S.E.
Civil
Engineering
Scheme

Program Structure for Second Year of Civil 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
2093111	Applied mathematics for Civil Engineering-I	2	--	1	2	1	--	3
2093112	Fluid Mechanics	3	--	--	3	--	--	3
2093113	Building Materials and Concrete Technology	3	--	--	3	--	--	3
2093114	Mechanics of Structures	3	--	--	3	--	--	3
2093311	Open Elective	2#	--	--	2	--	--	2
2093115	Fluid Mechanics Lab	--	2	--	--	--	1	1
2093116	Building Materials and Concrete Technology Lab	--	2	--	--	--	1	1
2093611	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)					
2093111	Applied mathematics for Civil Engineering-I	20	20	40	60	2	25	--	125
2093112	Fluid Mechanics	20	20	40	60	2	--	--	100
2093113	Building Materials and Concrete Technology	20	20	40	60	2	--	--	100
2093114	Mechanics of Structures	20	20	40	60	2	--	--	100
2093311	Open Elective	20	20	40	60	2	--	--	100
2093115	Fluid Mechanics Lab	--	--	--	--	--	25	25	50
2093116	Building Materials and Concrete Technology Lab	--	--	--	--	--	25	25	50
2093611	Mini Project	--	--	--	--	--	50	25	75
2993511	Entrepreneurship Development	--	--	--	--	--	50	--	50
2993512	Environmental Science	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**225**	**75**	**800**

Program Structure for Second Year of Civil Engineering

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER IV

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2094111	Applied mathematics for Civil Engineering-II	2	--	1	2	1	–	3
2094112	Surveying	3	–	--	3	–	–	3
2094113	Structural Analysis	3	--	--	3	–	–	3
2094211	Multidisciplinary minor	3	–	--	3	–	–	3
2094311	Open Elective	2#	–	--	2	–	–	2
2094114	Surveying Lab	–	2	–	–	–	1	1
2094115	Structural Analysis Lab	–	2	–	–	–	1	1
2094212	Multidisciplinary minor Lab	–	2	–	–	–	1	1
2094411	Computer Aided Architectural Planning, and Building Design (Capstone Mini-Project)	–	4	–	–	–	2	2
2994511	Business Model Development	–	2*+2	–	–	–	2	2
2994512	Design Thinking	–	2*+2	–	–	–	2	2
Total		**13**	**18**	**01**	**13**	**01**	**09**	**23**

* 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

Students must select 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)					
2094111	Applied mathematics for Civil Engineering-II	20	20	40	60	2	25	--	125
2094112	Surveying	20	20	40	60	2	--	--	100
2094113	Structural Analysis	20	20	40	60	2	--	--	100
2094211	Multidisciplinary minor	20	20	40	60	2	--	--	100
2094311	Open Elective	20	20	40	60	2	--	--	100
2094114	Surveying Lab	--	--	--	--	--	25	25	50
2094115	Structural Analysis Lab	--	--	--	--	--	25	25	50
2094212	Multidisciplinary minor Lab	--	--	--	--	--	25	--	25
2094411	Computer Aided Architectural Planning, and Building Design (Capstone Mini-Project)	--	--	--	--	--	50	25	75
2994511	Business Model Development	--	--	--	--	--	50	--	50
2994512	Design Thinking	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**250**	**75**	**825**

Sem. - III

Vertical – 1
Major

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093111	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)			
		Test 1	Test 2	Total					
2093111	Applied Mathematics for Civil Engineering-I	20	20	40	60	02	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:

On completion of the course students 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	Course Module / Contents		Hours	CO Mapping
1	**Laplace Transform**		05	CO1
	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.			
2	**Inverse Laplace Transform**		04	CO2
	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.			
3	**Fourier Series**		05	CO3
	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.			
4	**Complex Variables**		04	CO4
	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.			
5	**Matrices**		04	CO5
	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.			
6	**Numerical methods for PDE**		04	CO6
	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		

Text Books:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
3. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
2. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
3. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
4. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
5. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

