

University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई - ४०० ०३२
टेलिफोन नं - ०२२ - ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७

दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमलबजावणीच्या अनुषंगाने शैक्षणिक वर्ष २०२५-२६ पासून पदवी व पदव्युत्तर अभ्यासक्रम विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई - ४०० ०३२
२७ मे, २०२५


(डॉ. प्रसाद कारंडे)
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As Per NEP 2020

University of Mumbai



Syllabus for Major Vertical – 1 , 4, 5 & 6

Name of the Programme – B.E. (Civil and Infrastructure Engineering)

Faculty of Engineering

Board of Studies in Civil & Infrastructure Engineering

U.G. Second Year Programme	Exit Degree	U.G. Diploma in <u>Civil and Infrastructure Engineering.</u>
Semester	III	
From the Academic Year	2025-26	

University of Mumbai



(As per NEP 2020)

Sr. No	Heading	Particulars
1	Title of program O: _____	B.E. (<u>Civil and Infrastructure Engineering</u>)
2	Exit Degree	U.G. Diploma in <u>Civil and Infrastructure Engineering.</u>
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R. TEU-655C R. TEU-655D	Attached herewith
6	Semesters	Sem. III
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-
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BoS-Chairman-Civil Engineering
Faculty of Technology

Sd/-
Dr. Deven Shah
Associate Dean
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Sd/-
Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the 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 the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the Civil & Infrastructure engineering in the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of Civil & Infrastructure Engineering for open electives and multidisciplinary minor courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Program Core Course Cover Civil & Infrastructure Engineering core courses. Also, OE and MDM where a pool of subjects are given for selection. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. For the purpose Design Thinking is introduced in the Fourth Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner's learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based 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 a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks, and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2025-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

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Under Graduate Diploma in Engineering- Civil & Infrastructure Engineering.

Credit Structure (Sem. III & IV)

	R. TEU-655C									
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC , VEC ,IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	PCC301:3 PCC302:3 PCC303:3 PCC304:3 PCL301: 1 PCL302:1	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	UG Diploma 45
	R. TEU-655D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL401:1 PCL402:1	--	MDM: 4	OE:2	VSEC:2	VEC: 2 EEM:2	--	23	
	Cum Cr.	25	--	4	4	2	2+2+2+2	2	45	

Exit option: Award of UG Diploma in Major and MDM with 90 credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsory do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

S.E. Civil & Infrastructure Engineering Scheme

Program Structure for Second Year of Civil & Infrastructure Engineering

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER III

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2083111	Applied Mathematics for Civil Engineering-I	2	–	1	2	1	–	3
2083112	Mechanics of Solids	3	–	–	3	–	–	3
2083113	Concrete Technology: Materials & Machineries	3	–	–	3	–	–	3
2083114	Architectural Planning & Drawing	3	–	–	3	–	–	3
2083311	Open Elective (OE) Other than a particular program	2#	–	–	2	–	–	2
2083115	Mechanics of Solids Lab	–	2	–	–	–	1	1
2083116	Concrete Technology: Materials & Machineries Lab	–	2	–	–	–	1	1
2083611	Mini Project	–	4	–	–	–	2	2
2993511	Entrepreneurship Development	–	2*+2	–	–	–	2	2
2993512	Environmental Science	–	2*+2	–	–	–	2	2
Total		13	16	01	13	01	08	22

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Institute shall offer a course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

#Institute shall offer a course for MDM from other Engineering Boards.

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs.)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2083111	Applied Mathematics for Civil Engineering-I	20	20	40	60	2	25	–	125
2083112	Mechanics of Solids	20	20	40	60	2	–	–	100
2083113	Concrete Technology: Materials & Machineries	20	20	40	60	2	–	–	100
2083114	Architectural Planning & Drawing	20	20	40	60	2	–	–	100
2083311	Open Elective (OE) Other than a particular program	20	20	40	60	2	–	–	100
2083115	Mechanics of Solids Lab	–	–	–	–	–	25	25	50
2083116	Concrete Technology: Materials & Machineries Lab	–	–	–	–	–	25	25	50
2083611	Mini Project	–	–	–	–	–	50	25	75
2993511	Entrepreneurship Development	–	–	–	–	–	50	--	50
2993512	Environmental Science	–	–	–	–	–	50	--	50
Total		100	100	200	300	10	225	75	800

Sem. - III

Vertical – 1

Major

SEMESTER –III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083111	Applied Mathematics for Civil Engineering-I	02	-	01	02	-	01	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-I	IAT-II	Total					
2083111	Applied Mathematics for Civil Engineering-I	20	20	40	60	2	25	-	125

Pre-requisite: Applied Mathematics-I,
Applied 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 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.

