AC –

Item No. –

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4, 5 & 6		
Name of the Programme – B.E. (Civil Engineering)		
Faulty of Engineering		
Board of Studies in Civil Engineering		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in Engineering- Civil Engineering.
Semester		III & IV
From the Academic Year		2025-26

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:**_____	**B.E. (Civil Engineering)**
2	**Exit Degree**	**U.G. Diploma in Engineering- Civil Engineering.**
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:** _____	**Attached herewith**
6	**Semesters**	**Sem. III & IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Sd/-	**Sd/-**	**Sd/-**
Dr. Rajendra B. Magar	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-Civil Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**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 Engineering Branch of 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 Engineering in 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 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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Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Under Graduate Diploma in Engineering- Civil Engineering.

Credit Structure (Sem. III & IV)

	R: _____C								
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:_____D									
	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 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.

Sem. - IV

Vertical – 1
Major

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2094111	Applied Mathematics for Civil Engineering-II	2	-	1	2	-	1	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					
2094111	Applied Mathematics for Civil Engineering-II	20	20	40	60	2	--	--	100

Pre-requisite:

- Applied Mathematics-I,
- Applied Mathematics-II,
- Applied Mathematics for Civil Engineering-I.

Course Objectives:

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

Course Outcomes:

On completion of the course students will be able to:

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

Detailed Syllabus

Module	Course Module / Contents		Hrs	CO
1	**Vector Calculus**		05	CO1
	1.1	Solenoidal and irrotational (conservative) vector fields.		
	1.2	Line integrals – definition and problems.		
	1.3	Green's theorem (without proof) in a plane, Stokes' theorem (without Proof) only evaluation problems, Gauss' Divergence theorem (without proof) and problems (only evaluation).		
	Self- Learning Topics: Identities connecting Gradient, Divergence and Curl, Angle between surfaces. Verifications of Green's theorem, Stoke's theorem & Gauss- Divergence theorem, related identities & deductions.			
2	**Complex Integration**		05	CO2
	2.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).		
	2.2	Taylor's and Laurent's series (without proof).		
	2.3	Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof)		
	Self-learning Topics: Application of Residue Theorem to evaluate real integrations.			
3	**Statistical Techniques**		04	CO3
	3.1	Karl Pearson's Coefficient of correlation (r) and related concepts with problem.		
	3.2	Spearman's Rank correlation coefficient (R) (Repeated & non-repeated ranks problems)		
	3.3	Lines of regression.		
	Self-learning Topics: Covariance, fitting of exponential curve, Fitting of first and second degree curves.			
4	**Probability Theory**		04	CO4
	4.1	Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables,		
	4.2	Expectation, Variance, Co-variance.		
	4.3	Moments, Moment generating functions, (Four moments about the origin & about the mean).		
	Self- learning Topics: Conditional probability, Total Probability and Baye's Theorem. Properties variance and covariance.			
5	**Probability Distribution and Sampling Theory-I**		05	CO5
	5.1	Probability Distribution: Poisson and Normal distribution		
	5.2	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.		

Module	Course Module / Contents		Hrs	CO
	5.3	Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)		
	Self -learning Topics: Test of significance of large samples, Proportion test, Survey based project.			
6	**Sampling theory-II**		04	CO6
	6.1	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table).		
	6.2	Analysis of variance: F-test (significant difference between variances of two samples)		
	Self- learning Topics: ANOVA**:** One way classification, Two-way classification (short- cut method), Yate's Correction.			

Text Books:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,

References:

1. Vector Analysis, Murray R. Spiegel, Schaum Series
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation
3. Probability Statistics and Random Processes, T. Veerarajan, Mc. GrawHilleducation.