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 Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

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 the 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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093112	Fluid Mechanics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2093112	Fluid Mechanics	20	20	40	60	2	--	--	100

Rationale:

The **Fluid Mechanics** course provides Civil Engineering students with a comprehensive understanding of fluid properties, flow dynamics, and pressure measurement, essential for analyzing and designing fluid systems in civil infrastructure. Through this course, students gain the ability to apply key fluid laws, such as Bernoulli's and continuity equations, and understand flow behaviors in pipes, preparing them for practical engineering challenges in fluid flow and loss analysis

Course Objectives:

The students will be able to learn:

1. The properties of fluids, units and dimensions.
2. Pressure measurement, manometer, and Hydrostatic forces acting on different surfaces, Principle of buoyancy.
3. Kinematic and Dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations.
4. Importance of fluid flow and various discharge measuring devices used in pipes and channels.
5. The knowledge of closed conduit flows, determine various losses through pipes.
6. The concept of Laminar flow and Turbulent flow through pipes.

Course Outcomes:

On completion of the course students will be able to:

1. Describe various properties of fluids and types of flow.
2. Determine the pressure difference in pipe flows, hydrostatic forces on surfaces and buoyancy phenomenon.
3. Application of Continuity equation and Bernoulli's theorem to determine velocity and discharge.
4. Apply the working concepts of various devices to measure the flow through pipes and channels
5. Analyze flow through pipes, various losses through pipes and power transmission through nozzle.
6. Explain the concept of Laminar and turbulent flow, velocity distribution through circular pipes and hydrodynamically smooth and rough boundaries.

Detailed Syllabus

Pre Requisite:

Mathematics: Differential and integral equations.
Physics: Kinematics and dynamics.
Thermodynamics: Pressure

Module	Course Module / Contents		Hours	CO Mapping
1	**Properties of Fluids**		05	CO1
	1.1	Mass density, weight density, specific gravity, specific volume.		
	1.2	Viscosity (horizontal and inclined plane condition), compressibility and elasticity.		
	1.3	Surface tension, capillarity, vapor pressure.		
	1.4	Types of fluids.		
2	**Fluid Statics**		07	CO2
	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 U tube differential manometers having heavier fluids.		
	2.2	**Hydrostatic force on surfaces:** Total pressure and center of pressure, total pressure on horizontal plane surface, vertical plane surface, Inclined plane surface, center of pressure for vertical plane surface and for inclined plane surface.		
	2.3	**Buoyancy and floatation:** Archimedes principle, Buoyancy, Meta-Centre, Experimental method to find metacentric height.		
3	**Fluid Kinematics and Dynamics**		06	CO3
	3.1	**Fluid Kinematics :** Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles.		
	3.2	**Fluid Dynamics :** 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 real fluid, practical applications of Bernoulli's Equation.		
4	**Flow Measurement**		07	CO4
	4.1	**Venturimeter and Orificemeter** Derivation for discharge through Venturimeter and applications. Introduction to Orifice meter.		

	4.2	**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, Introduction to Mouthpieces		
	4.3	**Notches and weirs :** Classification of notches, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, Introduction to weirs.		
5	**Flow Through Pipe**		09	CO5
	5.1	Loss of head through pipes, Darcy-Weisbach equation, Major and minor losses. Hydraulic gradient line and Total energy gradient line		
	5.2	Pipes in series, equivalent pipes, pipes in parallel, siphon. Water hammer phenomenon, Power transmission through nozzle.		
6	**Introduction to Laminar and Turbulent Flow**		05	CO6
	6.1	**Laminar Flow :** Reynolds experiment, critical velocity, laminar flow through circular pipes.		
	6.2	**Turbulent Flow :** Prandtl's mixing length Theory, Hydro dynamically smooth and rough boundaries, velocity distribution in smooth and rough pipes.		

Text Books:

1. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
2. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi.
3. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt.Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
5. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.