DETAILED SYLLABUS:

Module	Detailed Contents	Hours	CO Mapping
I	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$. 1.2 Properties of Laplace Transform: Linearity, First Shifting theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.3 Evaluation of integrals by using Laplace Transformation. Self-learning topics: Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function, Second Shifting Theorem.	05	CO1
II	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.	04	CO2
III	Module: Fourier Series: 3.1 Dirichlet's conditions, Definition of Fourier series. Fourier series of periodic functions with period 2π and $2l$ (No questions should be asked on split function) 3.2 Fourier series of even and odd functions. (No question should be asked on split function) 3.3 Half range Sine and Cosine Series. Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform, Parseval's Identity.	04	CO3
IV	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), Cauchy-Riemann equations in cartesian coordinates (without proof) 4.2 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) is given. 4.3 Harmonic function, Harmonic conjugate. Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations, orthogonal trajectories.	04	CO4

V	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 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), Functions of square matrix.	04	CO5
VI	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.	04	CO6

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 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 Applied 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 (IA) for 20 marks:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test Duration of each test shall be one hour.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise a total of Six **questions each carrying 15 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Four questions** needs to be answered.

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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083112	Mechanics of Solids	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-I	IAT-II	Total					
2083112	Mechanics of Solids	20	20	40	60	2	--	--	100

Rationale :

Civil & Infrastructure 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 in to 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 behavior; determine the internal forces and analyses the stresses of various structural elements under action of different type of force systems. The knowledge of Mechanics of Solids will be foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design.

Course Objectives:

The students will be able to learn:

1. To compute area moment of inertia and to learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and estimate deformation of Elastic members under the action of axial forces and temperature change.
2. To learn relationship of distribution of axial force, shear force and bending moment for the loaded, statically determinate beams and portal frames and learn to represent graphically.
3. To analyze the distribution of shear stress and the flexural (bending) stress across the cross section of structural members.
4. To analyze and estimate the direct and bending stresses in columns and study buckling behavior of centrally and eccentrically loaded columns.
5. To analyze and determine the slope and deflection of elastic beams and general theorems used in this computation.
6. To relate the action of twisting moment with geometry of circular shafts and to determine strain energy stored in elastic members.

Course Outcomes:

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

1. Understand concept of stress-strain and determine different types of stress, strain in determinate homogeneous and Calculate Moment of Inertia for cross sections.

2. Calculate shear force and bending moment in statically determinate beams and portal frames for different loading conditions and illustrate axial force, shear force and bending moment diagram.
3. Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
4. Compute direct and bending stresses developed in the cross section of centrally and eccentrically loaded columns.
5. Evaluate slope and deflection of beams supported and loaded in different ways.
6. Use theory of torsion to determine the stresses in circular shaft and to calculate strain energy stored in members due to elastic deformation.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
I	Moment of Inertia, Simple Stresses and Strains, Principal planes and stresses	1.1	Moment of Inertia: Area Moment of inertia, Parallel and Perpendicular axis theorem, polar moment of inertia. Radius of gyration.(Rectangular, Triangular, Circular)	07	CO1
		1.2	Simple Stresses and Strains , Principal planes and stresses: 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, temperature stresses. Basics of Principal planes and stresses.		
II	Axial force, shear force and bending moment diagrams for beams and portal frames	2.1	Concept of Axial Force, Shear Force and Bending Moment. Axial Force Shear Force and Bending Moment Diagrams for statically determinate Simply Supported and Cantilever beams without internal hinges and for single loading like point load, UDL, UVL or Couple moment.	08	CO2
		2.2	Axial Force Shear Force and Bending Moment Diagrams for statically determinate 3-member Portal Frames without Internal hinges.		
III	Shear stresses and Bending stresses in beams	3.1	Distribution of shear stress across plane sections Commonly used for structural purposes.	05	CO3
		3.2	Theory of pure bending, Flexure formula for straight beam, simple problems involving application of Flexure formula, section modulus, moment of resistance.		
IV	Stresses and Deflection of columns	4.1	Direct and bending stresses Circular and rectangular Columns, Core of section, Determination of stresses.	05	CO4

		4.2	Buckling of Columns, Members subjected to axial loading, concept of buckling, effective length, different support conditions, Determination of crippling load by Euler's and Rankin's formula.		
V	Slope and Deflection in Beams	5.1	Slope and Deflection of Beams: Determination of Slope and deflection in beams, using Macaulay's method of double integration, Moment area method only. Simply supported or Cantilever beam of constant EI and subjected to Point load, UDL only shall be studied.	08	CO5
		5.2	General Theorems of Slope and Deflection: Betti and Maxwell Reciprocal Theorem, Principal of Virtual work. Application of Unit Load Method and Strain Energy Method for finding out slope and deflection in beams.		
VI	Torsion of Shafts and strain energy	6.1	Torsion in solid and hollow circular shafts, Shafts transmitting and receiving power at different points. Stresses in Shafts while transmitting power.	06	CO6
		6.2	Strain energy stored due to axial force (due to gradual, sudden and impact load) in regular solid and hollow bars. Strain Energy stored due to bending of beams. Strain energy stored in member due to torsion.		

