	-	100	150

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 analyse the problem.
- 2. To accustom the learners to apply various techniques and methods.
- 3. To familiarize the learners about interpreting the results and discuss the issues.
- 4. To advice the learners to write and infer conclusions of the project.
- 5. To accustom the learners to work as a team.
- 6. To apprize the learners on proper documentation of work.

Detailed Syllabus

After completion of the work at the end of Semester VIII, the student shall compile the report in a standard format and written in the systematic manner and chapter wise.

The student shall adhere to the following scheme of chapterization while compiling the final report in general. The Guide/ Supervisor shall ensure the student has written the Dissertation Report in appropriate language (grammatically correct).

Contribution to Outcomes

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

1: Perform on analytical, experimental or numerical method to solve identified problem

2: Produce alternative design solution to meet the functional requirements of the defined problem.

3: Represent the data in Tabular or graphical forms so as to facilitate, analysis & explain of the data.

4: Express Engineering principles & manage the finance required for the execution of the Project. 5: Infer at results, conclusion with its validation, also propose the future scope of work on the identified problem.

6: Communicate effectively their project work by writing reports and publishing technical papers based on entire project work.

Guidelines for Assessment of Project II

Project II 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 / Industrial trends
- 4. Clarity of objective and scope
- 5. Quality of work attempted
- 6. Validation of results
- 7. Quality of Written and Oral Presentation

Project Report has to be prepared strictly as per University of Mumbai report writing guidelines. Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiner approved by the University of Mumbai

Students should be motivated to publish a paper in Conferences/students competitions based on the work