References:

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

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/103/105103192/#
2.	http://nptel.ac.in/noc

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

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 the 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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093113	**Building Materials and Concrete Technology**	**3**	**-**	**-**	**3**	**-**	**-**	**3**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2093113	**Building Materials and Concrete Technology**	20	20	40	60	2	--	--	100

Rationale:

Materials are fundamental components or substances used in constructing buildings. However, materials alone cannot become structures without appropriate construction methods. This subject imparts essential knowledge about the properties and applications of various building materials, guiding their selection, mix proportioning, mixing, placing, compacting, and curing processes. It aims to provide students with a comprehensive understanding of the facts, concepts, principles, and procedures related to building materials and concrete technology, enabling them to ensure effective quality control during building construction.

Course Objectives:

1. To recognize and evaluate high-quality construction materials based on their durability, warranties, availability, and overall suitability for construction work.
2. To explore the manufacturing processes, properties, and applications of building materials such as stone, brick, glass, timber, along with surface treatment materials like paints and varnishes, to develop a comprehensive understanding of their uses.
3. To gain a detailed understanding of the properties and significance of various materials used in concrete manufacturing.
4. To study the characteristics of concrete in both fresh and hardened states, including the tests conducted to assess these properties and their importance.
5. To equip students with a comprehensive understanding of concrete mix design principles, methodologies as per Indian Standards, and the importance of proper curing techniques for achieving desired concrete properties.
6. To enable students to understand the principles and practices associated with ready-mixed concrete, special concreting techniques for extreme weather conditions and mass structures, and the fundamental concepts of non-destructive testing methods for concrete evaluation

Course Outcomes:

On completion of the course students will be able to:

1. To evaluate and classify building materials, including stones, bricks, blocks, glass, and timber, based on their properties and manufacturing processes, ensuring the selection of economical and durable options for construction.
2. To understand mortar types, masonry techniques, finishes, and methods for damp proofing, waterproofing, and termite proofing in construction.

3. To understand the classification, properties, and influence of aggregates, cement, lime, admixtures, and water on concrete, including their chemical composition, applications, and compatibility in concrete mix design.
4. To understand concrete grades, manufacturing, workability, vibration techniques, and durability tests.
5. To Design concrete mixes for specified compressive and flexural strengths following the guidelines of IS: 10262 and IS: 456. And calculate the constituents based on proportion with identification of methods for curing concrete.
6. To apply knowledge regarding the ready-mixed concrete practices, specialized techniques for extreme conditions and mass structures, and non-destructive testing methodologies.

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	**Building Materials-1**		06	CO1
	1.1	**Introduction to building materials:** Introduction, role of material in construction, classification of materials, economical and durable.		
	1.2	**Stones:** Classification and properties of building stones, relation to their structural requirements, quarrying, dressing, seasoning and preservative treatments.		
	1.3	**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.		
	1.4	**Glass:** Properties, types, uses.		
	1.5	**Timber:** Types of natural wood and artificial wood, preservative treatments, defects in timber, wood products and wood composites.		
2	**Building Materials-2**		06	CO2
	2.1	**Mortar:** Types, ingredients, proportions and suitability.		
	2.2	Masonry Construction and Masonry Finishes of Stone: Classification and bonding of stone. Masonry finishes - pointing, plastering and painting		
	2.3	Masonry Construction and Masonry Finishes of Bricks: Classification and bonding of Bricks.		
	2.4	Damp proofing, water proofing materials and Termite proofing.		
3	**Constituents of Concrete**		06	CO3
	3.1	**Fine and Coarse Aggregates:** Classification, physical and mechanical properties and 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. Different types of cement**:** Chemical composition, properties as per relevant IS codes and their applications.		
	3.3	**Lime:** Types and their usages.		
	3.4	**Admixtures:** Definition and purposes, types of mineral and chemical admixtures.		
4	**Concrete**		05	CO4
	4.1	Grades, manufacturing process, preparation of batch report, W/C ratio		
	4.2	Properties of fresh and hardened concrete, factors affecting of workability, vibration of concrete, Types of 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**		09	CO5
	5.1	Definition and objectives, Types of mix as per IS: 456.		
	5.2	Mix design for compressive strength and flexural strength in accordance with IS 10262 and IS 456.		
	5.3	Curing of concrete, purpose of curing, Methods of Curing of concrete		
	5.4	Calculation of ingredients of concrete for batching as per concrete mix proportions for different grades.		
6	**Special Concreting and Non-Destructive Testing**		06	CO6
	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	Hot weather concreting, Cold weather concreting and Mass concreting.		
	6.3	**Non-Destructive Testing:** Need, application and limitation, Schmidt Rebound hammer test, Ultrasonic Pulse Velocity test.		

