AC-23/07/2020
Item No.-125

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 First Year Engineering as per the Ordinance 6242
Passing Marks	**:**	40%
Ordinances / Regulations (if any)	**:**	Ordinance: O.6242
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: 2020-2021

Dr. S. K. Ukarande

Associate Dean
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Dr. Anuradha Muzumdar

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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.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

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

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

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

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

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract. /Oral	Total
		Test - I	Test – II	Avg.					
CEC301	Engineering Mathematics –III	20	20	20	80	03	25	-	125
CEC302	Mechanics of Solids	20	20	20	80	03	-	-	100
CEC303	Engineering Geology	20	20	20	80	03	-	-	100
CEC304	Architectural Planning & Design of Buildings	20	20	20	80	03	-	-	100
CEC305	Fluid Mechanics – I	20	20	20	80	03	-	-	100
CEL301	Mechanics of Solids	-	-	-	-	-	25	25	50
CEL302	Engineering Geology	-	-	-	-	-	25	25	50
CEL303	Architectural Planning & Design of Buildings	-	-	-	-	-	25	25	50
CEL304	Fluid Mechanics – I	-	-	-	-	-	25	25	50
CEL305	Skill Based Lab Course – I	-	-	-	-	-	50	-	50
CEM301	Mini Project – 1A	-	-	-	-	-	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 Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC401	Engineering Mathematics – IV	03	-	01	03	-	01	04
CEC402	Structural Analysis	04	-	-	04	-	-	04
CEC403	Surveying	03	-	-	03	-	-	03
CEC404	Building Materials & Concrete Technology	03	-	-	03	-	-	03
CEC405	Fluid Mechanics-II	03	-	-	03	-	-	03
CEL401	Structural Analysis	-	02	-	-	01	-	01
CEL402	Surveying	-	03	-	-	1.5	-	1.5
CEL403	Building Material Concrete Technology	-	02	-	-	01	-	01
CEL404	Fluid Mechanics-II	-	02	-	-	01	-	01
CEL405	Skill Based lab Course – II	-	02	-	-	01	-	01
CEM401	Mini Project – 1B	-	03$	-	-	1.5	-	1.5
Total		**16**	**14**	**01**	**16**	**07**	**01**	**24**

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

$ indicates work load of Learner (Not Faculty), for Mini Project.
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	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC501	Theory of Reinforced Concrete Structures	03	-	-	03	-	-	03
CEC502	Applied Hydraulics	03	-	-	03	-	-	03
CEC503	Geotechnical Engineering-I	03	-	-	03	-	-	03
CEC504	Transportation Engineering	04	-	-	04	-	-	04
CEDLO501X	Department Level Optional Course-1	03	-	-	03	-	-	03
CEL501	Theory of Reinforced Concrete Structures	-	02	-	-	01	-	01
CEL502	Applied Hydraulics	-	02	-	-	01	-	01
CEL503	Geotechnical Engineering-I	-	02	-	-	01	-	01
CEL504	Transportation Engineering	-	02	-	-	01	-	01
CEL505	Professional Communication and Ethics-II	-	02*+2	-	-	02	-	02
CEM501	Mini Project – 2A	-	04$	-	-	02	-	02
Total		**16**	**16**	**-**	**16**	**08**	**-**	**24**

Examination Scheme

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

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

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

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

Examination Scheme

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

$ indicates work load of Learner (Not Faculty), for Mini Project
$ 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 Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC701	Design & Drawing of Reinforced Concrete Structures	03	-	-	03	-	-	03
CEC702	Quantity Survey, Estimation and Valuation	03	-	-	03	-	-	03
CEDLO701X	Department Level Optional Course – 3	03	-	-	03	-	-	03
CEDLO702X	Department Level Optional Course – 4	03	-	-	03	-	-	03
CEILO701X	Institute Level Optional Course – I	03	-	-	03	-	-	03
CEL701	Design & Drawing of Reinforced Concrete Structures	-	02	-	-	01	-	01
CEL702	Quantity Survey, Estimation and Valuation	-	02	-	-	01	-	01
CEP701	Major Project-Part I	-	06*	-	-	03	-	03
Total		**15**	**10**	**-**	**15**	**05**	**-**	**20**

Examination Scheme									
Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (Hrs.)	Term Work	Pract /Oral	Total
		Test - I	Test – II	Avg.					
CEC701	Design & Drawing of Reinforced Concrete Structure	20	20	20	80	04	-	-	100
CEC702	Quantity Survey, Estimation and Valuation	20	20	20	80	04	-	-	100
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 Code	Course Name	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC801	Construction Management	03	-	-	03	-	-	03
CEDLO801X	Department Level Optional Course – 5	03	-	-	03	-	-	03
CEDLO802X	Department Level Optional Course – 6	03	-	-	03	-	-	03
CEILO801X	Institute Level Optional Course – II	03	-	-	03	-	-	03
CEL801	Construction Management	-	02	-	-	01	-	01
CEP801	Major Project – Part II	-	12$	-	-	06	-	06
Total		**12**	**14**	**-**	**12**	**07**	**-**	**19**

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

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

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

Sr. No.	Course Code CEDLO801X	Department Level Optional Course – 5
1	CEDLO8011	Bridge Engineering
2	CEDLO8012	Design of 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-III

Semester- III

Course Code	Course Name	Credits
CEC 301	Engineering Mathematics-III	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	01	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hrs	25	-	-	125

Pre-requisite: Engineering Mathematics-I,

Engineering Mathematics-II,

Course Objectives:

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills.
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Course Outcomes: Learner will be able to….

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and t^n , $where\ n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning topics:** Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	07 Hrs.
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	06 Hrs.
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) *3.2* Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	07Hrs.
04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z), Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function *f*(z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.	07Hrs.

	4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	
05	**Module: Matrices:** 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (**No theorems/ proof**) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices **Self-learning Topics:** Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	06 Hrs.
06	**Module: Numerical methods for PDE** 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method **Self-learning Topics:** Analytical methods of solving two and three dimensional problems.	06 Hrs.
	Total	39

Term Work:

General Instructions:

1 Batch wise tutorials are to be conducted. The number of student'sperbatch should be as per University pattern for practicals.

2 Students must be encouraged to write at least 6 class tutorials on entire syllabus.

3 A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

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). Duration of each test shall be one hour.

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.

References:

1 Engineering Mathematics, Dr. B. S. Grewal, KhannaPublication
2 Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,
3 Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosapublication
4 Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5 Higher Engineering Mathematics B.V. Ramana, McGraw HillEducation
6 Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation,
7 Text book of Matrices, Shanti Narayan and P K Mittal, S. ChandPublication
8 Laplace transforms, Murray R. Spiegel, Schaum's OutlineSeries

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Semester- III									
Course Code			Course Name					Credits	
CEC 302			Mechanics of Solids					4	
Contact Hours				Credits Assigned					
Theory	Practical	Tutorial		Theory	Practical	Tutorial		Total	
4	-			4	-	--		4	
Theory						Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem Exam		TE	PR	OR	
Test-I	Test-II	Average							
20	20	20	80	3 Hours		-	--	--	100

Rationale

Civil Engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting into axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads is prerequisite for an economical and safe design.

In this course, learners will understand the internal response behavior of material under different force systems. The knowledge of 'Mechanics of Solids' will be foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design.

Objectives

1) To learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members and thin cylinders subjected to internal pressure.
2) To learn to represent graphically the distribution of axial force, shear force and bending moment along the length of statically determinate beams and portal frames.
3) To compute area moment of inertia and to analyze the distribution of shear stress and the flexural (bending) stress across the cross section of structural members.
4) To study circular shafts under the action of twisting moment and to determine the direct and bending stresses in columns and study buckling behavior of centrally and eccentrically loaded columns.
5) To determine principal planes and stresses and strain energy computation in elastic members.
6) To learn the computation of slope and deflection of elastic beams and general theorems used in this computation.

Detailed Syllabus			
Module		**Course Modules / Contents**	**Periods**
1	**Module Name- Stresses and Strains in Elastic members, Spherical and Cylindrical shells**		**(9)**
	1.1	Types of Stresses and Strains, stress-strain curve, different types of Elastic moduli and relationships between them, Poisson's ratio, factor of safety. Bars of varying sections, composite sections, temperature stresses	**6**
	1.2	Thin cylindrical and spherical shells under Internal pressure: Determination of Hoop stress, Longitudinal stress, Shear stress and volumetric strain.	**3**
2	**Module Name- Axial force, shear force and bending moment diagrams for beams and portal frames**		**(9)**
	2.1	Concept of Axial Force, Shear Force and Bending Moment. a) A.F. S.F. and B M Diagrams for statically determinate S S and Cantilever **beams without internal hinges** and for single loading like point load, UDL, UVL or Couple moment. b) A.F. S.F. and B.M. Diagrams for statically determinate **beams with internal hinges** and combination of loading	**6**
	2.2	A.F. S.F. and B.M Diagrams for statically determinate **3-member Portal Frames with or without internal hinges .**	**3**
3	**Module Name- Area Moment of Inertia, Shear stresses and Bending stresses in beams**		**(9)**
	3.1	Area Moment of inertia, Parallel and Perpendicular axis theorem, polar moment of inertia. Radius of gyration. (Rectangular, Triangular, Circular, Semicircular section and their combination) Distribution of shear stress across plane sections Commonly used for structural purposes.	**5**
	3.2	Theory of pure bending, Flexure formula for straight beam, simple problems involving application of Flexure formula, section modulus, moment of resistance, flitch beams.	**4**
4	**Module Name- Torsion in Shafts, Columns**		**(10)**
	4.1	Torsion in solid and hollow circular shafts, shafts with varying cross sections, Shafts transmitting and receiving power at different points. Stresses in Shafts while transmitting power.	**4**
	4.2	Direct and bending stresses in Columns, Core of section.	**6**

		Buckling of Columns, Members subjected to axial loading, concept of buckling, effective length, different support conditions, Euler's and Rankine's formula. Concept of Eccentrically loaded columns.	
5	**Module Name- Principal planes and stresses, Strain Energy**		**(8)**
	5.1	General equation for transformation of stress, Principal planes and principal stresses, maximum Shear stress, stress determination by analytical and Graphical method (using Mohr's circle).	**4**
	5.2	Strain energy due to axial force and impact loads in columns, due to bending in beams, due to torsion of shaft.	**4**
6	**Module Name- Slope and Deflection in Beams , General Theorems**		**(7)**
	6.1	Concept of Slope and Deflection in Beams, Macaulay's Method for slope and deflection in S S and Cantilever beams subjected to point loads, UDL and couple moments.	**4**
	6.2	General Theorems: Betti and Maxwell's reciprocal Theorem,, Principle of Superposition, Principle of Virtual work, Castigliano's theorems.	**3**

Contribution to Outcome

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

1) Evaluate stress - strain behavior of elastic members and thin cylinders subjected to internal pressure.
2) Draw variation of axial force, shear force and bending moment diagram for statically determinate beams and frames.
3) Calculate Moment of Inertia for cross sections and analyse the material response under the action of shear and the effect of flexure (bending).
4) Predict the angle of twist and shear stress developed in torsion and compute direct and bending stresses developed in the cross section of centrally and eccentrically loaded columns.
5) Locate principal planes in members and calculate principal stresses using analytical and graphical method and to calculate strain energy stored in members due to elastic deformation.
6) Evaluate slope and deflection of beams supported and loaded in different ways.