Text 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. Lehi and A. S. Lehi, S. K. Kataria Publishers, New Delhi
7. Strength of Materials: Dr. V. L. Shah, Structures Publications, Pune

References:

1. Mechanics of Materials: James, M. and Barry J. ; Cengage Learning.
2. Mechanics of Materials: Andrew Pytel and Jaan Kiusalaas, Cengage Learning.
3. Mechanics of Materials: Timoshenko and Gere, Tata McGrawHill, New Delhi.
4. Mechanics of Materials: James M. Gere, Books/Cole.
5. Strength of Materials: G. H. Ryder, Mc-Millan.
6. Mechanics of Materials: E. P. Popov, Prentice Hall India (PHI) Pvt. Ltd.
7. Mechanics of Materials: Pytel and Singer, Mc-GrawHill, New Delhi.
8. Strength of Materials: William A. Nash and Nillanjan Mallick, Mc Graw Hill Book Co. (Schaum's Outline Series)

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/104/105104160/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks.** **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Three questions** need to be answered from Q .2 to Q.6

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083113	Concrete Technology: Materials & Machineries	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs.)			
		IAT-I	IAT -II	Total					
2083113	Concrete Technology: Materials & Machineries	20	20	40	60	2	--	--	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, selection of materials, its mix proportioning and equipment used for the construction. This course is intended for gaining useful knowledge with respect to materials, concrete technology, procedures related to building materials, and construction equipment so that student can learn the aspects required to execute quality during construction work.

Course Objectives:

1. To acquire knowledge about the different constituent materials and their composition in concrete and study of its mix design as per the need.
2. To articulate the important properties of fresh and hardened concrete and corresponding tests conducted for assurance of concrete in terms of properties.
3. To acquire knowledge about the properties of different building materials like brick, timber, steel, concrete blocks and chemicals.
4. To understand the techniques of field and laboratory testing, and awareness of recyclability and Sustainability of Building Materials.
5. To acquire knowledge of machinery and equipment used in construction activities, their types and suitability.
6. To learn the working and usage of heavy equipment and vehicles for various construction activities.

Course Outcomes:

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

1. Develop and implement the knowledge of constituent materials and their composition in concrete and its mix design.
2. Assess fresh and hardened concrete by conducting tests.

3. Select suitable building materials like brick, timber, steel, concrete blocks and chemicals materials on the basis of its properties.
4. Apply field and laboratory testing for assuring quality of materials and have awareness of recyclability and Sustainability of Building Materials.
5. Employ suitable machinery and equipment for construction activities.
6. Take a call on usage of right type of heavy equipment and vehicles for various construction activities

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
I	Constituent of Concrete and Mix design	1.1	Cement - Different types, Chemical composition and Properties, Hydration of cement, Tests on cement, IS Specifications. Aggregates – Classification, Mechanical properties and tests as per BIS, Grading requirements. Water - Quality of water for use in concrete. W/C ratio. Admixtures , Accelerators , Retarders, Plasticizers, Super plasticizers ,Water proofers ,Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag	08	CO1
		1.2	Principles of Mix Proportioning, Mix Design – Design Mix and Nominal Mix, BIS Method of Mix Design - Mix Design Examples, Calculation of ingredients of concrete for batching as per concrete mix proportions for different grades.		
II	Properties of concrete and testing	2.1	Workability of concrete, Segregation and Bleeding, Creep and shrinkage. Properties of Hard concrete - Compressive strength, split tensile strength, Flexural strength, Stress-strain curve for concrete, Modulus of elasticity.	08	CO2
		2.2	Types of concrete, Durability of concrete, Causes of loss of durability. Tests on concrete- UPV, Rebound Hammer, Carbonation, permeability.		
III	Building Materials	3.1	Timber - Types of natural wood and artificial wood, preservative treatments, defects in timber, wood products and wood composites. Plywood, Block board, alternatives, laminates.	08	CO3
		3.2	Steel - Properties of steel as building material, different types of steel used in construction. Strengthening mechanism in metals. Behavior in service and corrosion. Aluminium and Composites- different uses in construction		
		3.3	Bricks - Classification, Manufacturing of clay bricks, Requirement of good bricks.		

		3.4	Concrete blocks, Paver block, Autoclaved Aerated Concrete (AAC) blocks, Cellular Light Weight Concrete (CLC) blocks and ceramic tiles: raw materials, manufacturing process and properties.		
IV	Testing Methods, recyclability and Sustainability of Building Materials	4.1	Field and laboratory tests on bricks: compressive strength, water absorption, efflorescence, dimension and warpage	04	CO4
		4.2	Recyclability, Sustainability, Carbon cycle and role of construction material such as concrete and steel, CO2 contribution from cement and other construction materials		
V	Mixers, Vibrators, Lifts and Pumps	5.1	Mixers: Tilting, Non-Tilting and Reversing, Transit Mixers, Maintenance of Mixers	07	CO5
		5.2	Vibrators: Needle Vibrator, Formwork Vibrator, Table Vibrator, Platform Vibrator, Surface Vibrator and Vibratory Roller.		
		5.3	Pulley blocks, Lifts and conveyors, their components		
		5.4	Pumps: different types used for buildings, their components		
VI	Excavators, Earthmovers, carriers and Road Rollers	6.1	Types of Excavators, Applications of different types of excavator. Earthmoving equipment, tractors and attachments, dozers and rippers, scrapers, shovels, draglines, trenching machines, clamshell, hoes, dozers, trenching machines.	04	CO6