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 Pub., 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, New Delhi.
4. Engineering Materials: *P. Surendra Singh,* Vani Education Books, New Delhi.
5. Building Materials (Products, Properties and Systems): *M.L. Gambhir and Neha Jamwal,* Mc-Graw Hill Publications.
6. Properties of concrete: Neville, Isaac Pitman, London.
7. NPTEL Lecture series on Building Materials and Concrete Technology.

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

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 the 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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093114	Mechanics of Structures	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2093114	Mechanics of Structures	20	20	40	60	2	--	--	100

Rationale:

Civil Engineering structures are constructed with using engineering materials such as steel, concrete, timber and other metals or their composites. During their lifetime, the structures are subjected to loads/force systems which create axial forces, shear forces, bending moments, torsion and their combinations. Different materials respond to these by getting deformed and having induced stresses. The design and analysis of structures involves determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads. In this course, learners will explore the response and behaviour of material under different force systems. The understanding of 'Mechanics of Solids' provide essential theoretical background required for the subjects of Structural Analysis and Structural Design.

Course Objectives:

1. To learn stress - strain relationship and resultant deformation of elastic members and thin cylinders subjected to forces.
2. To represent graphically the axial force, shear force and bending moment distribution in statically determinate beams and portal frames.
3. To compute area moment of inertia and to analyse flexural stress and shear stress in structural members.
4. To study circular shafts, direct and bending stresses in columns and centrally and eccentrically loaded columns.
5. To determine principal planes and principal stresses and strain energy in elastic members.
6. To learn the computation of slope and deflection of elastic beams.

Course Outcomes:

On completion of the course students will be able to:

1. Evaluate stress - strain behaviour 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 flexure.
4. Predict the shear stress developed in torsion and direct and bending stresses developed in the cross section of centrally and eccentrically loaded columns.
5. Evaluate the principal stresses using analytical and graphical method and to calculate strain energy stored in members due to elastic deformation.
6. Evaluate internal forces in truss and three hinged arches

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	**Stresses and Strains in Elastic members**		06	CO1
	1.1	Types of Stresses and Strains, stress-strain curve, different types of elastic moduli and relationships between them. Three-dimensional stress and strain, Poisson's ratio, factor of safety.		
	1.2	Bars of varying sections, composite sections, temperature stresses.		
2	**Analysis of beams and portal frames**		08	CO2
	2.1	Concept of Axial Force, Shear Force and Bending Moment. AF, SF and BM Diagrams for statically determinate beams with and without internal hinges.		
	2.2	AF, SF and BM Diagrams for statically determinate three-member Portal frames with or without internal hinges.		
3	**Area moment of inertia, Bending and Shear stresses in beams**		09	CO3
	3.1	Area moment of inertia, Bending and Shear stresses in beams		
	3.2	Area moment of inertia, Bending and Shear stresses in beams		
	3.3	Area moment of inertia, Bending and Shear stresses in beams		
4	**Torsion in Shafts and Stresses in Columns**		07	CO4
	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.		
	4.2	Direct and bending stresses in columns, Core of section.		
	4.3	Buckling of Columns, Members subjected to axial loading, concept of buckling, effective length, different support conditions, Euler's and Rankine's formula.		
5	**Principal planes and stresses**		04	CO5
	5.1	General equation for transformation of stress, principal planes and principal stresses, maximum shear stress		
	5.2	Stress determination by analytical and graphical method using Mohr's circle.		
6	**Trusses and three hinged parabolic arches**		05	CO6
	6.1	Trusses: Analysis of perfect coplanar trusses by method of joint and method of section.		
	6.2	Three hinged arches: Determination of normal thrust, radial shear and bending moment for symmetrical & unsymmetrical parabolic three hinged arches.		