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
2094112	Surveying	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					
2094112	Surveying	20	20	40	60	2	--	--	100

Rationale:

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

Course Objectives:

The Student will be able to learn:

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

Course Outcomes:

On completion of the course students will be able to:

1. Apply the principles of surveying and field procedures for linear and angular measurements including legal aspects.
2. Use various methods for levelling and contouring.
3. Calculate precise angles of traverse and balancing using various methods
4. Explain the advancements in surveying instruments and methods
5. Calculate the area of land and volume of earthwork
6. Calculate the data require for setting out simple circular curves

Detailed Syllabus

Module	Course Module / Contents		Hours	CO
1	**Introduction**		**6**	**CO1**
	1.1	Introduction to Survey of India Department; Department of Registration and Stamps, Maharashtra. Role of revenue department in maintaining survey records, introduction to local survey terminologies like tehsildar, 7/12 utara, namuna 8, etc.		
	1.2	Chaining, Ranging and offsetting: Definitions, Principles, Instruments required, Obstacles, conventional signs and symbols.		
	1.3	Bearings – Different types, dip, declination and local attraction, compass traversing		
2	**Levelling and Contouring**		**8**	**CO2**
	2.1	Definitions, basic terms, types of instruments-dumpy level and Auto level, principal axes of dumpy level, temporary and permanentadjustments		
	2.2	Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of missing data, distance to the visible horizon, corrections due to curvature and refraction, reciprocal levelling, Numerical problems		
	2.3	Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors, difficulties in levelling work,corrections and precautions work in levelling		
	2.4	Contouring: terms, contour, contouring, contour interval, horizontal equivalent Direct and indirect methods of contouring, interpolation of contours, uses of Contours and characteristics of contour lines. Grade contour		
3	**Theodolite Surveying**		**8**	**CO3**
	3.1	Various parts and axes of transit, technical terms, temporary and permanent adjustments of a transit, measurement of horizontal andvertical angles, Methods of repetition and reiteration.		
	3.2	Different methods of running a theodolite traverse, Latitudes and departures, rectangular coordinates, Traverse adjustments by Bowditch's,transit and Modified transit rules, Gales Traverse Table, Numerical Problems.		
	3.3	Miscellaneous use of theodolite for various works such as prolongationof a straight line, setting out an angle, bearing measurements. Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing.		
4	**Indirect and Advanced Methods of Measurement**		**7**	**CO4**
	4.1	Tacheometry-Principle, Objective, Suitability and different methods of tacheometry, Stadia formula, Radial contouring, numerical on stadiamethod only		

Module	Course Module / Contents		Hours	CO
	4.2	Electronic Distance Measurement: Working Principles, types, applications in surveying		
	4.3	Total Station- Working Principles, applications in surveying		
	4.4	Introduction to GPS, GIS and Remote Sensing		
5	**Plane Table Surveying, Areas and Volumes**		**5**	**CO5**
	5.1	Definition, principle, accessories required for plane table surveying,merits and demerits, temporary adjustments, Different methods of plane table surveying		
	5.2	Areas: Area of an irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods. Planimeter: types including digital planimeter, area of zero circle, uses of planimeter.		
	5.3	Volumes: Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans.		
6	**Curves**		**5**	**CO6**
	6.1	Horizontal Curves-Definitions of different terms, necessity and types of curves. Methods of setting out Simple circular curves- linear methodsand Angular methods (Numericals on simple circular curves only)		
	6.2	Introduction to Vertical curves – Definitions, geometry and types.		

Text Books:

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

References:

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

Online References:

Sr. No.	Website Name
1.	**NPTEL (National Program on Technology Enhanced Learning)** Website: https://nptel.ac.in/ Relevant Courses1

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
2094113	Structural Analysis	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					
2094113	Structural Analysis	20	20	40	60	2	--	--	100

Rationale:

This syllabus outlines a comprehensive course on structural analysis, covering various aspects related to the behaviour of structures subjected different loading. It aims to equip students with the knowledge and skills necessary to analyze and design complex structures. Different components of civil engineering structures are subjected to various force systems and their combinations. For designing the components, these are analyzed for their response. The structural systems are determinate or indeterminate and so there are different analysis methods. These will be learnt in this course. Their application on solids and mechanisms, the action of force systems is studied and further extended in this subject. Learners will learn to apply these to the analysis of various members of structural systems such as beams, trusses, portal frames. These analyses will further be used while designing Steel and RCC structures.