Internal Assessment (20 Marks):

One **Compulsory Class Test,** based on approximately 40% of contents and another on 40% from the remaining content be taken. Average of the two will be considered as IA Marks.

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. Strength of Materials: *S. Ramamrutham*, Dhanpatrai Publishers.
2. Strength of Materials: *R.K. Rajput*, S. Chand Publications.
3. Mechanics of Materials: Vol-I: *S.B. Junnarkar and H.J. Shah*, Charotar Publications.
4. Strength of Materials: *Subramanian*, Oxford University Press
5. Strength of Materials: *S.S. Rattan*, Tata Mc-Graw Hill, New Delhi
6. Strength of Materials (Mechanics of Materials): *R.S. Lehri and A.S. Lehri*, S.K. Kataria Publishers, New Delhi
7. Strength of Materials: *Dr. V.L. Shah*, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: *James, M. and Barry J.*; Cengage Learning.
9. Mechanics of Materials: *Andrew Pytel and Jaan Kiusalaas*, Cengage Learning.
10. Mechanics of Materials: *Timoshenko and Gere*, Tata McGraw Hill, New Delhi.
11. Mechanics of Materials: *James M. Gere*, Books/Cole.
12. Strength of Materials: *G.H. Ryder*, Mc-Millan.
13. Mechanics of Materials: *E.P. Popov*, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: *Pytel and Singer*, Mc-Graw Hill, New Delhi.
15. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co. (Schaum's Outline Series)

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Semester-III

Course Code	Course Name	Credits
CEC 303	Engineering Geology	3

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

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

Rationale

Engineering geology is an applied geology discipline that involves the collection, analysis, and Interpretation of geological data and information required for the safe development of civil works. The objective of this course is to focus on the core activities of engineering geologists – site characterization, geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock in the characterization of geologic sites for civil work projects.

Understanding of the foundation rocks and structures present in them is of utmost importance for the safety and stability of Civil engineering structures. The study also helps in the assessment of groundwater, oil and gas and mineral resource evaluation.

Objectives

1. To acquire basic knowledge of Geology and to understand its significance in various civil engineering projects.
2. To study minerals and rocks in order to understand their fundamental characteristics and engineering properties.
3. To study structural geology for characterization of site, analysis and report geologic data using standards in engineering practice.
4. To study methods of subsurface investigation, advantages and disadvantages caused due to geological conditions and assessment of site for the construction of civil structures.
5. To study rock mass characterization for the construction of tunnels and assessment of rock as source of ground water.
6. To study the control of geology over the natural hazards and their preventive measures.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1	**Introduction & Physical Geology**		**5**
	1.1	Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects. Departments dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM.	
	1.2	Internal structure of the Earth and use of seismic waves in understanding the interior of the earth. Theory of Plate Tectonics.	
	1.3	Weathering types, Erosion and Denudation. Factors affecting weathering and product of weathering (engineering consideration) Superficial deposits and its geological Importance.	
	1.4	Brief study of geological action of wind, glacier and river.	
2	**Mineralogy and Petrology**		**7**
	2.1	Identification of minerals with the help of physical properties, rock forming minerals, megascopic identification of primary and secondary minerals, study of common ore minerals.	
	2.2	Igneous Petrology - Mode of formation, Texture and structure, form of Igneous rocks, Classification of Igneous rocks, study of commonly occurring igneous rocks, Engineering aspect of Granite and Basalt.	
	2.3	Sedimentary Petrology - Mode of formation, Textures, characteristics of shallow water deposits like lamination, bedding, current bedding etc., classification, study of commonly occurring sedimentary rocks and their engineering application.	
	2.4	Metamorphic Petrology - Mode of formation, agents and types of metamorphism, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks and their engineering application.	
3	**Structural Geology and Stratigraphy**		**12**
	3.1	Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Type of discontinuities in the rocks. **Fold:** Terminology, Classification on the basis of position of axial plane, Criteria for their recognition in field and engineering consideration. **Fault:** Terminology, Classification on the basis of movement of faulted block, Criteria for recognition in field, effects on outcrops and Engineering consideration.	

		Joints & Unconformity: Types and geological importance. Three point problems to determine attitude of the strata	
	3.2	Determination of thickness of the strata with the help of given data.	
	3.3	Geological Maps and their application for civil engineering works, Identification of symbols in maps.	
	3.4	General principles of Stratigraphy, geological time scale, Physiographic divisions of India and their characteristics. Stratigraphy of Deccan Volcanic Province.	
4	**Geological Investigation, study of dam and reservoir site:**		**7**
	4.1	Required geological consideration for selecting dam and reservoir site. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions.	
	4.2	Electrical resistivity and Seismic method of geological investigation. Rock Quality Designation and its importance to achieve safety and economy of the projects like dams and tunnels.	
	4.3	Borehole problems and their significance in determining subsurface geology of the area.	
5	**Tunnel Investigation and Ground Water Control**		**5**
	5.1	Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions.	
	5.2	Geo-mechanics classification (RMR) and its application.	
	5.3	Sources, zones, water table, unconfined, confined and Perched water tables. Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, Different types of rocks as source of ground water. Artesian well (flowing and non-flowing). Cone of Depression and its use in Civil engineering.	
6	**Geological Disasters and Control Measures**		**3**
	6.1	Landslides-Types, causes and preventive measures for landslides, Landslides in Deccan region.	
	6.2	Volcano- Central type and fissure type, products of volcano.	
	6.3	Earthquake- Terminology, Earthquake waves, construction and working of seismograph, Earthquake zones of India, elastic rebound theory, Preventive measures for structures constructed in Earthquake prone area.	

Contribution to Outcome

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

1) Explain the concepts of Geology and its application for safe, stable and economic design of any civil engineering structure.
2) Interpret the lithological characters of the rock specimen and distinguish them on the basis of studied parameters.
3) Describe the structural elements of the rocks and implement the knowledge for collection and analysis of the geological data.
4) Interpret the geological conditions for the dam site and calculate RQD for the assessment of rock masses.
5) Analyze the given data and suggest rock mass rating for assessment of tunnelling conditions.
6) Interpret the causes of geological hazards and implement the knowledge for their prevention.

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 lecturehours 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) Text book of Engineering Geology: N. Chenna, Kesavulu, Mc-Millan.
2) Text book of Engineering and General Geology, 8th edition (2010): Parbin Singh, S K Kataria& Sons.
3) Text book of Engineering Geology: P. K. Mukerjee, Asia.
4) Text book of Engineering Geology: Dr. R. B. Gupte, Pune VidyarthiGriha
5) Prakashan, Pune.
6) Principles of Engineering Geology: K. M. Banger.

Reference Books:

7) A Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
8) Structural Geology, 3rd edition (2010): Marland P. Billings, PHI Learning Pvt. Ltd. New Delhi
9) Earth Revealed, Physical Geology: David McGeeary and Charles C. Plummer
10) Principles of Geomorphology: William D. Thornbury, John Wiley Publications, New York.
11) Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen &UnwinLondon.
12) Engineering Geology: A Parthsarathy, V. Panchapakesan, R Nagarajan, Wiley India 2013.

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Semester - III

Course Code	Course Name	Credits
CEC304	Architectural Planning & Design of Buildings	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
02	-	-	02	-	-	02

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

Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

Objectives

1) To remember and recall the intricate details of building design and drawing.
2) To gain an understanding of the basic concepts of building design and drawing.
3) To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices, rules, regulation and byelaws, Building codes
4) To identify, analyze, research literate and solve complex building design and drawing problems.
5) To have new solutions for complex building design and drawing problems.
6) To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Course Outcomes

At the end of the course learners will be able to:

1) Remember and recall the intricate details of building design and drawing.
2) Understand the basic concepts of building design and drawing.
3) Learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices.
4) Identify, analyze, research literate and solve complex building design and drawing problems.
5) Have new solutions for complex building design and drawing problems.
6) Effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Detailed Syllabus		
Module	**Sub- Modules/ Contents**	**Periods**
1	**Principles and Codes of Practices for Planning and Designing of Buildings(Residential and Public buildings)**	**8**
1.1	Study of IS 962: 1989 – Code of Practice for Architectural and Building Drawings; How to develop Line plan into actual PLAN, ELEVATION, Section etc. including all the constructional details of various components in a BUILDING	
1.2	Principles of planning for Residential buildings	
1.3	Classification of buildings: Residential –Individual Bungalows & Apartments/Flats. Public – Education (Schools, Colleges etc.) &Health (Primary Health Center, Hospital) related buildings	
1.4	Study & drawing of SITE PLAN,FOUNDATION PLAN,ROOF PLAN of building; Study of building Bye – laws, Zoning Regulations and permissions required from commencement to completion of the building according to National Building Code (N.B.C.) of India and local Development Control (D.C.) rules	
1.5	Study of sun path diagram, wind rose diagram and sun shading devices	
1.6	Calculation of setback distances, carpet area, built-up area and floor spaceindex (FSI)	
1.7	Study of Principles of planning for public buildings: i) Building for education: schools, colleges, institutions etc. ii) Buildings for health: hospitals, primary health centers etc.	
2.	**Components and Services of a Building**	**3**
2.1	Staircase (dog -legged) planning, designing & drawing in details	
2.2	Foundations: stepped footing, isolated sloped footing and combined footing	
2.3	Openings: doors and windows	
2.4	Types of pitched roof and their suitability (plan and section)	
2.5	Building services: Water supply, sanitary and electrical layouts	
3.	**Perspective Drawings**	**4**
3.1	One-point perspective drawing	
3.2	Two-point perspective drawing	
4	**Town Planning, Architectural Planning & Built Environment**	**3**
4.1	Objectives and planning of TOWN PLANNING	
4.2	Master plan, Re-Development of buildings, Slum rehabilitation.	
4.3	Architectural Planning: introduction and principles	
4.4	Built Environment: introduction and principles	
5	**Green Buildings**	**2**
5.1	Introduction, uses ,objectives of Green Buildings and overview	
5.2	Study of Certification methods such as LEED, TERI, GRIHA, IGBC.	
6.	**Computer Aided Drawing (CAD)**	**6**
6.1	Details and learning methods of CAD in Civil Engineering structures	
6.2	Study and demonstration of any one of the professional CAD software's	
	Total	**26**

Theory Examination:

1) Only 4 questions (out of 6) need to be attempted.
2) Question no. 1 will be compulsory and based on the drawing work of any one building, may be residential or public building.. Some questions from the remaining may be on Theory portion.
3) 4. Any 3 out of the remaining 5 questions need to be attempted.
4) In question paper, weightage of each module maybe approximately proportional to the number of lecture hours assigned to it in the syllabus.