Text Books:

1. Strength of Materials: *S. Ramamrutham*, Dhanpat Rai 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:

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 McGraw Hill, 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-Graw Hill, New Delhi.
8. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co. (Schaum's Outline Series) 1.

Online References:

Sr. No.	Website Name
1.	**NPTEL (National Program on Technology Enhanced Learning)** Website: https://nptel.ac.in/ Relevant Courses

Assessment:

Internal Continuous Assessment: 40%

Internal Assessment Test (IAT) for 20 marks each:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

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 the 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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093115	Fluid Mechanics lab	--	2	-	--	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Total				
2093115	Fluid Mechanics lab	--	--	--	--	25	25	50

Lab Objectives:

The students will be able to learn:

1. The basic fluid mechanics concept.
2. Determine the metacentric height.
3. Verify Bernoulli's theorem experimentally and its application to fluid flow.
4. Experimentally determine discharge coefficients for flow measuring devices like venturimeter, orifice meter, notches, weirs orifices etc.
5. Estimate the head losses in pipe flow.
6. Observe and analyze flow regimes, distinguishing between laminar and turbulent flow using Reynold's apparatus.

Lab Outcomes:

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

1. Compute the viscosity of fluid.
2. Calculate the metacentric height.
3. Apply the concept of Bernoulli's theorem to fluid flow systems.
4. Determine coefficient of discharge of various flow measuring devices.
5. Calculate the head losses in pipes.
6. Classify flow as laminar or turbulent based on Reynold's experiment.

Text Books:

1. Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company
2. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.
3. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, 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

References:

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.

Online Resources:

Sr. No.	Website Name
1.	https://fm-nitk.vlabs.ac.in/List%20of%20experiments.html
2.	https://me.iitp.ac.in/Virtual-Fluid-Laboratory/

Detailed syllabus

Sr No	List of Experiments (Any 6)	Hrs	LO Mapping
1	Determination of viscosity of fluid.	02	LO1
2	Determination of the Metacentric height of a floating body.	02	LO2
3	Investigating the validity of the Bernoulli equation applied to a steady flow of water through a tapered duct.	02	LO3
4	Determination of coefficient of discharge of Venturimeter.	02	LO4
5	Determination of coefficient of discharge of Orifice meter.	02	LO4
6	Determination of coefficient of discharge of Notches (Rectangular or Triangular notch).	02	LO4
7	Determination of coefficient of discharge of weirs (Broad Crested weir or Ogee weir).	02	LO4
8	Determination of coefficient of discharge of orifice or mouthpiece.	02	LO4
9	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)	02	LO5
10	To determine different losses in pipe fittings (Estimation of the minor losses)	02	LO5
11	Study of different types of flow using Reynold's apparatus.	02	LO6

Sr No	List of Assignments / Tutorials	LO Mapping
1	Introduction to Fluid properties and types of fluid.	LO1
2	Pressure measurement and hydrostatic forces on surfaces.	LO2
3	Fluid Kinematics and Bernoulli's equation.	LO3
4	Flow measuring devices.	LO4
5	Flow through pipe and power transmitted through nozzle.	LO5
6	Types of flow: Laminar and Turbulent flow.	LO6

Assessment:
Term Work: Term Work shall consist of at least 06 practicals based on the experiment list. Also, Term work Journal must include 06 assignments as listed.
Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)
Practical& Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2093116	Building Materials and Concrete Technology Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Total				
2093116	Building Materials and Concrete Technology Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To evaluate the physical and mechanical properties of materials such as cement and aggregates used in concrete production.
2. To assess the physical and mechanical strength of burnt clay bricks for use in construction.
3. To analyze the properties of fresh and hardened concrete, with and without the inclusion of admixtures.
4. To explore various non-destructive testing methods used in the laboratory or on-site to assess the durability and strength of existing concrete structures.
5. To apply mix design principles in the laboratory for the production of concrete.
6. To evaluate the physical properties and mechanical strength of timber and tiles used in structural components.
7. To gain insights into the practical aspects of commonly used building materials through market surveys, focusing on their availability, cost, and significance.