Course Objectives:

1. To introduce and familiarize students with the concepts of slope, deflection, strain energy, and virtual work in statically determinate structures.
2. To enable students to construct and use influence line diagrams for structural analysis and calculate shear forces and bending moments under different loading conditions, including rolling loads.
3. To develop an understanding of determinate and indeterminate structures, including material behaviours, and methods to assess determinacy and indeterminacy.
4. To equip students with the ability to analyse indeterminate structures using force methods.
5. To equip students with the ability to analyse indeterminate structures using displacement methods
6. To provide knowledge of plastic analysis techniques and enable students to determine collapse loads for beams using static and kinematic methods.

Course Outcomes:

1. Classify structures into determinate and indeterminate categories, considering their static and kinematic behaviour, material properties (linear and non-linear), and geometric non-linearity.
2. Apply analytical methods to calculate slopes and deflections in statically determinate beams, rigid jointed frames, and pin-jointed trusses to solve real-world structural problems.
3. Construct and interpret influence line diagrams to evaluate the criteria for maximum shear force and bending moment under rolling loads.

4. Analyze indeterminate structures by applying force methods to evaluate structural behaviour.
5. Apply displacement methods to analyze indeterminate structures and evaluate their internal forces and deformations under various loading conditions.
6. Evaluate the collapse load of single and multiple-span beams by applying plastic analysis techniques

Prerequisite: Applied Mathematics, Engineering Mechanics and Mechanics of Solids

Detailed Syllabus

Module	Course Module / Contents		Hours	CO Mapping
1	**Determinate and Indeterminate Structures.**		03	CO1
	1.1	Types of structures occurring in practice and their classification, Linear and non-linear behaviour of materials, geometric non-linearity.		
	1.2	Static and Kinematic determinacy and indeterminacy of structures.		
2	**Slope and Deflections in Statically Determinate Structures**		08	CO2
	2.1	Concept of Strain Energy, Slope and deflection in beams, Principle of Superposition, Principle of Virtual work, Castigliano's theorems, Betti's theorem and Maxwell's reciprocal theorem.		
	2.2	Macaulay's Method, Moment Area Method, Application of Unit Load Method for calculating slope and deflection for rigid jointed frames and Pin jointed truss.		
3	**Rolling Loads and Influence Line Diagrams**		06	CO3
	3.1	Influence lines for support reactions, shear force and bending moment at a section for a cantilever, simply supported and overhanging beams without internal hinges.		
	3.2	Determination of S.F. and B.M. at a section, Criteria for maximum shear force and bending moment, Absolute maximum shear force and bending moment under rolling loads (UDL and series of point loads) for simply supported girder.		
4	**Analysis of indeterminate structures by Force methods.**		08	CO4
	4.1	Clapeyron's theorem of three moments to fixed beam and continuous beam.		
	4.2	Flexibility coefficients and their use in formulation of compatibility equations. Application of flexibility method to propped cantilevers, fixed beams, continuous beams, and Simple rigid jointed frames. (Degree of static indeterminacy not more than 3).		
5	**Analysis of indeterminate structures by Displacement Methods**		11	CO5
	5.1	Introduction to the concept of slope deflection equation. Stiffness coefficients for prismatic members and their use for formulation of equilibrium equations.		
	5.2	Application of direct stiffness method to indeterminate beams & simple rigid jointed frames (only single		

		translation degree of freedom including the effect of support settlement and kinematic indeterminacy not more than 3)		
	5.3	Moment distribution method: Application to indeterminate beams & simple rigid jointed frames (only single translation degree of freedom including the effect of support settlement and Kinematic indeterminacy not more than 3)		
6	**Plastic Analysis of Structures.**		06	CO6
	6.1	Plastic analysis of structures: Introduction to plastic analysis, the concept of a plastic hinge, plastic moment carrying capacity, shape factor.		
	6.2	Static and kinematic method of plastic analysis. Determination of collapse load for single and multiple span beams.		