Internal Assessment:

There will be **Two** class tests (to be referred to as an '**Internal Assessment'**) to be conducted in the semester. The first internal assessment (IA-I) will be conducted in the mid of the semester based on the 50% of the syllabus. It will be of 20 marks. Similarly, the second internal assessment (IA-II) will be conducted at the end of the semester and it will be based on next 50% of the syllabus. It will be of 20 marks. Lastly, the average of the marks scored by the students in both the Internal Assessment will be considered. Duration of both the IA examination will be of one hour duration, respectively. Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (Monojit Chakraborti Publications, Kolkata)

Recommended Books

1) Planning and Designing Buildings by Y. S. Sane (Modern Publication House, Pune)
2) Building Drawing and Detailing by B.T.S. Prabhu, K.V. Paul and C. V. Vijayan (SPADES Publication, Calicut)
3) Building Planning by Gurucharan Singh (Standard Publishers & Distributors, New Delhi)

References:

1) IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
2) National Building Code of India – 2005 (NBC 2005)
3) Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (https://mmrda.maharashtra.gov.in)
4) Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (https://www.nmmc.gov.in/development-control-regulations)
5) Development Plan and Control Regulation KDMC, https://mmrda.maharashtra.gov.in

Reference Codes:

1) National Building Code of India, 2005
2) IS 779-1978 Specification for Water Meter
3) IS 909-1975 Specification for Fire Hydrant
4) IS 1172-1983 Code of Basic Requirement for Water Supply, Drainage & Sanitation
5) IS 1742-1983 Code of Practice for Building Drainage

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Semester- III

Course Code	Course Name	Credits
CEC305	Fluid Mechanics - I	03

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

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

Rationale

The concept of fluid mechanics in civil engineering is essential to understand the processes and science offluids. The course deals with the basic concepts and principles in hydrostatics, hydro kinematics andhydrodynamics with their applications in fluid flow problems.

Objectives

The students will be able to learn:

1. The properties of fluids, units and dimensions
2. Pressure measurement, manometry, Hydrostatic forces acting on different surfaces, Principle of buoyancy and stability of floating body
3. Kinematic and Dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.
4. Importance of fluid flow and various velocity measuring and discharge measuring devices used in pipes and channels.
5. The basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.

Detailed Syllabus			
Module		Course Modules / Contents	Periods
1	**Properties of Fluids**		05
	Mass density, weight density, specific gravity, specific volume, viscosity, compressibility and elasticity, surface tension, capillarity, vapour pressure, types of fluids, and introduction to real life applications.		
2	**Fluid Statics**		11
	2.1	**Pressure Measurement:** Pascal's law, hydrostatic law, pressure variation in fluids at rest. Pressure scale, Absolute, atmospheric, gauge pressure, measurement of pressure using manometers	
	2.2	**Hydrostatic force on surfaces:**	

		Total pressure and centre of pressure, total pressure on horizontal planesurface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks.	
	2.3	**Buoyancy and floatation:** Archimedes principle, Meta-Centre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, Experimental and analytical methods, metacentric height for floating bodies containing liquid, Time period of Transverse oscillations of floating bodies.	
3	**Fluid Kinematics**		**05**
	Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, streamline, streak line, path line,velocity potential and stream function, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity		
4	**Fluid Dynamics**		**06**
	Control volume and control surface, Forces acting on fluid in motion, Navier Stokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation, Bernoulli's equation for compressible fluid and real fluid, practical applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube, Rota meter.		
5	**Flow measurement**		**08**
	5.1	**Orifices and mouthpieces** Classification of orifices, flow through orifices, determination of hydraulic coefficients, flow through large rectangular orifice, flow through fully submerged and partially submerged orifice, time of emptying a tank through an orifice at its bottom. Classification of Mouthpieces, Flow through external cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's mouthpieces.	
	5.2	**Notches and weirs** Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, stepped notch, Cipolleti weir, broad crested weir, ogee weir, discharge over a submerged weir, ventilation of weirs.	
6	**6.1**	**Compressible flow**	**04**
		Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties.	
Total			**39**

Contribution to Outcome

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

1) Describe various properties of fluids and types of flow
2) Determine the pressure difference in pipe flows, application of Continuity equation and Bernoulli's theorem to determine velocity and discharge
3) Apply hydrostatic and dynamic solutions for fluid flow applications
4) Analyse the stability of floating bodies
5) Apply the working concepts of various devices to measure the flow through pipes and channels
6) Explain the compressible flow, propagation of pressure waves and stagnation properties

Internal Assessment (20 Marks): Consisting Two

Compulsory Class Tests:

First test based on approximately 40% of contents and second test based on remainingcontents (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) Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
2) Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
3) Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4) Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt.Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
5) Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
6) Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

Reference Books:

1) Fluid Mechanics: Frank M. White, Tata McGraw Hill International Edition.
2) Fluid Mechanics: Streeter White Bedford, Tata McGraw International Edition.
3) Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Fennimore, Tata McGraw Hill, New Delhi.
4) Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India (Pvt.) Ltd.
5) Introduction to Fluid Mechanics: Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer. Oxford Higher Education.

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Semester- III

Course Code	Course Name	Credits
CEL301	Mechanics of Solids- LAB	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

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

Objectives

1) To learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members.
2) To compute the distribution of shear stress and the flexural (bending) stress across the cross section of structural members
3) To study circular shafts under the action of twisting moment.
4) To learn the computation of slope and deflection of elastic beams and general theorems used in this computation.

Outcomes

Learner will be able to…

1) Evaluate stress - strain behavior of materials and assess the structural behavior by the virtue of stresses developed and deformation of elastic members.
2) Analyze the material response under the action of shear and the effect of flexure (bending).
3) Predict the angle of twist and shear stress developed in torsion.
4) Evaluate slope and deflection of beams supported and loaded in different ways.

Term Work : Term work comprises of Laboratory work and assignments.

Laboratory work: (At least 6- Performances - Any one from each Module)

Mechanics of Solids (Practical performance)		
Schedule	**Name of Experiment**	**Duration (Hours)**
1st week	1) Using UTM find different Moduli of a material or 2) The Tension Test on M S rod or 3) The Tension Test on M S Flat	**2**
3rd week	1) The Compression Test on Concrete cube or 2) The Compression Test on Timber or 3) The Compression Test on Brick	**2**
5th week	1) Test of Bending Using a Strain Guage or 2) Test of Bending Using a other electronic devices or 3) Test of Shear Stress in Beams	**2**
7th week	1) Using Torsion Testing Machine, verify the torsion equation, find different Moduli of a material. or 2) Spring Stiffness Test using strain gauges or other electronic devices	**2**
9th week	1) Charpy impact testing and Energy concept. or 2) Izod impact testing and Energy concept.	**2**
11th week	1) Using U T M perform experiments and verify Slope and deflection equations, 3 points and 4 points loading. (Performance) or 2) Deflection of Simply supported Beams (Performance) or 3) Deflection of Cantilever Beams (Performance)	**2**
Total Duration = 12 Hours		

Assignment:

(At least 1 from each module as per the Course instructor's guidelines; it is to be assessed during Laboratory hours. In order to avoid Copying/ repetition, Course Instructor may give different assignments to different groups.)

Mechanics of Solids		
Schedule	**Assignment**	**Duration (Hours)**
2nd week	**Stresses and strains in Elastic members, Spherical and Cylindrical shells** • Prepare a model of Cylindrical vessel or • Prepare a model of spherical vessel or • Prepare a model of Cylindrical vessel with hemispherical ends or • Prepare a chart showing diagrammatic representation of stresses or • A set of 5 questions on a module designed by course instructor, or • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • Write a Computer program in C++ or MSExcel on how to find a particular quantity from given data (Ex: Find output, Elongation 'δ' from the input values of P,L,A and E) • A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document – Appendix I)	**2**

4th week	**Axial force, shear force and bending moment diagrams for beams and portal frames** • A set of 5 questions on a module designed by course instructor, or • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document) or • Prepare a chart showing AFD, SFD & BMD for different symmetric and asymmetric loads on S S beams or • Prepare a chart showing AFD, SFD & BMD for different loads on Cantilever beams	**2**
6th week	**Area Moment of Inertia, Bending stresses and Shear stresses in beams** • Prepare a chart showing MI @ XX, YY &ZZ axes passing through the centroid. or • Prepare 3D models of different typical cross sections of beams and find their cross sectional area, Ixx, Iyy and Izz.. or • Prepare charts showing typical cross sections and variation of Bending stresses and shear stresses across the cross section. or • A set of 5 questions on a module designed by course instructor, or • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Flexural stress 'f' from the input values of P,L,I and E) • A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document)	**2**
8th week	**Torsion of Shafts, Columns** • Prepare 3D models of different solid and hollow circular cross sections of shafts and find their cross sectional area, Ixx, Iyy and Izz. or • A set of 5 questions on a module designed by course instructor, or • Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Shear stress 'q' or angle 'Ɵ' from the input values of T,L,G and J) • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document)	**2**
10th week	**Principal planes and stresses, Strain Energy** • Draw typical stress transformation cases of Mohr's circle using graph paper. or • A set of 5 questions on a module designed by course instructor, or • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • A chart about scientists and their contribution to the study of 'Mechanics of solids' (Example given at the end of this document)	**2**

12th week	**Slope and Deflection in Beams ; General Theorems** • Prepare chart to explain General theorems for slope and deflection. or • A set of 5 questions on a module designed by course instructor, or • A site visit to a relevant place or • A model / chart based on a module or • Design of a new experiment based on a module or • A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document)	**2**
Total Duration = 12 Hours		

Appendix -I:

A chart about scientists and their contribution to the study of 'Mechanics of solids' be made by students. Contributions of Scientists like GiordanoRiccati, Leonhard Euler, Saint Venant, Christian Otto Mohr, William J M Rankine, Carlo Castigliano, EnricoBetti, Robert Hooke, W. H. Macaulay, Augustin- Louis Cauchy, Simeon Poisson can be studied and presented.

Important Websites:

1) http://www.iitk.ac.in/mseold/mse_new/facilities/laboratories/Material Testing Lab / MSE313A.pdf
2) https://home.iitm.ac.in/kramesh/Strength of Materials Laboratory Manual.pdf
3) https://www.researchgate.net/publication/338139499_Me_8381-Strength_Of_Materials_Lab_Manual

Assessment:

To be done in 13th week

- **Term Work:**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work- : 15 Marks
Assignments- : 10 Marks

The sum will be multiplied by a factor of attendance between 0.5 (for poor attendance) to 1 (very good attendance).

- *End Semester Oral Examination*

Oral examination will be based on entire syllabus

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Semester- III		
Course Code	**Course Name**	**Credits**
CEL302	**Engineering Geology Lab. Practice**	**1**

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

Theory					Term Work/Practical/Oral			
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	Total
Test-I	Test-II	Average						
-	-	-	-	3 hrs	25	-	25	50

Objectives

1. To acquire basic knowledge of Geological Lab practices and apply it for the safe development of Civil Engineering works.
2. To examine the mineral and rock sample and understand their fundamental properties for their evaluation as construction and foundation material.
3. To study the Geological maps and their sections in terms of selecting the sites for various civil engineering structures.
4. To study Borehole problems for determination of subsurface geology of the area.
5. To Study the drilling data and calculate RQD for assessment of rock masses for Civil Engineering purposes.

Outcomes

Learner will be able to…

1. Identify various rock forming minerals on the basis of physical properties.
2. Explain the characteristics of Igneous, Sedimentary and Metamorphic rocks and assess their suitability as construction material and foundation rock.
3. Interpret the rock characteristics and comment on their suitability as water bearing horizons.
4. Interpret the geological map and assess the suitability of the site for Civil Engineering works.
5. Solve the borehole problems and interpret it in order to understand subsurface Geology of the area.
6. Calculate RQD and evaluate the rock masses for Civil Engineering Works.