Lab Outcomes: Student will be able to

1. Evaluate the physical and mechanical properties of materials like cement, aggregates and metal ensuring their suitability for construction.
2. Assess the physical and mechanical strength of burnt clay bricks, tiles and timber for their application in construction.
3. Apply concrete mix design principles to produce concrete in the laboratory, optimizing mix proportions for different applications.
4. Analyze the properties of fresh and hardened concrete, both with and without admixtures, and their impact on concrete performance.
5. Use non-destructive testing methods to evaluate the durability and strength of existing concrete structures.
6. Gain practical insights into commonly used building materials through market surveys, considering factors such as availability, cost, and application.

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 Pub., 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.

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, New Delhi.
4. Engineering Materials: P. Surendra Singh, Vani Education Books, New Delhi.
5. Building Materials (Products, Properties and Systems): M.L. Gambhir and Neha Jamwal, Mc-Graw Hill Publications.
6. Properties of concrete: Neville, Isaac Pitman, London.
7. NPTEL Lecture series on Building Materials and Concrete Technology.

Online Resources:

Sr. No.	Website Name
1.	**NPTEL (National Program on Technology Enhanced Learning)** Website: https://nptel.ac.in/ Relevant Courses

List of Experiments.

Sr. No.	List of Experiments (Any Ten)	Hrs	LO
01	Physical properties of OPC: Physical test, Fineness, Standard consistency, Soundness, Setting time, Compressive strength.	**02**	**LO1**
02	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**	**LO1**
03	Tests on burnt clay bricks and tiles	**02**	**LO2**
04	Concrete mix design in the laboratory	**02**	**LO3**
05	Effect of w/c ratio and admixtures on workability (slump cone, compaction factor, V-B test, flow table) and strength of concrete.	**02**	**LO4**
06	Non-destructive testing of concrete: Rebound hammer and ultrasonic pulse velocity	**02**	**LO5**
07	The Tension Test on mild steel/TOR steel bars.	**02**	**LO1**
08	Market survey on common building materials.	**02**	**LO6**
09	Compression test on timber (Parallel/ perpendicular to the grains). (optional)	**02**	**LO2**
10	Physical properties of OPC: Physical test, Fineness, Standard consistency, Soundness, Setting time, Compressive strength.	**02**	**LO1**

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. Market Survey should be conducted in group.

Assessment:
Term Work: The term work shall consist of:

- Report of experiments.
- 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 a greater number of experiments and site/ industrial visits.

Term Work Marks: 25 Marks (Total marks)

Individual practical performance	**:**	05 Marks
Reports of experiment	**:**	05 Marks
Assignments including market survey	**:**	05 Marks
Site Visit/Industrial visit	**:**	05 Marks
Attendance	**:**	05 Marks

Practical& Oral Exam: 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.

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			
		Test1	Test 2	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

Prerequisite:

Fundamentals of communication and leadership skills.