Text Books:

1. Basic Structural Analysis: C.S. Reddy, Tata McGraw Hill New Delhi.
2. Mechanics of Structures: Vol-I and II: S. B. Junnarkar and H.J. Shah, Charotar Publishers, Anand.
3. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons Publishers, Delhi
4. Structural Analysis I: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy Knowledge ware, Mumbai.
5. Strength of Materials: Rajput, S. Chand Publications, Delhi
6. Structural Analysis I and II: Bhavikatti, Vikas Publisher House Pvt. Ltd.
7. Structural Analysis: Devdas Menon, Narosa Publishing House.
8. Comprehensive Structural Analysis: Vol-I and II by Vaidyanathan R. and Perumal R. Laxmi Publications.
9. Structural Analysis: L.S. Negi and R.S Jangid, Tata Mc-Graw Hil, India
10. Fundamentals of Structural Analysis: Sujit Kumar Roy and Subrota Chakrabarty, S. Chand Publications.
11. Structural Analysis: T.S Thandavamoorthy, Oxford University Press.
12. Structural Analysis: Manmohan Das, Bharghab Mohan, Prentice Hall International.

References:

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

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/101/105101085/
2.	https://www.coursera.org/learn/materials-structures
3.	http://digimat.in/nptel/courses/video/105105166/105105166.html

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
2094114	Surveying Lab	-	2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Total				
2094114	Surveying Lab	--	--	--	--	25	25	50

Lab Objectives:

The students will be able to learn:

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

Lab Outcomes: Student will be able to

1. Perform basic linear and angular surveying using chain, cross-staff, and prismatic compass to determine bearings and compute angles
2. Conduct leveling operations including simple and compound leveling to measure elevation differences accurately
3. Measure horizontal and vertical angles using theodolites and apply tachometry for computing heights and distances.
4. Utilize advanced surveying instruments such as total stations for precise distance measurement and data collection.
5. Apply graphical and computational methods in surveying through Plane Table Surveying and planimeter-based area measurement.
6. Set out curves and alignments using Rankine's method for practical field applications in road and railway projects.

Text Books:

1. Surveying and Levelling: R. Agor, Vol.-I, 11th Edition, Khanna Publishers (ISBN 8174 092358)
2. Surveying and Levelling: Kanetkar and Kulkarni, Vol. -I, 24th Edition, Pune Vidyarthi Griha, Pune. (ISBN 8185825114)
3. Surveying and Levelling: Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol. -II 4th Edition, Laxmi Publications (ISBN9788170088530)
4. Surveying and Levelling: N N Basak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN 9789332901537)

References:

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

Online Resources:

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

List of Experiments.

Perform minimum **six** practical's out of 01 to 09 and all the projects are **mandatory**

Sr. No.	List of Experiments	Hrs	LO
01	Chain and cross staff surveying.	02	LO1
02	Measuring bearings of a closed traverse with prismatic compass and computation of interior angles.	02	LO1
03	Simple and compound levelling	02	LO2
04	Measurement of horizontal and vertical angles.	02	LO3
05	Finding constants, heights and distances using tachometry.	02	LO3
06	Measurement of distances using total station.	02	LO4
07	Plane Table Surveying by intersection method.	02	LO5
08	Find an area of irregular figure using a conventional planimeter	02	LO5
09	Setting out a simple curve by Rankine's method.	02	LO6

A survey camp of three days is to be arranged to execute the following projects for undergoing the students through practical instructions in civil engineer's career with the actual field exposure at an ideal site location.

Sr. No.	List of Experiments	LO
01	**Project I:** Road project using Auto level for a minimum length of 300 m including fixing of alignment, profile levelling, cross-sectioning at 20m interval, plotting of 'L'section and 'C' section. (Two full imperial sheets, the first sheet with key plan and 'L' section and the second sheet covering any three typical Cross-sections)	LO2
02	**Project II:** Block Contouring project using Auto level for minimum 50m × 50m area and generating contours by MS Excel. (Take contour interval as 0.2 meter)	LO2
03	**Project III:** Tachometric contouring project on a hilly area with at least two instrument stations about 50 m to 80 m apart and generating contours by taking contour intervals as 1 meter.	LO3

Assessment:
Term Work: Term Work shall consist of practical work, projects and assignments based on the above list.