A) List of Experiments

Module	Detailed Contents	Lab Sessions/Hr
1	**Study of Physical Properties of Minerals:** Identification of common Rock forming minerals on the basis of physical Properties- **Silica Group:** Quartz and its varieties; Cryptocrystalline silica: Jasper and Agate; **Feldspar Group:** Orthoclase, Plagioclase; **Carbonate Group:** calcite; **Amphibole Group:** Asbestos, Actinolite and Hornblende; **Pyroxene Group:**Augite; **Mica Group:**Muscovite, Biotite and Talc; **Element Group:** Graphite.	**6**
2	Identification of Metallic minerals: Galena, Pyrite, Hematite, Magnetite.	**2**
3	**Identification of rocks:** **Igneous Rocks**-Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic Tuffs.	**4**
4	**Sedimentary Rocks-** Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestones, Laterites.	**2**
5	**Metamorphic Rocks-** Schist and its varieties, Gneiss and its varieties, Slate, Marbles, Quartzite and Phyllite.	**2**
6	**Geological Maps:** a) Horizontal strata: Drawing the cross section and assessment of geological history of the area. b) Inclined Strata: Calculation of dip and strike in an inclined strata and assessment of geological history of the area. c) Assessment of the geological conditions for a proposed dam site in the given map. d) Assessment of the geological conditions for a proposed tunnel site in the given map. e) Assessment of the geological conditions for groundwater reserve in the given map.	**6**
7	Borehole problems to interpret subsurface geology	**2**
8	Calculation of RQD from the given data and assessment of rock quality.	**2**

B) Assessment:

- **Term Work**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work Shall beas follows:

Laboratory work- : 10 Marks
Assignments- : 10 Marks
Attendance : 05 Marks

- *End Semester Oral Examination*

Oral examination will be based on the entire syllabus.

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Semester- III

Course Code	Course Name	Credits
CEL 303	Architectural Planning & Design of Buildings Lab	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

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

@ For the course 'Building Design and Drawing, the oral examination shall be conducted in conjunction with the sketching examination.

Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

Course Objectives

1) To remember and recall the intricate details of building design and drawing.
2) To gain an understanding of the basic concepts of building design and drawing.
3) To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices.
4) To identify, analyze, research literate and solve complex building design and drawing problems.
5) To have new solutions for complex building design and drawing problems.
6) To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Course Outcomes:

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

1) Plan and design of residential and public building by implementing the principles of planning of buildings, Green building principles, byelaws, regulations and codes for planning

2) Preparing various working and detailed drawing of the buildings in CAD.
3) Preparing layouts of various building services.
4) Preparing perspective views for all types of buildings
5) Preparing the reports based on the drawings prepared, if required

Practical:

Students should make all the drawings during the Practical time allotted to them.

1) Drawings (Manually) should be drawn in the allotted Drawing hall only.
2) Drawings (CAD sheets) should be drawn on the Desktop/Laptop in Computational Lab.

After completing the work, Print out of those sheets should be submitted for gradation/Marks.

Assignments:

Two Assignments should be completed, covering all the modules in the syllabus.

1) Assignment-1 should be on 50% of the syllabus, to be completed before Internal Assessment-I exam.
2) Assignment-2 should be on the remaining 50% of the Syllabus, to be completed before Internal Assessment-II exam.

Site Visit:

Students should visit any Residential building/Public building physically and take Measurements inside of all rooms & over all outside of the building & can submit asmalldrawing sheet with the help of CAD. (**Optional** only)

Practical Examination (Oraland Sketching)

Practical examination will consist of sketching and oral examination based on the entire syllabus.

Term Work:

Drawings & Assignments:

1) Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, Site plan, Foundation Plan and details of one FOOTING, Roof Plan ,schedule of opening and construction notes of a **residential building(bungalow or apartment)** to be constructed as a (G+1) R.C.C. framed structure **(only Manual Drawing)**
2) **One-Point** Perspective drawingfor any Residential structure(**only Manual drawing)**
3) Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, schedule of opening and construction notes of a **public building(**Education/Health related **)** be constructed as a (G+1) R.C.C. framed structure (**only CAD drawing Sheet**)
4) **Two-Point** perspective drawing for any one public building (**only CAD drawing Sheet**)
5) Assignment No.- 1
6) Assignment No.- 2

Distribution of Term-work Marks: The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification acceptance of term-work warrants the satisfactorily the appropriate completion of the required quality & quantity of work for the minimum passing marks to be obtained by the students. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

	Particulars	**Marks**
1	Drawing Sheet (Manual)	**7.5** Marks
2	Drawing Sheet (CAD Based)	**7.5** Marks
3	Assignments	**5** Marks
4	Attendance	**5** Marks
	Total	**25 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 **(Consider Practical attendance)**

Recommended Books:

- Building Drawing with an Integrated Approach to Built Environment by *M. G. Shah, C. M. Kale, S.Y. Patki*(Tata McGraw-Hill Education)
- Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (MonojitChakraborti Publications, Kolkata)
- Planning and Designing Buildings by *Y. S. Sane* (Modern Publication House, Pune)
- Building Drawing and Detailing by *B.T.S. Prabhu, K.V. Paul and C. V. Vijayan* (SPADES Publication, Calicut)
- Building Planning by *Gurucharan Singh* (Standard Publishers & Distributors, New Delhi)

References:

- IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
- National Building Code of India – 2005 (NBC 2005)
- Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (https://mmrda.maharashtra.gov.in)
- Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (https://www.nmmc.gov.in/development-control-regulations)
- Development Plan and Control Regulation KDMC, https://mmrda.maharashtra.gov.in

Reference Codes:

- National Building Code of India, 2005
- IS 779-1978Specification for water meter
- IS 909-1975 Specification for fire hydrant
- IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation
- IS 1742-1983 code of practice for building drainage

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Semester- III		
Course Code	**Course Name**	**Credits**
CEL304	**Fluid Mechanics – I (Lab)**	**01**

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorial**	**Total**
-	**02**	**-**	**-**	**01**	**-**	**01**

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

Course Objectives:

The students will be able to learn:

1. The basic fluid mechanics concepts
2. Measuring pressure, velocity and discharge of fluid flow through pipes and channels

Course Outcomes:

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

1. Calculate the metacentric height
2. Verify the Bernoulli's theorem
3. Determine the discharge coefficients
4. Measure fluid flow using various devices
5. Determine the hydraulic coefficients of an orifice

List of Experiments (Minimum Six)

Module	Detailed Contents	Lab Sessions/Hr
1	Determination of the Metacentric height of a floating body	02 hrs
2	Investigating the validity of the Bernoulli equation applied to a steady flow of water through a tapered duct	04 hrs
3	Determination of coefficient of discharge of Venturimeter.	02 hrs
4	Determination of coefficient of discharge of Orifice meter.	02 hrs
5	Determination of coefficient of discharge of Nozzle meter.	04 hrs
6	Determination of coefficient of discharge of Notches (Rectangular and Triangular notch).	02 hrs
7	Determination of coefficient of discharge of weirs (Broad Crested weir and Ogee weir).	04 hrs
8	To determine the value of coefficient of contraction, coefficient of velocity and coefficient of discharge for the given orifice	04 hrs
9	Determination of coefficient of discharge of mouthpiece.	02 hrs

Assessment:

Term Work

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15 Marks
Assignments	:	05 Marks
Attendance	:	05 Marks

End Semester Oral Examination

Oral examination will be based on entire syllabus.

Reference Books:

- Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company
- Hydraulics and Fluid mechanics: Dr.P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
- Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd-New Delhi
- Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
- Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
- Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
- Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

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Semester-III

Course Code	Course Name	Credits
CEL305	Skill Based Lab Course-I Computer Aided Drafting & Building Information Modelling	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	3	-	-	1.5	-	1.5

Theory					Term Work /Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	-	50

Objectives:

1. To enable the learners efficiently draft and label buildings components using the concepts of 2D and 3D drawing and detailing
2. To introduce the concepts of object-based modelling in 3-D environment to learners
3. To enable the learners to work on drawing and drafting softwares so that they can conveniently understand and design civil engineering components through the softwares.

Outcomes: Learner will be able to…

1. Transfer the plan from a drawing sheet to a 2-D drafting software
2. Visualize the various elements in the software like points, lines, polygons, etc. as objects of the real world and relate it with civil engineering components.
3. Apply civil engineering concepts to draft efficient civil engineering plans in accordance to various building bye laws and forms.
4. Conceptualize the space, logistic and statutory constraints in the real world to draw an efficient plan so that optimization is achieved
5. Attach and retrieve information pertaining to various civil engineering components through 3-D modelling software
6. Demonstrate a virtual walkthrough of buildings

C) List of Experiments (Minimum Eight)

Module	Detailed Contents	Lab Sessions/Hr
1	Listing out the various Computer Aided Drawing and Drafting (CADD) tools available for civil engineering projects in the market and highlighting the capabilities and advantages of each	03
2	Basic introduction to compatibilities, utilities and attributes of peculiar drafting softwares w.r.t their various commands, features, capabilities and functions.	03
3	Line plan of a residential structure using a CADD tool	03

4	Developed plan of a residential structure (minimum G+4) using a CADD tool	06
5	Developed plan of a public building using a CADD tool	06
6	Basic introduction to compatibilities, utilities and attributes of peculiar building information modelling (BIM) softwares w.r.t their various commands, features, capabilities and functions.	03
7	Creating families and basic models on BIM	06
8	Creating architectural plan on BIM of a G+1 bungalow	03
9	Demonstrating a walkthrough on BIM for clients and presenting it	03
10	Clash detection and removal	03

D) Assessment:

- **Term Work**

Including Laboratory Work comprising of minimum 6 software generated sheets and one walkthrough presentation on BIM, distribution of marks for Term Work shall be as follows:

Laboratory work : 30 Marks (comprising of minimum 6 software generated sheets)

Presentation : 10 Marks (showing 3-D walk through the building)

Attendance : 10 Marks

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Semester- III

Course Code	Course Name	Credits
CEM 301	Mini Project -1 A	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

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

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee : 10
- Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
- First shall be for finalisation of problem
- Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1) Quality of survey/ need identification
2) Clarity of Problem definition based on need.
3) Innovativeness in solutions
4) Feasibility of proposed problem solutions and selection of best solution
5) Cost effectiveness
6) Societal impact
7) Innovativeness
8) Cost effectiveness and Societal impact
9) Full functioning of working model as per stated requirements
10) Effective use of skill sets
11) Effective use of standard engineering norms
12) Contribution of an individual's as member or leader
13) Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines forAssessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1) Quality of problem and Clarity
2) Innovativeness in solutions
3) Cost effectiveness and Societal impact
4) Full functioning of working model as per stated requirements
5) Effective use of skill sets
6) Effective use of standard engineering norms
7) Contribution of an individual's as member or leader
8) Clarity in written and oral communication

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Semester-IV

Semester- IV

Course Code	Course Name	Credits
CEC 401	Engineering Mathematics-IV	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	01	03	-	01	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem. Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 hrs	25	-	-	125

Pre-requisite:

- Engineering Mathematics-I,
- Engineering Mathematics-II,
- Engineering Mathematics-III,

Objectives:

1) To study the concept of Vector calculus & its applications in engineering.
2) To study Line and Contour integrals and expansion of complex valued function in a power series.
3) To familiarize with the concepts of statistics for data analysis.
4) To acquaint with the concepts of probability, random variables with their distributions and expectations.
5) To familiarize with the concepts of probability distributions and sampling theory with its applications.