Module	Course Module / Contents		Hours	LO Mapping
1	**Introduction to Entrepreneurship**		02	LO1
	1.1	Definition, Characteristics, and Types of Entrepreneurs.		
	1.2	Entrepreneurial Motivation and Traits.		
	1.3	Start-up Ecosystem in India.		
	1.4	Challenges in Entrepreneurship		

2	**Business Idea Generation & Validation**		04	LO2
	2.1	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping.		
	2.2	Business Model Canvas (BMC).		
	2.3	Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.		
3	**Business Planning & Strategy**		04	LO3
	3.1	Writing a Business Plan.		
	3.2	SWOT Analysis and Competitive Analysis.		
	3.3	Financial Planning and Budgeting.		
	3.4	Risk Assessment and Management		
4	**Funding and Legal Framework**		05	LO4
	4.1	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital.		
	4.2	Government Schemes & Start-up India Initiatives		
	4.3	Business Registration & Legal Formalities.		
	4.4	Intellectual Property Rights (IPR) & Patents		
5	**Marketing & Digital Presence**		05	LO5
	5.1	Branding and Digital Marketing. Social Media Marketing & SEO.		
	5.2	Customer Relationship Management (CRM). E-commerce & Online Business Models		
6	**Business Pitching & Prototype Development**		05	LO6
	6.1	Pitch Deck Preparation & Presentation Techniques.		
	6.2	Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch. Case Studies of Successful Start-ups		

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 practicals 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	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	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:

Module	Course Module / Contents		Hours	CO Mapping
1	**The Multidisciplinary Nature of Environmental Studies**		03	LO1
	1.1	Definition, scope and importance. Need for public awareness, Role of information technology in environment and human health.		

	1.2	Human population and the environment: Population growth, variation among nations.		
	1.3	Population Explosion- family welfare program. Environment and human health Women and child welfare		
2	**Natural Resources**		04	LO2
	2.1	Renewable and non-renewable resources.		
	2.2	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: Equitable use of resources for sustainable lifestyles.		
3	**Ecosystems**		05	LO3
	3.1	Concepts of an ecosystem. Introduction, types, characteristic features.		
	3.2	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).		
	3.3	Case study on various ecosystems in India.		
4	**Biodiversity and its Conservation**		05	LO4
	4.1	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity		
	4.2	Consumptive Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation		
	4.3	Case study on Bio diversity in India.		
5	**Environmental Pollution Definition**		05	LO5
	5.1	Causes, effects and control measures of: a) Air pollution b) Water pollution c) Soil pollution.		
	5.2	Solid waste management: Causes, effect and control measures of urban and industrial wastes.		
	5.3	Role of an individual in prevention of pollution, Case study on Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention.		

6	**Social Issues and Environment**		04	LO6
	6.1	From unsustainable to sustainable development. Urban problems related to energy.		
	6.2	Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solution.		
	6.3	Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Consumerism and waste products.		
	6.4	Environment protection act. Public awareness. Case study on Environmental Ethics.		

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 Press1999

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 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
2093611	Mini Project	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2093611	Mini Project	--	--	--	--	50	25	75

Objectives:

1. To identify, analyze, and clearly define a relevant engineering problem within a chosen domain.
2. To demonstrate the ability to conduct a comprehensive literature review, and identifying potential solutions or research gaps.
3. To apply basic engineering principles and fundamentals, culminating in the design and implementation of a working prototype, model, or conceptual framework.
4. To collaborate within a group setting, demonstrating teamwork skills, in the planning, execution, and presentation of their work.
5. To effectively communicate their project findings through a professionally prepared poster or model, as well as a clear and concise presentation.
6. To inculcate self-directed learning by independently researching and developing critical thinking skills through problem analysis, solution evaluation, and reflection on the project process.

Outcomes:

Students will be able to

1. Apply basic engineering principles and fundamentals to develop and evaluate defined engineering problem.
2. Analyze a chosen engineering problem, breaking it down into its constituent parts, and justifying its significance and scope.
3. Evaluate existing research and knowledge related to their chosen problem, identifying potential solutions or research gaps through a comprehensive literature review.
4. Create a working prototype, model, or conceptual framework that demonstrates a potential solution to the identified engineering problem.
5. Collaborate effectively within a group setting, demonstrating teamwork skills, communication, and shared responsibility in the planning, execution, and presentation.
6. Communicate project findings effectively through a professionally prepared poster or model, as well as a clear and concise presentation, demonstrating their understanding of the problem, solution, and project outcomes.