Term Work Marks: 25 Marks (Total marks) = 09 Marks (Experiment) + 06 Marks (Project work) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: 25 Marks (Total marks) = 10 Marks (Practical exam) + 15 Marks (Oral exam)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2094115	Structural Analysis Lab	-	2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Total				
2094115	Structural Analysis Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To develop an in-depth understanding of structural components by considering the degree of indeterminacy.
2. To compute the distribution of shear stress, flexural (bending) stress and twisting moment across the cross section of structural members
3. To learn methods for evaluating rotation and displacement of statically determinate structure.
4. To study the concept of Influence Line Diagrams and rolling loads.
5. To analyse the indeterminate structures using Force and Displacement methods.
6. To study Plastic Analysis.

Lab Outcomes: Student will be able to

1. Classify structural components and evaluate their degree of indeterminacy based on span, loading, support conditions, etc.
2. Determine the rotation and displacement of statically determinate structures using different theorems and principles.
3. Construct and interpret influence line diagrams to analyse the effects of rolling loads on statically determinate structures
4. Analyse indeterminate structures using force Methods and displacement Methods.
5. Apply knowledge of plastic analysis by evaluating collapse load and Plastic moments.
6. To comprehend substantial conclusions by conducting various test on materials.

Text Books:

1. Basic Structural Analysis: C.S. Reddy, Tata McGraw Hill New Delhi.
2. Mechanics of Structures: Vol–I and II: S. B. Junnarkar and H.J. Shah, Charotar Publishers, Anand.
3. Strength of Materials: S. Ramamrutham, Dhanpat Rai and Sons Publishers, Delhi
4. Theory of Structures: S. Ramamrutham, Dhanpat Rai and Sons Publishers, Delhi
5. Structural Analysis I: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy Knowledge ware, Mumbai.
6. Strength of Materials: Rajput, S. Chand Publications, Delhi

7. Structural Analysis I and II: Bhavikatti, Vikas Publisher House Pvt. Ltd.
8. Structural Analysis: Devdas Menon, Narosa Publishing House.
9. Basic Structural Analysis: K.U. Muthu, Azmi Ibrahim, M. Vijyanand, Maganti Janadharn and. International Publishing House Pvt. Ltd.
10. Comprehensive Structural Analysis: Vol-I and II: Vaidyanathan R. and Perumal R. Laxmi Publications.
11. Structural Analysis: L.S. Negi and R.S Jangid, Tata Mc-Graw Hil, India
12. Fundamentals of Structural Analysis: Sujit Kumar Roy and Subrota Chakrabarty, S. Chand
13. Publications.
14. Structural Analysis: T.S Thandavamoorthy, Oxford University Press.
15. Structural Analysis: Manmohan Das, Bharghab Mohan Prentice Hall International.

References:

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

Online Resources:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/101/105101085/
2.	https://www.coursera.org/learn/materials-structures
3.	http://digimat.in/nptel/courses/video/105105166/105105166.html

List of Experiments.

Sr. No.	List of Experiments	Hrs	LO
01	Test of Shear Stress in Beams	2	LO6
02	Using Torsion Testing Machine, verify the torsion equation, find different Moduli of a material.	2	LO6
03	Charpy impact testing and Energy concept. OR Izod impact testing and Energy concept.	2	LO6
04	Using Universal Testing Machine perform experiments and verify slope and deflection equations, three points and four points loading. (performance) OR Deflection of Simply Supported Beams (Performance) OR Deflection of Cantilever Beams (Performance)	2	LO6

List of Assignments.

Sr. No.	List of Assignments	Hrs	LO
01	Numerical based on degree of indeterminacy (Beam, Rigid jointed frame and Truss)	2	LO1
02	1. Write a detail report/Poster on theorems such as Principle of Superposition, Principle of Virtual work, Castigliano's theorems, Betti's theorem and Maxwell's reciprocal theorem. 2. Minimum two numerical on each method for finding Slope and Deflection for Statically determinate structure and their validation by using any analysis software	2	LO2
03	1. Solve set of questions given by the course instructor **Or** 2. Design an experiment for ILD of reactions of beam. **Or** 3. Write a report on IRC and classification of rolling loads	2	LO3
04	1. Solve set of questions given by the course instructor on Clapeyron's theorem of three moments and validate the final output by using handy application tools or Software applications. 2. Solve set of questions given by the course instructor on Flexibility method and validate the final output by using handy application tools or Software applications.	2	LO4
05	1. Solve set of questions given by the course instructor for Analysis of Rigid joined frame structure using Direct stiffness method. 2. Solve set of questions given by the course instructor for Analysis of Rigid joined frame structure using Moment Distribution Method.	2	LO5
06	Solve set of questions given by the course instructor for Shape factor, Plastic Moment and Collapse load	2	LO5

Assessment:
Term Work: Term Work shall consist of practicals based on the above list. Also, Term work Journal must include at assignments based on above list.