Outcomes: Learner will be able to….

1) Apply the concept of Vector calculus to evaluate line integrals, surface integrals using Green's theorem, Stoke's theorem & Gauss Divergence theorem.
2) Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
3) Apply the concept of Correlation, Regression and curve fitting to the engineering problems in data science.
4) Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
5) Apply the concept of probability distribution to engineering problems& Testing hypothesis of small samples using sampling theory
6) Apply the concepts of parametric and nonparametric tests for analysing practical problems.

Module	Detailed Contents	Hrs.
01	**Module : Vector Calculus** 1.1 Solenoidal and irrotational (conservative) vector fields. 1.2 Line integrals – definition and problems. 1.3 Green's theorem (without proof) in a plane, Stokes' theorem (without Proof), Gauss' Divergence theorem (without proof) and problems (only evaluation). **Self Learning Topics**: Identities connecting Gradient, Divergence and Curl, Angle between surfaces. Verifications of Green's theorem, Stoke's theorem & Gauss-Divergence theorem, related identities & deductions.	**07**
02	**Module: Complex Integration** 2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 2.2 Taylor's and Laurent's series (without proof). 2.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof) **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations.	**07**
03	**Module: Statistical Techniques** 3.1 Karl Pearson's Coefficient of correlation (r) and related concepts with problems 3.2 Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems) 3.3 Lines of regression 3.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	**06**
04	**Module: Probability Theory:** 4.1 Conditional probability, Total Probability and Baye's Theorem. 4.2 Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, 4.3 Expectation, Variance, Co-variance, moments, Moment generating functions, (Four moments about the origin &about the mean). **Self- learning Topics:** Properties variance and covariance,	**06**
05	**Module: Probability Distribution and Sampling Theory-I** 5.1 Probability Distribution: Poisson and Normal distribution 5.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 5.3 Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test) **Self -learning Topics:** Test of significance of large samples, Proportion test, Survey based project.	**07**
06	**Module: Sampling theory-II** 6.1 Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction. 6.2 Analysis of variance: F-test (significant difference between variances of two samples) **Self- learning Topics:** ANOVA**:** One way classification, Two-way classification (short-cut method).	**06**

Term Work:

General Instructions:

1) Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
2) Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3) A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

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). Duration of each test shall be one hour.

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
- 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)
- Only Four questions need to be solved.

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Vector Analysis, Murray R. Spiegel, Schaum Series
5. Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation
6. Probability Statistics and Random Processes, T. Veerarajan, Mc. GrawHilleducation.

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Semester-IV									
Course Code			Course Name						Credits
CEC402			Structural Analysis						4
Contact Hours				Credits Assigned					
Theory	Practical	Tutorial		Theory	Practical	Tutorial			Total
4	-	-		4	-	-			4
Theory						Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam		TW	PR	OR	
Test-I	Test-II	Average							
20	20	20	80	3 hrs		-	-	-	100

Rationale

Different components of civil engineering structures are subjected to various force systems and their combinations. For designing the components, these are analyzed for their response. The structural systems are determinate or indeterminate in nature and so there are different analysis methods. These will be learnt in this course. Subject knowledge of Engineering Mechanics and Mechanics of solids is the prerequisite of this course.

Their application on solids and mechanisms, the action of force systems is studied and further extended in this subject. Learner will learn to apply these to the analysis of various members of structural systems such as beams, trusses, portal frames and arches. These analyses will further be used while designing of Steel and RCC structures.

Objectives

1. To analyze for axial force in the Coplanar, perfect trusses and analysis of 3- Hinged arches.
2. To study the concept of Influence Line Diagrams for Reactions, SF and B M in beams and axial forces in trusses and their application for rolling load systems.
3. To learn methods for evaluating rotation and displacement parameters in respect of frames and trusses using various methods. To understand static and kinematic indeterminacy of structures.
4. To analyze the indeterminate structures using Flexibility methods and Using Clapeyron's Theorem.
5. To analyze the indeterminate structures such as beams & simple rigid jointed frames using direct stiffness method.
6. To analyze the indeterminate structures using Moment Distribution as Stiffness method and Plastic analysis of structures.

Detailed Syllabus			
Module		**Course Modules / Contents**	Duration
1	**Trusses and 3 hinged Arches**		**(9)**
	1.1	**Trusses**: Analysis of Perfect Coplanar Trusses by Method of Joints (3) Analysis of Perfect Coplanar Trusses by Method of sections. (3)	**6**
	1.2	**Three hinged elastic arches,** Determination of normal thrust, radial shear and bending moment for Symmetrical & Unsymmetrical parabolic three hinged arches. (3)	**3**
2	**Influence line diagrams and rolling loads**		**(09)**
	2.1	Influence lines for Reactions, shear force and bending moment at a section of cantilever, simply supported, overhanging beams without internal hinges. (2) Rolling loads, Determination of S F and BM at a section, Value and criteria for maximum shear force and bending moment, absolute maximum shear force and bending moment under rolling loads (UDL and series of point loads) for simply supported girder. (4)	**6**
	2.2	I L D for Axial forces in members of Pin jointed trusses (3)	**3**
3	**Determinate and Indeterminate structures**		**(8)**
	3.1	Deflection of Statically determinate structures, methods based on energy principles and Castigliano's theorems to evaluate deflection in portal frames, bent up and arch type structures. Application of Unit Load Method for calculating slope and deflection of a point on rigid jointed frames and deflection of a point on Pin jointed truss.	**5**
	3.2	Static and kinematic indeterminacies: Types of structures occurring in practice, their classification, linear and non-linear behavior of materials, geometric non-linearity, static and kinematic determinacy and indeterminacy of structure.	**3**
4	**Analysis of indeterminate structures by Flexibility method**		**(9)**
	4.1	Analysis of fixed beam. Application of Clapeyron's theorem of three moments to fixed beam and continuous beam.	**4**
	4.2	Flexibility coefficients and their use in formulation of compatibility equations. Application of flexibility method to propped cantilevers, fixed beams & continuous beams, Simple rigid jointed frames.	**5**
5	**Analysis of indeterminate structures by Stiffness method**		**(8)**
	5.1	**Direct stiffness method:** Stiffness coefficients for prismatic members and their use for formulation of equilibrium equations.	**4**
	5.2	Application of Direct stiffness method to indeterminate beams & simple rigid jointed frames.	**4**

6	**Moment distribution method and Plastic Analysis of structures.**		**(9)**
	6.1	**Moment distribution method:** Application to indeterminate beams & simple rigid jointed frames & frame with inclined member but having only single translation degree of freedom including the effect of support settlement.	**5**
	6.2	**Plastic analysis of structures**: Introduction to plastic analysis, concept of plastic hinge, plastic moment carrying capacity, shape factor. Static and kinematic method of plastic analysis.Determination of collapse load for single and multiple span beams.	**4**

Contribution to Outcome

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

1. Calculate axial forces in the Coplanartrusses by using Method of joints and method of sections and also calculate radial shear, normal thrust and bending moment in parabolic 3- Hinged arches.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them..
3. Evaluate rotation and displacement at a joint of frames and deflection at any joint of truss and will be able to compute static and kinematic indeterminacy of structure.
4. Apply Flexibility methods and make use of Clapeyron's Theorem to analyze the indeterminate structures.
5. Analyse the indeterminate structures such as beams & simple rigid jointed frames using direct stiffness method.
6. Analyse the indeterminate structures using Moment Distribution as Stiffness method and make plastic analysis.

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. Basic Structural Analysis: *C.S. Reddy*, Tata McGraw Hill New Delhi.
2. Mechanics of Structures: Vol-I: S. B. Junnarkar and H.J. Shah, Charotar Publishers, Anand.

3. Analysis of Structures: Vol. I and II, Vazirani and Ratwani Strength of Materials: S. Ramamrutham, Dhanpatrai and Publishers, Delhi
4. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons, Delhi
5. Structural Analysis I: HemantPatil, YogeshPatil, Jignesh Patel, Synergy Knowledgeware, Mumbai.
6. Strength of Materials: Rajput, S. Chand Publications, Delhi
7. Structural Analysis: Bhavikatti, Vikas publisher house Pvt, ltd.
8. Structural Analysis: DevdasMenon, Narosa Publishing House.
9. Basic Structural Analysis: K.U. Muthu, Azmi Ibrahim, M. Vijyanand,
10. MagantiJanadharnand. I.K.International Publishing House Pvt. Ltd.
11. Comprehensive Structural Analysis: Vol-I and II by Vaidyanathan R. and Perumal R.LaxmiPublications.
12. Elementary Structural Analysis: Jindal
13. Structural Analysis: L.S. Negi and R.S. Jangid, Tata Mc-Graw Hill India
14. Fundamentals of Structural Analysis: Sujit Kumar Roy and SubrotaChakrabarty, S. Chand Publications.
15. Structural Analysis: T.S. Thandavamoorthy, Oxford University Press.
16. Structural Analysis: Manmohan Das, Bharghab Mohan Pentice Hall International. .

Reference Books:

1. Structural Analysis: *Hibbler*, Pentice Hall International.
2. Structural Analysis: *Chajes*, ElBS London.
3. Theory of Structures: *Timoshenko and Young*, Tata McGraw Hill New Delhi.
4. Structural Analysis: *Kassimali*, TWS Publications.
5. Element of Structural Analysis: *Norris and Wilbur*, McGraw Hill.
6. Structural Analysis: *Laursen H.I*, McGraw Hill Publishing Co.
7. Structural theorem and their application: *B.G. Neal*, Pergaman Press.
8. Fundamentals of Structural Analysis: *K.M. Leet*, C.M. Uang and A.M. Gilbert, Tata McGraw Hill, New Delhi.
9. Elementary theory of Structures: *Hseih*, Prentice Hall

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Semester- IV

Course Code	Course Name	Credits
CEC403	Surveying	03

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

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

Rationale

As it is always said "well begun is half done". All civil engineering projects such as buildings, roads, bridges, railways, airports, dams, water treatment plants, sewage treatment plants begin with surveying. Knowledge of surveying is thus fundamental and very useful to all civil engineers. In this course, the students are well informed about the principles and methods of surveying. The students are made conversant with various instruments which are used in the field to take measurements for preparation of drawings. The course introduces the advancements in instruments and methods of surveying. The study deals with the methods of computing land areas and volume of earthworks. The course also covers horizontal and vertical curves.

Objectives

The students will be able to learn:

1. The basic principles and classification of surveying.
2. Various methods of measurements in surveying.
3. The appropriate techniques of surveying and skills of collecting field data for preparing drawings.
4. Advancements in instruments and methods of surveying.
5. The methods of computing areas and volumes using the site specific data for various purposes.
6. The setting out techniques of curves.