Text Books:

1. A Building Construction: S.C. Rangwala, Charotar Publications, Gujarat, India.
2. Building Construction: S.P. Arora, Dr.S.P. Bindra, Dhanpat Rai 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, New Delhi.
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. Construction Planning, Equipment and Methods, Robert Peurifoy, McGraw Hill Education

References:

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 Neha Jamwal , McGraw Hill Publications.
6. Properties of concrete: Neville, Isaac Pitman, London.
7. NPTEL Lecture series on Building Materials, Concrete Technology and construction equipment.
8. Government of India, Ministry of Railways, Compendium of Construction Equipments.
<https://rdso.indianrailways.gov.in>

Assessment:**Internal Assessment -IA1 for 20 marks & IA2 for 20 marks each**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Three questions** need to be answered from Q .2 to Q.6

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083114	Architectural Planning & Drawing	03	-	-	03	-	-	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-I	IAT-II	Total					
2083114	Architectural Planning & Drawing	20	20	40	60	2	--	--	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.

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, rules, regulation and byelaws, Building codes.
- 4) To identify problems associated with design and drawing of complex building.
- 5) To analyze and define 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) Describe the basic concepts of building planning and its bye-laws.
- 2) Understand various working plans of residential and public buildings.
- 3) Identify the design and drawing technique of different building components and its services.
- 4) Effectively visualize and understand the concepts of perspective drawing of buildings.
- 5) Understand the concepts of architectural planning and RERA.
- 6) Learn the applications of CAD software and fundamentals of BIM.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
I	Introduction to Building planning and Bye-laws	1.1	Basics of Building, major components and building types, Requirements of a good building planning.	04	CO1
		1.2	Principles of planning, building Bye-laws: Principles, objectives, necessity, applications		
		1.3	Factors affecting building planning. Detail study on elements of building planning.		
		1.4	Study of sun path diagram, wind rose diagram and sun shading devices.		
		1.5	Calculation of setback distances, carpet area, built-up area and floor space index (FSI).		
II	Principles and Codes of Practices for Planning and Designing of Buildings (Residential and Public buildings)	2.1	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.	16	CO2
		2.2	Classification of buildings: residential –individual bungalows & apartments/flats. public – education (schools, colleges etc.) & health (primary health center, hospital) related building		
		2.3	Study & drawing of SITE PLAN, FOUNDATION PLAN, ROOF PLAN of building; Application 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		
		2.4	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.		
III	Components and Services of a Building	3.1	Staircase (dog -legged) planning, designing & drawing in details.	07	CO3
		3.2	Foundations: stepped footing, isolated sloped footing and combined footing.		
		3.3	Openings: doors and windows.		
		3.4	Types of pitched roof and their suitability (plan and section).		
		3.5	Building services: Water supply, sanitary and electrical layouts.		
IV	Perspective Drawings	4.1	One-point perspective drawing.	04	CO4
		4.2	Two-point perspective drawing.		
V	Architectural Planning & Overview of RERA	5.1	Architectural Planning: introduction and principles.	04	CO5
		5.2	Introduction & Necessity of RERA, Key Features of RERA ACT		
		5.3	Advantages & Disadvantages of the RERA, Carpet definition in RERA		

		5.4	Implementing RERA in Maharashtra State. ODPS (Online development Permission System)		
VI	Computer Aided Drawing (CAD)& BIM	6.1	Details and learning methods of CAD in Civil Engineering structures	04	CO6
		6.2	Study and demonstration of any one of the professional CAD software's		
		6.3	Fundamental of Building Information Modelling (BIM)		

Text 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

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ Question paper format

- Only 4 questions (out of 6) need to be attempted.
- 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.
- Any 3 out of the remaining 5 questions need to be attempted.
- In question paper, weightage of each module maybe approximately proportional to the number of lecture hours assigned to it in the syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083115	Mechanics of Solids Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2083115	Mechanics of Solids Lab	-	-	-	-	25	25	50

Lab Objectives:

The students will be able to learn:

1. To learn stress-strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members.
2. To learn computing the compressive stress in structural members.
3. To learn computing the flexural (bending) stress across the cross section of structural members.
4. To study the behavior of circular shafts under the action of twisting moment
5. To learn the concept of amount of energy absorbed by the material during fracture.
6. To learn the computation of slope and deflection of elastic beams and make use of general theorems used in this computation.

Lab Outcomes:

Upon completion of the course, students shall have ability 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 compression and compute the compressive stress in structural members.
3. Evaluate flexural (bending) stress across the cross section of structural members like beams supported and loaded in different ways.
4. Predict the angle of twist and shear stress developed in torsion.
5. Analyze the material response under the action of impact load.
6. Make the computation of slope and deflection of elastic beams and apply general theorems used in this computation.