Term Work Marks: 25 Marks (Total marks) = 05 Marks (Experiment) + 15 Marks (Assignments) + 5 Marks (Attendance)

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

Vertical – 4

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2094411	Computer Aided Architectural Planning, and Building Design (Capstone Mini-Project)	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Plotting & Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Total				
2094411	Computer Aided Architectural Planning, and Building Design (Capstone Mini-Project)	--	--	--	--	50	25	75

Lab Objectives:

1. To develop a comprehensive understanding of the principles, bye laws and techniques for architectural design of residential and public buildings
2. To apply building design and drawing skills to create functional, aesthetically pleasing, and sustainable building solutions for a variety of projects
3. To proficiently use CAD software for creating accurate 2D architectural drawings, including plans, elevations, sections etc.
4. To develop detailed building services drawings such as plumbing, electrical and HVAC using CAD software.
5. To generate 3D architectural drawings using CAD software.
6. To effectively utilize Building Information Modeling (BIM) software to create, manage, and visualize complex building projects.

Lab Outcomes:
Students will be able to:

1) Demonstrate a comprehensive understanding of architectural design principles, bye-laws, and techniques, as applied to residential and public buildings.
2) Apply architectural design principles to create functional, aesthetically pleasing, and sustainable building solutions for various project types.
3) Create accurate 2D architectural drawings, including plans, elevations, and sections using CAD software.
4) Apply their knowledge of building services to create detailed 2D drawings for plumbing, electrical, and HVAC systems using CAD software.
5) Create 3D architectural models using AutoCAD software to visualize and analyze building designs.
6) Understand effectively use of BIM software to create, manage, and visualize complex building projects, evaluating the impact of design decisions on various project parameters.

Prerequisite: Familiarity of various building elements, basic of drawing 2D shapes and perspectives.

Sr No	List of Experiments	Hrs	LO
01	**Concepts & Discussions** • Classification of buildings: Residential –Individual Bungalows & Apartments/Flats. Public – Education (Schools, Colleges etc.) &Health (Primary Health Center, Hospital) related buildings • Principles of planning for Residential buildings • Study of sun path diagram, wind rose diagram and sun shading devices **Practical** • Planning of G+1 Bungalow and drawing plan for the same on A1 Sheet	04	LO1
02	**Concepts & Discussions** • Overview of structural components (beams, columns, foundations), Study of Section, Foundation plan, Roof plan, Site plan. • Calculation of setback distances, carpet area, built-up area and floor space index (FSI) • Study of building Bye – laws, Zoning Regulations and permissions required from commencement to completion of the building according to National Building Code (N.B.C.) of India and local Development Control (D.C.) rules. **Practical** • Drawing Section, Foundation plan, Roof plan, Site plan for the Bungalow on A1 Sheet	04	LO1
03	**Concepts & Discussions** • Study of Principles of planning for public buildings: i) Residential building, ii) Building for education: schools, colleges, institutions etc. iii) Buildings for health: hospitals, primary health centers etc. **Practical** • Planning and drawing any 1 Public building on A1 Sheet	04	LO1
04	**Concepts & Discussions** • Introduction and Principles of Architecture • Importance of elevation drawings in architectural design • Concepts of perspective drawing. **Practical** • Developing Elevation with One-point and Two-point perspective of Bungalow.	04	LO2
05	**Concepts & Discussions** • Importance of Computer-Aided Design (CAD) in Civil Engineering and Architecture. • Overview of other commonly used software **Practical** • Familiarization with the CAD interface. • Basic operations in AutoCAD: creating lines, shapes, and modifying elements.	04	LO3