Module	Course Modules/ Contents		Periods
1	**Introduction**		**5**
	1.1	Definition, principles, objectives, fundamental classification-plane and geodetic.	
	1.2	Chaining, Ranging and offsetting: Definitions, Principles, Instruments required, Obstacles, conventional signs and symbols.	
	1.3	Bearings – Different types, compass – prismatic, surveyor, dip,declination and local attraction, compass traversing	
2	**Levelling and Contouring**		**8**
	2.1	Definitions, basic terms, types of instruments-dumpy level and Auto level, principal axes of dumpy level, temporary and permanent adjustments	
	2.2	Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of missing data, distance to the visible horizon,corrections due to curvature and refraction, reciprocal levelling, Numerical problems	
	2.3	Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors,difficulties in levelling work, corrections and precautions work in levelling	
	2.4	Contouring: terms, contour, contouring, contour interval, horizontal equivalent Direct and indirect methods of contouring, interpolation of contours, uses of Contours and characteristics of contour lines. Grade contour	
3	**Theodolite Surveying**		**8**
	3.1	Various parts and axes of transit, technical terms, temporary and permanent adjustments of a transit, measurement of horizontal and vertical angles, Methods of repetition and reiteration.	
	3.2	Different methods of running a theodolite traverse, Latitudes and departures,rectangular coordinates,traverse adjustments by Bowditch's, transit and Modified transit rules, Gales Traverse Table, Numerical Problems.	
	3.3	Miscellaneous use of theodolite for various works such as prolongation of a straight line,setting out an angle, bearing measurements.Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing.	
4	**Indirect and Advanced Methods of Measurement**		**7**
	4.1	Tacheometry-Principle, Objective, Suitability and different methods of tacheometry, Stadia formula, Radial contouring , numerical on stadia method only	
	4.2	Electronic Distance Measurement: Working Principles, types, applications in surveying	
		Total Station- Working Principles, applications in surveying	
	4.3	Introduction to GPS	

	Plane Table Surveying, Areas and Volumes		**5**
5	5.1	Definition, principle, accessories required for plane table surveying, merits and demerits, temporary adjustments, Different methods of plane table surveying	
	5.2	Areas: Area of an irregular figure by trapezoidal rule, average ordinate rule,Simpson's 1/3 rule, various coordinate methods.Planimeter: types including digital planimeter, area of zero circle, uses of planimeter.	
	5.3	Volumes: Computation of volume by trapezoidal and prismoidal formula,volume from spot levels, volume from contour plans.	
6	**Curves**		**6**
	6.1	Horizontal Curves-Definitions of different terms, necessity and types of curves.Methods of setting out Simple circular curves- linear methods and Angular methods (Numericals on simple circular curves only)	
	6.2	Vertical curves– Definitions, geometry and types. Tangent correction and chord gradient methods.	
		Total	**39**

Contribution to Outcomes

After completion of the course, the learner will be able to:

1. 1.Apply the principles of surveying and field procedures to conduct the various surveys
2. Use various methods for taking linear and angular measurements
3. Collect, record and analyse the field data for preparing drawings.
4. Explain the advancements in instruments and methods
5. 5.Calculate the area of land and volume of earthwork
6. Set out curves

Internal Assessment (20 marks):

Consisting **Two Compulsory Class Tests:**

First test based on approximately 40% of the 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. The question paper will consist of **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 other module other than module 3)
4. ***Only****Four questions need to be solved.*

Recommended Books:

1. Surveying and Levelling: R. Agor, Vol. I, 11th Edition, Khanna Publishers (ISBN8174092358)
2. Surveying and Levelling:Kanetkar and Kulkarni, Vol. -I, 24th Edition, Pune Vidyarthi Griha, Pune. (ISBN 8185825114)
3. Surveying and Levelling:Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol. -II 4th Edition, Laxmi Publications (ISBN9788170088530)
4. Surveying and Levelling: N NBasak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN 9789332901537)

Reference Books:

1. Surveying: Volume -I: Dr K.R. Arora, Standard Book House.
2. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
3. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata McGraw Hill
4. Textbook of Surveying, C Venkatramaiah, University Press, Hyderabad, Latest Edition
5. Fundamentals of Surveying, S.K. Roy, Prentice Hall India, New Delhi
6. Surveying for Engineers, John Uraine and Bill Price, Palgrave Macmillan
7. Surveying: Theory and Practice, James Anderson, Edward M. Mikhail, Tata Mcgraw Hill

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Semester - IV

Course Code	Course Name	Credits
CEC 404	Building Materials & Concrete Technology	03

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

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

Rationale

Materials are essential elements, constituent parts (or) substances which are used to raise a building, but materials could not be turned into structures without a method of construction. This course provides necessary knowledge about properties, uses of different types of building materials and the selection of materials, its mix proportioning, mixing, placing, compacting and curing. This course is intended for gaining useful knowledge with respect to facts, concepts, principles and procedures related to building materials and concrete technology so that student can effectively execute quality control during building construction work.

Objectives

1. To identify the good and significant materials to be used for the construction work and their associated quality, durability, warrantees, and availability.
2. To study the manufacturing process, properties and use of different types of building materials like stone, brick, glass, timber and the materials such as paints and varnishes used for the treatment of surfaces so as to achieve good knowledge about the building materials.
3. To acquire a thorough knowledge about the properties and significance of different materials used for the manufacturing of concrete.
4. To study the properties, test conducted and significance of concrete in terms of properties of fresh and hardened concrete.
5. To understand the concept and optimization of mix design of concrete for different exposure conditions.
6. To enable the students to understand the mechanized and precise procedure of concrete production in Ready Mix Plants. To understand the basic non-destructive tests conducted on concrete to check the in place strength and durability of concrete.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1	**Introduction to building materials and concrete:**		**03**
	1.1	**Introduction to building materials:** Introduction, role of materials in construction, classification of materials, economical and durable materials.	
	1.2	**Introduction to concrete:** History of concrete, necessity, limitations, merits and demerits.	
2	**Building Materials:**		**09**
	2.1	**Stones:** Classification and properties of building stones, relation to their structural requirements, quarrying, dressing, seasoning and preservative treatments.	
	2.2	**Bricks and blocks:** Burnt clay bricks: raw materials, manufacturing processes, classification, properties, defects, tests as per BIS codes. Bricks for special use: refractory bricks. Concrete blocks, Paver block, Autoclaved Aerated Concrete (AAC) blocks, Cellular Light Weight Concrete (CLC) blocks and ceramic tiles: raw materials, manufacturing process and properties.	
	2.3	**Glass:** Properties, types, uses.	
	2.4	**Timber:** Types of natural wood and artificial wood, preservative treatments, defects in timber, wood products and wood composites.	
	2.5	Damp proofing, water proofing materials and Termite proofing.	
	2.6	**Mortar:** Types, ingredients, proportions and suitability.	
	2.7	**Paints, Enamels and Varnishes:** Composition. Painting on: plastered surfaces, wood surfaces, meta l surfaces. Effect of weather on: Enamels, distemper, white wash and colour wash, varnish, French polish, Wax Polish.	
	2.8	**Miscellaneous Materials:** Gypsum, Plaster of Paris, Heat and sound insulating materials.	
3	**Constituent of Concrete:**		**09**
	3.1	**Fine and Coarse Aggregates:** Classification, physical and mechanical propertiesand their influence on the properties of concrete, gradation, Alkali aggregate reaction. Properties of manufacturing sand.	
	3.2	**Cement (OPC):** Grades, Manufacturing, Chemical composition, Hydration of cement, Physical properties as per BIS code. Effects of chemical constituents on the properties of cement. Different types of cement**:** Chemical composition, properties as per relevant IS codes and their applications.	
	3.3	**Water:** Desiredquality of water for concrete.	
	3.4	**Lime:**Types and their usages.	
	3.5	**Admixtures:** Definition and purposes, types of mineral and	

		chemical admixtures. Test on admixtures: chemistry and compatibility with concrete.	
4	**Concrete:**		**06**
	4.1	Grades, manufacturing process, preparation of batch report, Duff Abram's W/C ratio law & its significance.	
	4.2	Properties of fresh and hardened concrete, factors affecting of workability, vibration of concrete, Types of vibrators: Internal, external, surface and table vibrators.	
	4.3	Durability: factors affecting durability, relation between durability and permeability, laboratory tests on durability such as Permeability test, Rapid chloride penetration test (RCPT).	
5	**Concrete Mix Design:**		**08**
	5.1	Definition and objectives, Types of mix as per IS:456, Mix design for compressive strength and flexural strength in accordance with IS 10262 and IS 456.	
	5.2	Methods of Curing of concrete, Methods of determining compressive Strength of accelerated-cured concrete test specimens as per IS 9013, Calculation of ingredients of concrete for batching as per concrete mix proportions for different grades.	
6	**Concreting Methods and Test**		**04**
	6.1	**Ready Mixed Concrete:** Advantages of RMC, Components and Lay-out of RMC plant. Distribution and Transport, Handling and Placing. Codes recommendations.	
	6.2	**Non-Destructive Testing:** Need, application and limitation, Schmidt Rebound hammer test, Ultrasonic Pulse Velocity test.	

Contribution to Outcome

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

1. To develop and implement the conceptual knowledge of building materials in the construction industry.
2. Assess the properties of building stones and their classifications. Understand the concept of various methods of manufacturing of bricks and different types of concrete blocks.
3. To expose students to various quality control aspects of civil engineering materials by performing different lab tests on materials.
4. Identify the ingredients and properties of fresh and hardened concrete.
5. To interpret and design concrete mix for various grades for various exposure conditions.
6. To study the new technology for manufacturing, testing and quality of concrete.

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 module3)
4. ***Only*** *Four questions need to be solved.*

Recommended Books:

1. A Building Construction: S*.C. Rangwala,* Charotar Publications, Gujarat, India.

2. Building Construction: *S.P. Arora, Dr.S.P. Bindra,*DhanpatRai Publication, New Delhi.

3. Building Construction: *Dr. B.C. Punmia, A.K.Jain, A.R.Jain,*Laxmi Publication., New Delhi.

4. Concrete Technology Theory and Practice: *M.S. Shetty, S*.Chand Publication.

5. Concrete Technology: *M.L. Gambhir,* Tata McGraw Hill, NewDelhi. **6.** Concrete Technology: *A.M. Neville & J. J. Brooks.,* ELBS-Longman. **7.** Concrete Technology: *A.M. Neville & Isaac Pitman,* London.

8. Concrete Technology: *A. R. Shanthakumar,* Oxford University Press.

9. Materials of Construction: *D. N. Ghose,* Tata McGraw Hill, Delhi. **10.** Building Materials: *S.K. Duggal,* New Age International Publishers. **11.** Concrete Technology: *D. F. Orchardi,* Wiley, 1962.

12. Relevant codes: BIS, ACI & BS.

Reference Books/Reference Materials:

1. Engineering Materials: *S.R. Rangwala,*Charotar Publications.

2. Architectural Materials science: D. Anapetor, Mir Publishers.
3. Introduction to Engineering Materials: B. K. Agrawal, Tata McGraw Hill, NewDelhi.
4. Engineering Materials: P. Surendra Singh, Vani Education Books,New Delhi.
5. Building Materials (Products, Properties and Systems): M.L. Gambhir and NehaJamwal,McGraw Hill Publications.
6. Properties of concrete: Neville, Isaac Pitman, London.
7. NPTEL Lecture series on Building Materials and Concrete Technology.

Semester- IV

Course Code	Course Name	Credits
CEC405	Fluid Mechanics - II	03

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

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

Rationale

The course introduces the fluid flow science, problems and their applications in varied conditions. The study deals with the characteristics of fluid flow in pipes namely compressible, laminar and turbulent with their applications in detail.