Sr. No.	Stages of Project	Hrs	LO
01	A Problem Definition Report outlining the chosen engineering problem, its context, relevant engineering principles, defined objectives, constraints, and preliminary conceptual sketches.	4	LO1
02	A Problem Analysis and Justification Report detailing the breakdown of the problem, stakeholder analysis, preliminary data, justification of significance, defined project scope, and a clear problem statement.	8	LO2
03	A Comprehensive Literature Review Report summarizing existing knowledge, identifying potential solutions and research gaps, and demonstrating how the review informs the project's direction.	12	LO3
04	A Working Prototype, Physical Model, or Detailed Conceptual Framework along with a Development and Testing Report outlining the design process, functionality, and preliminary evaluation.	12	LO4
05	Evidence of effective teamwork, such as meeting minutes, shared task management documents, individual contribution logs, and a team self-assessment of collaboration and communication.	8	LO5
06	A professionally prepared Poster or Model, a clear and concise Presentation (slides or script), and a comprehensive Final Project Report documenting all stages of the project.	8	LO6

Suggested Topics for Mini Project:

Below are examples of potential mini-project topics. Students are encouraged to explore other relevant areas; However, all project proposals must be approved by the internal faculty panel. Students shall be encouraged to perform mini project on multidisciplinary areas also.

Sr. No	Topic
1	Identify any one key civil engineering projects (roads, bridges, buildings, water supply systems). Evaluate their impact on the community and suggest potential improvements.
2	Create a model of different brick bonding patterns (e.g., English bond, Flemish bond) and analyze their strengths and weaknesses. Prepare a report and document the results.
3	Create a model of a masonry wall using different materials (e.g., bricks, mortar) and test its strength and stability. Prepare a report and document the results.
4	Conduct a comparative analysis of different types of cement (OPC, PPC, slag cement). Research their chemical composition, properties, and suitability for various applications. Perform basic tests on cement samples and document the results.
5	Design a concrete mix for a specific application (e.g., a small slab or beam). Prepare concrete samples and conduct tests for compressive strength and workability. Analyze the results and discuss the factors affecting concrete quality.
6	Create a model of a concrete beam using different materials (e.g., cement, sand, aggregate) and test its strength. Prepare a report and document the results.
7	Create a model of a column with different end conditions (e.g., fixed, pinned) and analyze its buckling and stress.
8	Create a model of a beam with different loads (e.g., point load, uniformly distributed load) and analyze its deflection and stress.

Sr. No	Topic
9	Research and present information regarding sustainable building materials. Find local sources of sustainable materials.
10	Create a model of a roofing system using different materials (e.g., tiles, asphalt) and analyze its waterproofing and durability.
11	Create a model of a simple truss using different materials (e.g., wood, steel) and analyze its stability and strength.
12	Research regarding modern surveying tools such as GPS, and total stations. Apply the same on small project.
13	Investigate the local water resources (rivers, lakes, groundwater). Analyze the water quality and availability. Propose solutions for water conservation and sustainable management.
14	Design a water supply system for a small community or building. Calculate water demand and determine the required pipe sizes and storage capacity. Research local water quality standards and include filtration recommendations.
15	Conduct a traffic flow analysis at a local intersection or road segment. Identify traffic congestion problems and propose solutions for improvement. Create a traffic management plan.
16	Research and analyze the mass transportation system in your city or region. Evaluate its efficiency, accessibility, and environmental impact. Suggest improvements for sustainable transportation.
17	Create a report that describes the local transportation infrastructure. Include information regarding roads, railways, and airports. Include future plans for the local area.
18	Application of recent modern tools including Artificial Intelligence and Machine Learning techniques for Civil Engineering Domain Problems

Guidelines for the 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 shall convert their understanding into model or poster as may be suitable, based on nature of study, using various components of their domain areas.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Project

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

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 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.

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. Full functioning of working model or Poster as per stated requirements
4. Effective use of skill sets
5. Effective use of standard engineering norms
6. Contribution of an individual's as member or leader
7. Clarity in written and oral communication.