Sr No	List of Experiments	Hrs	LO
	• Generating CAD drawing of the plan of Bungalow, Implementing dimensioning and detailing standards.		
06	**Practical** • Generating Sectional view and Foundation plan for the Bungalow using AutoCAD. • Implementing dimensioning and detailing standards.	04	LO3
07	**Practical** • Generating Roof plan, site plan and Elevation for the Bungalow using AutoCAD	04	LO3
08	**Concepts & Discussions** • Introduction to building services: plumbing, electrical, and HVAC. • Integration of services in building design. **Practical** • Designing plumbing layouts, electrical wiring diagrams in CAD. • Introduction to layers for different services.	04	LO4
09	**Concepts & Discussions** • Introduction to 3D modeling and its role in architectural design. • Software tools for 3D modeling (AutoCAD 3D, Revit, SketchUp) **Practical** • Creating 3D models of buildings in AutoCAD. • Basic rendering and visualization techniques.	04	LO5
10	**Concepts & Discussions** • Advanced 3D modeling techniques: parametric modeling, complex geometries. • Using 3D models for design communication and presentations. **Practical** • Creating detailed 3D models with advanced elements (curved surfaces, complex shapes). • Exporting models for presentations and construction documentation.	04	LO5
11	**Concepts & Discussions** • Introduction to Building Information Modeling (BIM) concepts. • Benefits of BIM in the construction industry. **Practical** • Working with basic BIM tools in Revit. • Creating basic building information models: walls, floors, and structural components.	04	LO6
12	**Concepts & Discussions** • Advanced BIM concepts: clash detection, cost estimation, project collaboration. • Using BIM for construction management and lifecycle analysis. **Practical** • Developing detailed BIM models.	04	LO6

Sr No	List of Experiments	Hrs	LO
	• Performing clash detection and analyzing model data for project planning.		

Sr No	List of Drawings and outputs	Hrs	LO
01	A1 sheets showing plan, section, site plan, roof plan, foundation plan and elevation of bungalow (G+1).	08	LO1, LO2
02	A1 sheet showing plan of any one public building.	04	LO2
03	A1 sheet showing one point/ two-point perspective of bungalow.	04	LO2
04	GENERATING Print out of AutoCAD showing plan, section, site plan, roof plan, foundation plan and elevation of bungalow.	12	LO3
05	Print out of AutoCAD plan plumbing and electrical details for bungalow.	04	LO4
06	Print out of 3D model of bungalow.	08	LO5
07	Output from BIM software.	08	LO6

Recommended Books:

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

Reference Codes:

1. National Building Code of India, 2016
2. IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
3. IS 779-1978Specification for water meter
4. IS 909-1975 Specification for fire hydrant
5. IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation
6. IS 1742-1983 code of practice for building drainage

Online Resources:

Sr. No.	Website Name
1.	https://mmrda.maharashtra.gov.in (Development Control Regulations for Mumbai Metropolitan Region for 2016 - 2036)
2.	https://www.nmmc.gov.in/development-control-regulations (Development Control Regulations for Navi Mumbai Municipal Corporation - 1994)
3.	https://mmrda.maharashtra.gov.in (Development Plan and Control Regulation KDMC)

Assessment :

Term Work: Term Work shall consist of drawings based on the above list.

Term Work Marks: 50 Marks based on distribution below:

15 Marks – Full Imperial Drawing sheets

20 Marks - CAD prints

10 Marks - BIM outputs

5 Marks - Attendance

Practical & Oral Exam: 25 Marks based on distribution below
10 Marks – Written test based on syllabus.
10 Marks - Plotting based on the practicals. (2 hours in batches).
05 Marks - Oral exam based on syllabus.

Vertical – 5

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2994511	Business Model Development	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2994511	Business Model Development	--	--	--	--	--	50	--	50

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

Lab Objectives:

1. To introduce a learner to entrepreneurship and its role in economic development.
2. To familiarize a learner with the start-up ecosystem and government initiatives in India.
3. To explain the process of starting a business.
4. To familiarize a learner with the building blocks of a business.
5. To teach a learner to plan their own business with the help of Business Model Canvas.
6. To teach a learner to have financial plan for a business model.