Objectives

The students will be able to learn:

1. The knowledge of closed conduit flows, determine various losses through pipes, Pipe network and Water hammer effect
2. Theory of Laminar flow and Turbulent flow,
3. Understand the concept of Boundary Layer theory, flow separation and forces around submerged bodies
4. Application of moment of momentum principle on pipe bends and sprinklers
5. The importance of dimensionless numbers, dimensional analysis and similarities.

Detailed Syllabus

Module		Course Modules / Contents	Periods
1	**Flow through pipes**		14
	1.1	**Flow through pipes:** Loss of head through pipes, Darcy-Weisbach equation, Major and minor losses. Hydraulic gradient line and Total energy gradient line, pipes in series,equivalent pipes, pipes in parallel, flow through laterals, flow through Branched pipes, three reservoir problem, siphon.	
	1.2	**Pipe network and water hammer:** Hardy cross method, water hammer in Pipes-Gradual closure and instantaneous closure of valve control measures	

	1.3	**Flow through nozzles:** Power transmitted through nozzle, condition for maximum power transmitted,diameter of nozzle for maximum transmission of power	
2	**Laminar Flow**		**05**
	Reynolds experiment, critical velocity, laminar flow through circular pipes, flow between two parallel plates: stationary and moving.		
3	**Turbulent Flow**		**04**
	Causes of turbulence, shear stress in turbulent flow, Reynolds's stresses, Prandtl's mixing length Theory, Hydro dynamically smooth and rough boundaries, velocity distribution in smooth and rough pipes, Karman-Prandtl's velocity distribution equation.		
4	**Boundary Layer Theory**		**07**
	Development of boundary layer over flat surfaces. Boundary layer thickness, energy thickness and momentum thickness, Boundary layer separation and control. Introduction to flow around submerged body, drag and lift, terminal velocity of body, Magnus Effect.		
5	**Dynamics of Fluid Flow**		**04**
	Momentum principle, Moment of momentum principle (applications: Pipe bends and sprinklers).		
6	**Dimensional Analysis**		**05**
	Dimensional homogeneity, Buckingham's π theorem, Rayleigh's method, dimensionless numbers and their significance, Model (or similarity) laws, application of model laws: Reynolds's model law, Froude's model law, Euler's Model law, Weber's Model law, Mach model law, scale effect in models.		
Total			**39**

Contribution to Outcome

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

1. Analyze flow through pipes, various losses through pipes, pipe network and power transmission through nozzle
2. Explain the concept of Laminar flow and velocity distribution through parallel plates and pipes
3. Explain the concept of Turbulent flow and velocity distribution in pipes
4. Describe boundary layer concept , boundary layer separation and flow around submerged bodies
5. Apply Moment of Momentum Principle Explain the importance of dimensionless numbers, dimensional analysis and similarity behavior of model and prototype

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. Hydraulics and Fluid mechanics: Dr P.M. Modi and Dr. S.M. Seth, Standard book House, Delhi
2. Theory and Application of Fluid Mechanics: K. Subramanya, Tata McGraw hill publishing company
3. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
5. Fluid Mechanics and Hydraulics: Dr. S. K. Ukarande, Ane Books Pvt. Ltd. (Revised Edition, 2012), ISBN97893 8116 2538
6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
7. Fluid Mechanics and Machinery: C.S.P.Ojha, R. Berndtsson and P.N. Chandramouli. Oxford Higher Education.

Reference Books:

1. Fluid Mechanics: Frank M. White, Tata Mc-Graw-Hill International edition.
2. Fluid Mechanics: Streeter White Bed ford, Tata McGraw International edition.
3. Fluid Mechanics with engineering applications: R.L. Daugherty, J.B.Franzini, E.J.,Finnemore, TataMcGraw Hill New Delhi.
4. Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India Pvt. Ltd.,Delhi.

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Semester- IV

Course Code	Course Name	Credits
CEL401	Structural Analysis Tutorial	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

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

Objectives:

1. To analyse for axial force in the Coplanar, perfect trusses and analysis of 3- Hinged arches.
2. To study the concept of Influence Line Diagrams and rolling loads.
3. To learn methods for evaluating rotation and displacement of frames and trusses.
4. To analyse the indeterminate structures using Flexibility methods and Stiffness methods.
5. To understand Plastic analysis.

Outcomes:

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

1. Calculate axial forces in the Coplanar trusses by using Method of joints and method of sections and also calculate radial shear, normal thrust and bending moment in parabolic 3-Hinged arches.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them..
3. Evaluate rotation and displacement at a joint of frames and deflection at any joint of truss and will be able to compute static and kinematic indeterminacy of structure.
4. Analyse the indeterminate structures such as beams & simple rigid jointed frames using Flexibility methods and direct stiffness method.

List of Tutorials and Assignments		
Week (Activity)	**Content**	**Hours**
1st week (Tutorial)	Analysis of Trusses and Three hinged elastic arches (Numericals based on this Module will be solved in tutorial room.)	**2**

2nd week (Assignments)	1) Analysis of Trusses and Three hinged elastic arches 2) Solve set of questions given by the course instructor or 3) Write a report on use of arches in civil engineering or 4) Difference in behaviour of trusses and arches if used in bridges or 5) Write a report on limitations of trusses /arches or 6) Report Famous Truss structures / arch structures in world or 7) 6 Write a report on use of trusses in Civil Engineering	**2**
3rd week (Tutorial)	Influence line diagrams and rolling loads (Numericals based on this Module will be solved in tutorial room.)	**2**
4th week (Assignments)	Influence line diagrams and rolling loads 1) Solve set of questions given by the course instructor or 2) Write a report on use of arches in civil engineering or 3) Design an experiment for ILD of reactions of beam. or 4) Design an experiment for ILD of axial forces of a multi-bay truss. or 5) write a report on IRC and classes of rolling loads	**2**
5th week (Tutorial)	Determinate and Indeterminate structure (Numericals based on this Module will be solved in tutorial room.)	**2**
6 th week (Assignments)	Determinate and Indeterminate structure 1) Solve set of questions given by the course instructor or 2) Prepare a chart explaining static and kinematic indeterminacy or 3) Write a computer program in C++ or MS-excel or similar for ILD of reactions. or 4) Write a computer program in C++ or MS-excel or similar for ILD for axial forces in Truss members.	**2**
7th week (Tutorial)	Analysis of indeterminate structures by Flexibility method (Numerical based on this Module will be solved in tutorial room.)	**2**
8th week (Assignments)	Analysis of indeterminate structures by Flexibility method 1) Solve set of questions given by the course instructor or 2) Prepare a poster on Flexibility and Stiffness approach or 3) Solve a set of 4-5 questions given by the course instructor on Flexibility methods and validate the same using relevant Structural Analysis or design software.	**2**
9th week (Tutorial)	Analysis of indeterminate structures by Direct stiffness method (Numericals based on this Module will be solved in tutorial room).	**2**
10th week (Assignments)	Analysis of indeterminate structures by Direct stiffness method 1) Solve set of questions given by the course instructor or 2) Write a report on Stiffness methods in civil engineering or 3) Prepare a poster on Clapeyron's theorem for continuous beam.or 4) Solve a set of 4-5 questions given by the course instructor on Direct stiffness method and validate the same using relevant Structural Analysis or design software.	**2**

11th week (Tutorial)	Moment distribution method, Plastic analysis of structures (Numerical based on this Module will be solved in tutorial room.)	**2**
12th week (Assignments)	Moment distribution method, Plastic analysis of structures 1) Solve set of questions given by the course instructor or 2) Write a report on Plastic analysis of structures or 3) Solve a set of 4-5 questions given by the course instructor on Moment distribution method and validate the same using relevant Structural Analysis or design software.	**2**
13th week	Viva-Voce Examination	**2**

- *Assessment:*

Term Work: Term work will include Tutorial work and Assignments both, Distribution of marks for Term Work shall be as follows:

Tutorial work-	:	15 Marks
Assignments-	:	10 Marks
Total Term work	:	25 Marks
Attendance	: Apply multiplying Factor 0.5 to 1.0 to the above total.	

End Semester Oral Examination

Oral examination will be based on entire syllabus.

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Semester- IV

Course Code	Course Name	Credits
CEL402	Surveying(Lab)	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	25	75

@ For the course "Surveying (Lab)" the oral examination shall be conducted in conjunction with the practical conduction.

Course Objectives:

The students will be able to learn:

1) Various surveying instruments, their least counts, various parts and suitable uses.
2) Methods of measurements in the field.
3) Skills for collecting, recording and analysing the field data.
4) Advanced instruments and methods.
5) First hand practical experience by receiving field exposure to collect site specific data.
6) Setting out techniques.

Course Outcomes:

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

1) Operate and use the surveying instruments according to the accuracy and suitability.
2) Measure linear and angular dimensions in horizontal and vertical planes.
3) Collect, record and analyse the field data systematically.
4) Prepare plans of the existing features on the ground, sections and contours.
5) Compute the area of land and the volume of earthwork.
6) Set out curves and foundation plans.

List of practical's and projects:

Perform minimum **six** practical's out of 01 to 10 and all the projects are **mandatory**

Module	**Detailed Contents**	**Lab Sessions/Hr**
1	Chain and cross staff surveying.	03 hrs
2	Measuring bearings of a closed traverse with prismatic compass and computation of interior angles.	03 hrs
3	Simple and compound levelling	03 hrs
4	Measurement of horizontal and vertical angles.	03 hrs
5	Finding constants, heights and distances using tachometry.	03 hrs
6	Measurement of distances, bearings and area using total station.	03 hrs
7	Plane Table Surveying by intersection method.	03 hrs
8	Find an area of irregular figure using a conventional planimeter and verify it using a digital planimeter.	03 hrs
9	Setting out a simple curve by Rankine's method.	03 hrs
10	Setting out a simple foundation plan.	03 hrs
Projects		
A survey camp of three days is to be arranged to execute the following projects for undergoing the students through practical instructions in civil engineer's career with the actual field exposure at an ideal site location .		
1	**Project I:** Road project using Auto level for a minimum length of 500 m including fixing of alignment, profile levelling, cross-sectioning at 20m interval, plotting of 'L' section and 'C' section. (Two full imperial sheets, the first sheet with key plan and 'L' section and the second sheet covering any three typical Cross-sections)	
2	**Project II:** Block Contouring project using Auto level for minimum 60 m × 60 m area and generating contours by MS Excel. (Take contour interval as 0.2 meter)	
3	**Project III:** Tachometric contouring project on a hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours by taking contour intervals as 1 meter.	

Assessment:

Teamwork

Including above practical work, projects and assignments, distribution of marks for Term Work shall be as follows:

Practical Work-	:	15 marks
Assignments -	:	05 marks
Attendance-	:	05 marks

Projects-

Field work	:	15marks
Office work (Drawings)	:	10marks
Total	:	50marks

- **End Semester Practical/ Oral Examination**

Practical Examination : 10 Marks

Oral Examination : 15 Marks.