Prerequisite:

Basic concepts of materials of strength.

DETAILED SYLLABUS

List of Experiments

Mechanics of Solids (Practical performance)			
Sr. No.	Name of Experiment	Duration (Hours)	LO
1	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	02	LO1
2	1. The Compression Test on Concrete cube or 2. The Compression Test on Timber or 3. The Compression Test on Brick	02	LO2
3	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	02	LO3
4	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	02	LO4
5	1. Charpy impact testing and Energy concept. or 2. Izod impact testing and Energy concept.	02	LO5
6	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)	02	LO6

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			
Sr. No.	Name of Assignment	Duration (Hours)	CO Mapping
1	Stresses and strains in Elastic members, Spherical and Cylindrical shells 1. Prepare a model of Cylindrical vessel or 2. Prepare a model of spherical vessel or 3. Prepare a model of Cylindrical vessel with hemispherical ends or 4. Prepare a chart showing diagrammatic representation of stresses or 5. A set of 5 questions on a module designed by course instructor, or 6. A site visit to a relevant place or 7. A model / chart based on a module or 8. Design of a new experiment based on a module or 9. Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Elongation 'δ' from the	02	CO1

	input values of P,L,A and E) 10. 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	Axial force, shear force and bending moment diagrams for beams and portal frames 1. A set of 5 questions on a module designed by course instructor, or 2. A site visit to a relevant place or 3. A model / chart based on a module or 4. Design of a new experiment based on a module or 5. A chart about scientists and their contribution to the study of ‘Mechanics of Structures’ (Example given at the end of this document) or 6. Prepare a chart showing AFD, SFD & BMD for different symmetric and asymmetric loads on S S beams or 7. Prepare a chart showing AFD, SFD & BMD for different loads on Cantilever beams.	02	CO2
3	Area Moment of Inertia, Bending stresses and Shear stresses in beams 1. Prepare a chart showing MI @ XX, YY & ZZ axes passing through the centroid. or 2. Prepare 3D models of different typical cross sections of beams and find their cross sectional area, I_{xx} , I_{yy} and I_{zz} or 3. Prepare charts showing typical cross sections and variation of Bending stresses and shear stresses across the cross section. or 4. A set of 5 questions on a module designed by course instructor, or 5. A site visit to a relevant place or 6. A model / chart based on a module or 7. Design of a new experiment based on a module or 8. 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) 9. A chart about scientists and their contribution to the study of ‘Mechanics of Structures’ (Example given at the end of this document)	02	CO3
4	Columns 1. Prepare 3D models of different solid and hollow circular cross sections of shafts and find their cross sectional area, I_{xx} , I_{yy} and I_{zz} . or 2. A set of 5 questions on a module designed by course instructor, or 3. 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 ‘ Θ ’ from the input values of T,L,G and J) 4. A site visit to a relevant place or 5. A model / chart based on a module or 6. Design of a new experiment based on a module or 7. A chart about scientists and their contribution to the study of ‘Mechanics of Solids’ (Example given at the end of this document)	02	CO4
5	Torsion of Shafts, Strain Energy 1. Draw typical stress transformation cases of Mohr’s circle using graph paper. or 2. A set of 5 questions on a module designed by course instructor, or 3. A site visit to a relevant place or 4. A model / chart based on a module or 5. Design of a new experiment based on a module or 6. A chart about scientists and their contribution to the study of ‘Mechanics of solids’ (Example given at the end of this document)	02	CO5

6	Slope and Deflection in Beams ; General Theorems 1. Prepare chart to explain General theorems for slope and deflection. or 2. A set of 5 questions on a module designed by course instructor, or 3. A site visit to a relevant place or 4. A model / chart based on a module or 5. Design of a new experiment based on a module or 6. A chart about scientists and their contribution to the study of ‘Mechanics of Solids’ (Example given at the end of this document)	02	CO6
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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. Lehi and A. S. Lehi, S. K. Kataria Publishers, New Delhi
7. Strength of Materials: Dr. V. L. Shah, Structures Publications, Pune

Reference Books:

1. Mechanics of Materials: James, M. and Barry J.; Cengage Learning.
2. Mechanics of Materials: Andrew Pytel and Jaan Kiusalaas, Cengage Learning.
3. Mechanics of Materials: Timoshenko and Gere, Tata McGrawHill, New Delhi.
4. Mechanics of Materials: James M. Gere, Books/Cole.
5. Strength of Materials: G. H. Ryder, Mc-Millan.
6. Mechanics of Materials: E. P. Popov, Prentice Hall India (PHI) Pvt. Ltd.
7. Mechanics of Materials: Pytel and Singer, Mc-GrawHill, New Delhi.
8. Strength of Materials: William A. Nash and Nillanjan Mallick, Mc Graw Hill Book Co. (Schaum's Outline Series)

Appendix -I:

A chart about scientists and their contribution to the study of ‘Mechanics of solids’ be made by students. Contributions of Scientists like Giordano Riccati, Leonhard Euler, Saint Venant, Christian Otto Mohr, William J M Rankine, Carlo Castiglione, Enrico Betti, 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/MaterialTestingLab/MSE313A.pdf
2. [https://home.iitm.ac.in/kramesh/Strength of Materials Laboratory Manual.pdf](https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf)
3. https://www.researchgate.net/publication/338139499_Me_8381-Strength_Of_Materials_Lab_Manual

Assessment:**Term Work:**

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

Laboratory work: 10 Marks

Assignments : 10 Marks

Attendance : 05 Marks

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

End Semester Oral Examination

Oral examination will be based on entire syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083116	Concrete Technology: Materials & Machineries Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2083116	Concrete Technology : Materials & Machineries Lab	-	-	-	-	25	25	50

Lab Objectives:

The students will be able to learn:

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 utilize the knowledge of mix design in the manufacturing of concrete, in the laboratory
5. To test the physical attributes and mechanical strength of timber and tiles used in the construction of various components of the structure.
6. To understand the practical scenario of the commonly used building materials in terms of their availability, cost and significance through market surveys

Lab Outcomes:

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

1. To test physical properties of cement.
2. To test physical properties of aggregates.
3. To test physical properties of concrete and design the concrete mix.
4. To evaluate the effects of admixtures on physical properties of concrete and design the concrete mix.
5. To test physical properties of bricks, timber and tiles.
6. To bridge the gap between theoretical and market practices by market survey.

DETAILED SYLLABUS-

List of Experiments

Sr. No.	List of Experiments	Hrs.	LO Mapping
1	Testing of Cement: fineness, Consistency, setting time, Soundness and strength.	02	LO1
2	Physical Properties of Fine and Coarse Aggregates: Specific gravity, bulk density, Moisture content, Water absorption, Fineness modulus, Silt content and bulking of sand	04	LO2
3.	Effect of w/c ratio on workability (slump cone, compaction factor, V- B test, flow table) and strength of concrete	02	LO3
4	Study of admixtures and their effect on workability and strength of concrete.	02	LO4
5	Tests on burnt clay bricks	02	LO5
6	Test on tiles	02	LO5
7	Compression test on timber (Parallel/ perpendicular to the grains).	02	LO5
8	Market survey on common building materials and construction equipments.	04	LO6

Site Visit/ Industrial Visit:

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

Sr No	List of Assignments / Tutorials	CO Mapping
1	Constituent of Concrete and Mix design	CO1
2	Properties of concrete and testing	CO2
3	Building Materials	CO3
4	Testing Methods, recyclability and Sustainability of Building Materials	CO4
5	Mixers, Vibrators, Lifts and Pumps	CO5

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

References:

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 Neha Jamwal , McGraw Hill Publications.

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.

Practical Work	:	10 Marks
Assignments	:	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
75% - 80%: 03 Marks; 81% - 90%: 04 Marks; 91% onwards: 05 Marks.

Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Vertical – 5

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993511	Entrepreneurship Development	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2993511	Entrepreneurship Development	-	-	-	-	50	-	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce students to entrepreneurship concepts and startup development.
2. To develop business idea generation, validation, and business model preparation.
3. To provide hands-on experience in market research, financial planning, and business pitching.
4. To enhance problem-solving and decision-making skills in entrepreneurial ventures.
5. To familiarize students with government schemes and support systems for entrepreneurs.
6. To develop communication and presentation skills required for business pitching.

Lab Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the fundamental concepts of entrepreneurship and business models.
2. Conduct market research and develop business plans.
3. Utilize financial planning and cost analysis for startups.
4. Apply entrepreneurial skills to identify and solve business challenges.
5. Develop prototypes using open-source software for business operations.
6. Pitch business ideas effectively with structured presentations.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.	01	--
I	Introduction to Entrepreneurship	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	02	LO1
II	Business Idea Generation & Validation	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	04	LO2
III	Business Planning & Strategy	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management	04	LO3
IV	Funding and Legal Framework	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Intellectual Property Rights (IPR) & Patents	05	LO4
V	Marketing & Digital Presence	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models	05	LO5
VI	Business Pitching & Prototype Development	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch. Case Studies of Successful Start-ups	05	LO6

Text Books:

1. "Entrepreneurship Development and Small Business Enterprises" – Poornima M. Charantimath, Pearson, 3rd Edition, 2021.
2. "Innovation and Entrepreneurship" – Peter F. Drucker, Harper Business, Reprint Edition, 2019.
3. "Startup and Entrepreneurship: A Practical Guide" – Rajeev Roy, Oxford University Press, 2022.
4. "Essentials of Entrepreneurship and Small Business Management" – Norman Scarborough, Pearson, 9th Edition, 2021.
5. "The Lean Startup" – Eric Ries, Crown Publishing, 2018.