Oral examination will be conducted after conduction of practical examination & it will be based on term work & Practical examination

Reference Books:

1) Surveying and Levelling *: R. Agor, Vol-I, 11th Edition*, Khanna Publishers (ISBN 8174092358)
2) Surveying and Levelling :*Kanetkar and Kulkarni*,Vol-I, 24th Edition, Pune VidyarthiGriha, Pune. (ISBN 8185825114)
3) Surveying and Levelling : *Dr. B.C. Punmia,* Vol.-I, 16th Edition, Vol -II 4th Edition, Laxmi Publications (ISBN9788170088530)
4) Surveying and Levelling: *N NBasak*, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN 9789332901537)
5) Surveying: Vol-I: Dr K.R. Arora, Standard Book House.
6) Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
7) Surveying and Levelling (Vol.-I): S.K. Duggal, Tata Mc-Graw Hill

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Semester- IV

Course Code	Course Name	Credits
CEL 403	Building Materials & Concrete Technology (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

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

Objectives:

1) To determine physical and mechanical properties of materials used in the manufacturing of concrete like cement and aggregates.
2) To test the physical attributes and mechanical strength of burnt clay bricks used in the construction of structures.
3) To determine the various properties of fresh and hardened concrete with and without the addition of admixtures.
4) To study the different basic non-destructive tests conducted in the laboratory or on site to determine the durability and strength of existing concrete structures.
5) To utilize the knowledge of mix design in the manufacturing of concrete, in the laboratory.
6) To test the physical attributes and mechanical strength of timber and tiles used in the construction of various components of the structure.
7) To understand the practical scenario of the commonly used building materials in terms of their availability, cost and significance through market surveys.

Outcomes: Learner will be able to…

1) Develop collaborative skills to work in a team/group
2) Test physical properties of cement, aggregates and concrete.
3) Test various other building materials like tiles, bricks and timber
4) Evaluate the effects of admixtures on physical properties of concrete.
5) Design the concrete mix.
6) To bridge the gap between theoretical and market/industrial practices by market surveys.

List of Experiments (first seven are compulsory)

Module	Detailed Contents	Lab Sessions/Hr
1	Physical properties of OPC: Physical test, Fineness, Standard consistency, Soundness, Setting time, Compressive strength.	**02/04**
2	Physical Properties of Fine and Course Aggregates: Specific gravity, bulk density, Moisture content, Water absorption, flakiness index, elongation index, Fineness modulus, Silt content and bulking of sand	**02/04**
3	Tests on burnt clay bricks	**01/02**
4	Effect of w/c ratio on workability (slump cone, compaction factor, V-B test, flow table) and strength of concrete	**02/04**
5	Study of admixtures and their effect on workability and strength of concrete.	**01/02**
6	Non-destructive testing of concrete: Rebound hammer and ultrasonic pulse velocity	**01/02**
7	Concrete mix design in the laboratory	**01/02**
8	Test on tiles(optional)	**01/02**
9	Compression test on timber (Parallel/ perpendicular to the grains). (optional)	**01/02**
10	Market survey on common building materials (optional)	**01/02**

Site Visit/ Industrial Visit:

The students shall visit the brick, paver blocks, concrete block, cement, glass and RMC industrial plants. They shall prepare a report of the visit and the same shall be evaluated by the concerned teacher.

Assessment:

The term work shall consist of:

- Report of experiments performed.
- Industrial visit report to at least **any one** of the above mentioned industrial plants.
- Although minimum numbers of market surveys and industrial visits are prescribed, the students shall be encouraged to perform more number of experiments and site/ industrial visits.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work including industrial/ site visit report. The final certification and acceptance of term work warrants the satisfactory performance of laboratory work by the student, appropriate completion of the assignments. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

Individual Practical performance **:** 07 Marks

Assignments : 03 Marks

Reports of experiment **:** 05 Marks

Site Visit/Industrial visit	:	05 Marks
Attendance	:	05 Marks
Total	*:*	*25 marks*

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted tom75% - 80%: 03 Marks; 81% - 90%: 04 Marks; 91% onwards: 05 Marks.

End Semester Practical/Oral Examination

The oral examination shall be based on the entire syllabus and term work comprising of the report of the experiments/ practical conducted by the students and a detail report of the industrial/ site visit.

Recommended Books:

1) A Building Construction: S.*C. Rangwala*, Charotar Publications, Gujarat, India.
2) Building Construction: S.P. Arora, Dr.S.P. Bindra,DhanpatRai Publication, New Delhi.
3) Building Construction: Dr. B.C. Punmia, A.K.Jain, A.R.Jain,Laxmi Publication., New Delhi.
4) Concrete Technology Theory and Practice: M.S. Shetty, S.Chand Publication.
5) Concrete Technology: M.L. Gambhir, Tata McGraw Hill, NewDelhi.
6) Concrete Technology: A.M. Neville & J. J. Brooks., ELBS-Longman.
7) Concrete Technology: A.M. Neville & Isaac Pitman, London.
8) Concrete Technology: A. R. Shanthakumar, Oxford University Press.
9) Materials of Construction: D. N. Ghose, Tata McGraw Hill, Delhi.
10) Building Materials: S.K. Duggal, New Age International Publishers.
11) Concrete Technology: D. F. Orchardi, Wiley, 1962.
12) Relevant codes: BIS, ACI & BS.

Reference Books/Reference Materials:

1) Engineering Materials: *S.R. Rangwala*,Charotar Publications.
2) Architectural Materials science: D. Anapetor, Mir Publishers.
3) Introduction to Engineering Materials: B. K. Agrawal, Tata McGraw Hill, NewDelhi.
4) Engineering Materials: P. Surendra Singh,Vani Education Books, New Delhi.
5) Building Materials (Products, Properties and Systems): M.L. Gambhir and NehaJamwal, McGraw Hill Publications.
6) Properties of concrete: Neville, Isaac Pitman, London.
7) NPTEL Lecture series on Building Materials and Concrete Technology.

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Semester- IV

Course Code	Course Name	Credits
CEL404	Fluid Mechanics – II (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	02	-	-	01	-	01

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

Course Objectives:

The students will be able to learn:

1) to verify the basic fluid mechanics concepts experimentally
2) the fluid flow pattern in pipes
3) to estimate the losses in pipe flow
4) the velocity distribution in pipes

Course Outcomes:

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

1) Verify the Reynold's experiment
2) Estimate the viscosity of fluid
3) Calculate the losses in pipes
4) Assess the flow pattern and velocity distribution in pipe flow
5) learn the water hammer phenomenon through demonstration
6) learn the wind tunnel testing through demonstration

List of Experiments (Minimum Six)

Module	Detailed Contents	Lab Sessions/Hr
1	Study of different types of flow using Reynold's apparatus	02 hrs
2	Determination of viscosity of fluid	02 hrs
3	Estimation of the head loss due to friction incurred by a fluid along a pipeline (To find the friction factor for the given pipes of different sizes)	04 hrs
4	To determine different losses in pipe fittings (Estimation of the minor losses)	04 hrs
5	Laminar flow through pipes	02 hrs
6	Velocity distribution in circular pipes	04 hrs
7	Turbulent flow through pipe	02 hrs
8	Study of Water Hammer phenomenon	04 hrs
9	Study of wind tunnel	02 hrs

Assessment:

- **Term Work**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work-	:	15 Marks
Assignments-	:	05 Marks
Attendance	:	05 Marks

- *End Semester Oral Examination*

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Reference Books:

1) Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company
2) Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
3) Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd-New Delhi
4) Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
5) Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
6) Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
7) Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

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Semester- IV

Course Code	Course Name	Credits
CEL405	Skill Based Lab Course-II Total Station and Geographical Information System	1

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

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

Objectives:

1) To enable the learners, operate the Total Station and generate its output in terms of plans, elevations and 3D views
2) To enable the learners, operate the Global Navigation Satellite System (GNSS) receivers and retrieve the information
3) To enable the learners work on a Geographical Information System (GIS) platform for assimilating geographical data

Outcomes: Learner will be able to…

1) Operate a Total Station and traverse the field
2) Perform various operations like computing height of a structure, computing area of plot, subdividing area, demarcating boundaries, etc. Using Total Station
3) Set out foundation plan using Total Station
4) Compute the point, line and area features using Global Navigation Satellite System
5) Plot various existing features in a geographic area on a GIS platform
6) Add attribute and perform various statistical operations in GIS

List of Experiments (Minimum Eight)

Module	Detailed Contents	Lab Sessions/Hr
1	Introduction to concepts, fundamental features and working principal of Total Station (TS)	02
2	Temporary settings of a TS in field and perform basic functions on	02

	total station like traversing, area of open plot, height calculations, etc.	
3	Collect detailed features of a plot (comprising features such as 2-3 buildings, courtyards, security cabins, playgrounds, trees, gates, poles, roads, drainage lines, etc.) using TS	04
4	Transfer data collected through TS on a convenient computer aided drafting (CAD) software	02
5	Feeding a CAD plan in TS and setting out a foundation plan using TS	02
6	Introduction to fundamental features of Global Navigation Satellite System (GNSS) and collect point, line and polygon features through a GNSS receiver	02
7	Computing latitudes, longitudes, altitudes of points, length of roads, area of plots, etc. using a GNSS system	02
8	Basic introduction to compatibilities, utilities and attributes of peculiar Geographical Information System (GIS) softwares available in market w.r.t their various commands, features, capabilities and functions.	02
9	Collecting ground points through GNSS and TS for integrating it with spatial data obtained from a GIS platform like google earth, openstreetnetwork, etc. and developing a model on a GIS software	04
10	Add various layers in term of attributes and perform various statistical operations and queries in GIS	04

Assessment:

- **Term Work**

Including Laboratory Work comprising of minimum 8 software generated sheets distribution of marks for Term Work shall be as follows:

Laboratory work : 40 Marks (comprising of min 8 software generated sheets:
4 using TS and GNSS data in CADD tool and 4 using GIS tool)

Attendance : 10 Marks

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Semester- IV

Course Code	Course Name	Credits
CEM 401	Mini Project -1B	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	03	-	-	1.5	-	1.5

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

Objectives

1) To acquaint with the process of identifying the needs and converting it into the problem.
2) To familiarize the process of solving the problem in a group.
3) To acquaint with the process of applying basic engineering fundamentalsto attempt solutions to the problems.
4) To inculcate the process of self-learning and research.

Outcome: Learner will be able to…

1) Identify problems based on societal /research needs.
2) Apply Knowledge and skill to solve societal problems in a group.
3) Develop interpersonal skills to work as member of a group or leader.
4) Draw the proper inferences from available results through theoretical/ experimental/simulations.
5) Analyse the impact of solutions in societal and environmental context for sustainable development.
6) Use standard norms of engineering practices
7) Excel in written and oral communication.
8) Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9) Demonstrate project management principles during project work.

Guidelines for Mini Project

1) Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2) Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3) Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4) A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.

5) Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
6) Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
7) Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8) The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9) With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10) However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book 10
    - Marks awarded by review committee 10
    - Quality of Project report 05
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Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
- First shall be for finalisation of problem
- Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
- First review is based on readiness of building working prototype to be conducted.

- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1) Quality of survey/ need identification
2) Clarity of Problem definition based on need.
3) Innovativeness in solutions
4) Feasibility of proposed problem solutions and selection of best solution
5) Cost effectiveness
6) Societal impact
7) Innovativeness
8) Cost effectiveness and Societal impact
9) Full functioning of working model as per stated requirements
10) Effective use of skill sets
11) Effective use of standard engineering norms
12) Contribution of an individual's as member or leader
13) Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines forAssessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1) Quality of problem and Clarity
2) Innovativeness in solutions
3) Cost effectiveness and Societal impact
4) Full functioning of working model as per stated requirements
5) Effective use of skill sets
6) Effective use of standard engineering norms
7) Contribution of an individual's as member or leader
8) Clarity in written and oral communication

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