References:

1. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" – Bill Aulet, MIT Press, 2017.
2. "Zero to One: Notes on Startups, or How to Build the Future" – Peter Thiel, 2014.
3. "The \$100 Startup" – Chris Guillebeau, Crown Business, 2019.
4. "Business Model Generation" – Alexander Osterwalder & Yves Pigneur, Wiley, 2020.
5. "Blue Ocean Strategy" – W. Chan Kim & Renée Mauborgne, Harvard Business Review Press, 2019.

Online Resources:

Website Name
1. Startup India Portal – https://www.startupindia.gov.in
2. MIT OpenCourseWare – Entrepreneurship – https://ocw.mit.edu/courses/sloan-school-of-management/
3. Coursera – Entrepreneurship Specialization – https://www.coursera.org/specializations/entrepreneurship
4. Harvard Business Review – Entrepreneurship Articles – https://hbr.org/topic/entrepreneurship
5. Udemy – Startup & Business Courses – https://www.udemy.com/courses/business/entrepreneurship/

List of Experiments.

Sr No	List of Experiments	Hrs.
01	Business Idea Generation using Mind Mapping.	02
02	Conducting Market Research & Customer Validation.	02
03	Preparing a Business Model Canvas for a Startup Idea.	02
04	Developing a Financial Plan & Break-even Analysis.	02
05	Creating a Website using WordPress/Wix.	02
06	Social Media Marketing Campaign using Open-source Tools.	02
07	Digital Prototyping using Figma/Inkscape.	02
08	Business Pitch Deck Preparation & Presentation.	02
09	Exploring Government Schemes for Startups.	02
10	Legal Compliance & IPR Basics (Case Study).	02

Sr No	List of Assignments / Tutorials	Hrs.
01	a. Write a report on any successful entrepreneur and their startup journey. b. Conduct SWOT analysis for a real-life startup.	02
02	Develop a business idea and create a one-page business plan.	02
03	Conduct market research using surveys & present findings.	02
04	Design a simple logo and branding strategy for a startup.	02
05	Create a financial model and cost estimation for a startup.	02
06	Make a case study report on startup failure analysis.	02

List of Open-Source Software

1. Canva – Designing pitch decks, social media posts, and branding materials.
2. Trello / Asana – Project management for startups.
3. GIMP / Inkscape – Graphic design and logo creation.
4. WordPress / Wix – Website development for startups.
5. OpenCart / PrestaShop – E-commerce website setup.
6. Figma – UI/UX design and prototyping.
7. LibreOffice Calc – Financial planning and budgeting.
8. Google Suite (Docs, Sheets, Slides) – Documentation and presentations.
9. Python (Pandas, Flask, Django) – Data analytics and web application development.
10. MailChimp – Email marketing and customer engagement.

Assessment:

Term Work: Term Work shall consist of at least 08 to 10 practical's based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 50 Marks (Total marks) = 20 Marks (Experiment) + 15 Marks (Assignments) + 5 Marks (Attendance) + 10 Marks (Report)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993512	Environmental Science	--	2*+2	-	--	2*+2	-	2

Course Code	Course Name	Theory					Term work	Practical / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
2993512	Environmental Science	--	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Rationale:

Most of the engineering branches are offspring of applied sciences, and their practices have a significant impact on the environment. Understanding environmental studies is essential for engineers to develop sustainable solutions, minimize ecological footprints, and promote responsible resource management. This course equips students with the knowledge of ecosystems, biodiversity, pollution control, and environmental laws, enabling them to integrate sustainability into engineering practices.

Lab Objectives:

1. To understand the scope, importance, and role of environmental studies in public awareness and health.
2. To study different natural resources, their issues, and sustainable conservation.
3. To understand ecosystem types, structures, and functions.
4. To explore biodiversity, its importance, threats, and conservation.
5. To learn about pollution types, causes, effects, and control measures.
6. To understand environmental challenges, sustainability, and ethics.

Lab Outcomes:

1. Explain the significance of environmental studies and the role of IT in environment and health.
2. Describe resource types, associated problems, and conservation methods.
3. Classify ecosystems and explain their role in ecological balance
4. Analyze biodiversity levels and conservation strategies, especially in India.
5. Explain pollution impacts and suggest preventive measures.
6. Discuss environmental issues and propose sustainable solutions.

DETAILED SYLLABUS:

Unit Name	Topic Name	Topic Description	Hours	LO Mapping
I	The Multidisciplinary Nature of Environmental Studies	Definition, scope and importance. Need for public awareness, Role of Civil & Infrastructure Engineering in environment and human health. Human population and the environment: Population growth, variation among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare	03	LO1
II	Natural Resources	Renewable and non-renewable resources. Natural resources & associated problems: a) Forest resources: b) Water resources: Natural resources & associated problems c) Mineral resources: d) Food resources: e) Energy resources: Role of an individual in conservation of natural resources: f) Equitable use of resources for sustainable lifestyles.	04	LO2
III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries). Case study on various ecosystems in India.	05	LO3
IV	Biodiversity and its Conservation	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	05	LO4
V	Environmental Pollution	Causes, effects and control measures of:	05	

	Definition	a) Air pollution b) Water pollution c) Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Case study on Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention		LO5
VI	Social Issues and Environment	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solution. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Consumerism and waste products. Environment protection act. Public awareness Case study on Environmental Ethics	04	LO6

Textbooks

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021
2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016
3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann, Springer 2008
4. Sustainable IT: Slimming Down and Greening Up Your IT Infrastructure, David F. Linthicum, IBM Press 2009
5. Environmental Modelling: Finding Solutions to Environmental Problems, David L. Murray, Cambridge University Press 2016
6. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, 9th Edition, John Wiley & Sons 2020
7. Business Ethics: Concepts and Cases, Manuel Velasquez, Pearson 2012

Reference Books

1. Environmental Law and Policy in India, Shyam Divan and Armin Rosencranz, 2nd Edition, Oxford University Press 2018
2. The International Handbook of Environmental Laws, David Freestone and Jonathon L. Rubin, Edward Elgar Publishing 2000
3. E-Waste Management: Challenges and Opportunities in Developing Countries, Ruediger Kuehr and Ram K. Jain, Springer 2008
4. The E-Waste Handbook: Managing Electronic Waste, Klaus Hieronymi, Ruediger Kuehr, and Ram K. Jain, Earthscan 2009
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press 1999

Online References:

Sr. No.	Website Name
1.	Centre for Science and Environment (CSE), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)

List of Experiments.

Sr No	List of Experiments	Hrs.
01	Study of Environmental Components and Ecosystems.	2
02	Visit and Report on Solid Waste Management Plant.	2
03	Study of Renewable Energy Sources (Solar, Wind, Biogas).	2
04	Analysis of Air and Water Quality Parameters.	2
05	Study of Local Biodiversity and Conservation Methods.	2
06	Awareness Activity on Environmental Issues.	2
07	Rainwater Harvesting System Design	2
08	Case Study on Environmental Pollution & Control Measures.	2
09	Report on Climate Change Impact and Adaptation.	2
10	Study of Environmental Laws and Acts.	2
11	Study of Disaster Management Techniques.	2
12	Report on Role of IT in Environmental Protection.	2

Sr No	List of Assignments / Tutorials	Hrs.
01	Prepare a report on Renewable and Non-Renewable Resources.	2
02	Write a case study on Ecosystem Types in India	2
03	Write a report on Biodiversity in India.	2
04	Prepare a report on Pollution Types and Control Measures.	2
05	Prepare a report on Environmental Ethics and Sustainability.	2
06	Prepare a case study report on Global Warming and Climate Change.	2
07	Report on Role of an Individual in Environmental Protection.	2
08	Write a report on Disaster Management Techniques.	2
09	Prepare a report on Environmental Laws and Acts in India.	2
10	Case Study on E-waste Management and Recycling Techniques.	2

Assessment :

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term work Journal must include at least 8 to 10 assignments.

Term Work Marks: 50 Marks (Total marks) = 20 Marks (Experiment) + 15 Marks (Assignments) +

5 Marks (Attendance) + 10 Marks (Report)

Vertical – 6

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2083611	Mini Project	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2083611	Mini Project	--	--	--	--	50	25	75

Rationale :

From primitive habitats of early years to modern infrastructure, the civil engineering industry's growth has been need based and society centric. Civil and infrastructure engineers deal with many challenges on daily basis that most people do not have any idea. Mumbai University proposed Mini projects in the syllabus so that the budding civil engineers can connect with the world outside their textbooks and have the idea of future course.

The Mini project should actually provide solution to a typical problem after a brainstorming and in a stipulated period. The competitions ahead will give students the experience of the civil engineering industry's real-world problems and make students brainstorm ideas, learn, and explore the civil engineering industry.

Course Objectives:

1. To recognize societal problems and convert them into a problem statement by understanding of facts and ideas in a group activity.
2. To deal with new problems and situations by applying acquired knowledge, facts, techniques and rules in a different way.
3. To examine and break information into parts, by analyzing motives or causes.
4. To learn evaluating information, validity of ideas and work based on a set of criteria.
5. To create solutions by compiling information together in a novel way.
6. To design model by combining elements in a new pattern or proposing new solutions.

Course Outcomes:

Learner will be able to...

1. Identify problems based on societal/research needs and formulate a solution strategy.
2. Apply fundamentals to develop solutions to solve societal problems in a group.
3. Analyze the specific need, formulate the problem and deduce the interdisciplinary approaches, software based solutions and computer applications.
4. Develop systematic flow chart, evaluate inter disciplinary practices, devices, available software, estimate and recommend possible solutions.
5. Draw the proper inferences from available results through theoretical/experimental/simulations and assemble physical systems.
6. Create devises or design a working model for a particular application

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 shall 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 : 20
- Marks awarded by review committee : 20
- Quality of Project report : 10

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

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 finalization 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. Feasibility of proposed problem solutions and selection of best solution
4. Cost effectiveness
5. Societal impact
6. Effective use of skill sets
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Guidelines for Assessment 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 / non-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.

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

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