Lab Outcomes:

The learner will be able to:

1. Discuss the role of entrepreneurship in the economic development of a nation and describe the process of starting a business.
2. Describe start-up ecosystems in Indian and global context.
3. Identify different types of business models.
4. Identify customer segments, channels and customer relationship components for a particular business.
5. Identify key activities, key partners and key resources for a particular business.
6. Develop a financial plan for a business with the help of cost structure and revenue model.

DETAILED SYLLABUS:

Prerequisite:

Basic Design Thinking principles

Module	Course Module / Contents		Hours	LO Mapping
1	**Introduction to Entrepreneurship**		04	LO1, LO2
	1.1	Definition, the role of entrepreneurship in the economic development, the entrepreneurial process		
	1.2	Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset		

	Self-learning Topics: Case studies: Henry Ford https://www.thehenryford.org/docs/default-source/default-document-library/default-document library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business			
2	**Entrepreneurship Development**		05	LO2, LO3, LO4
	2.1	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses		
	2.2	Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development		
3	**Start-up financing**		04	LO2, LO3, LO4, LO5
	3.1	Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes for start-up funding		
	Self-learning Topics: Successful business pitching			
4	**Intellectual Property Rights (IPR)**		04	LO2, LO3, LO4
	4.1	Types of IPR: Patents, trademarks and copyrights, Patent search and analysis		
	4.2	Strategies for IPR protection, Ethics in technology and innovation		
5	**Business Model Development**		04	LO3, LO4, LO5, LO6
	5.1	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP		
	Self-learning Topics: The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything by Guy Kawasaki			
6	**Digital Business Management**		04	LO2, LO3
	6.1	Digital Business models (Subscription, Freemium *etc*)		
	6.2	Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing		
	6.3	Disruption and innovation in digital business		
	Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m			

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online Resources:

Sr. No.	Website Name
1.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
2.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
3.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/

List of Experiments.

The lab activities are to be conducted in a group. One group can be formed with 4-5 students. A group has to develop a Business Model Canvas and a digital prototype (Web App/ mobile app). Weekly activities are to be conducted as follows:

Sr No	Lab activities	Hrs
01	Problem identification (Pain points, Market survey)	2
02	Design a digital solution for the problem (Ideation techniques)	2
03	Preparing a business model canvas: Value proposition, Key partners, Key resources, Key activities	2
04	Preparing a business model canvas: Customer segment, Customer relationships and channels	2
05	Preparing a business model canvas: Cost and Revenue structure	2
06	Prototype development: Low fidelity	2
07	Prototype development: Customer feedback	2
08	Prototype development: High fidelity	2
09	Presentation of high-fidelity prototype	2

Sr No	List of Assignments / Tutorials	Hrs
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Assessment:

Term Work: Term Work shall consist of 10 lab activities based on the above list. Also, Term work journal must include any 2 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 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
2994512	Design Thinking	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2994512	Design Thinking	--	--	--	--	--	50	--	50

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

Lab Objectives:

1. To introduce a learner to the principles of Design Thinking.
2. To familiarize a learner with the process (stages) of Design Thinking.
3. To introduce various design thinking tools.
4. Study of the techniques for generation of solutions for a problem.
5. To expose a learner to various case studies of Design Thinking.
6. Create and test a prototype.

Lab Outcomes:

Students will be able to …

1. Compare traditional approach to problem solving with the Design Thinking approach and discuss the principles of Design Thinking
2. Define a user persona using empathy techniques
3. Frame a problem statement using various Design Thinking tools
4. Use ideation techniques to generate a pool of solutions for a problem
5. Create prototypes using different techniques
6. Test the prototypes and gather feedback for refining the prototype

DETAILED SYLLABUS:

Module	Course Module / Contents		Hours	CO Mapping
1	**Introduction to Design Thinking**		05	LO1, LO2
	1.1	Definition, Comparison of Design Thinking and traditional problem-solving approach.		
	1.2	Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)		
	Self-learning Topics: Design thinking case studies from various domains https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index			

2	**Empathy**		05	LO2, LO3
	2.1	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.		
	Self-learning Topics: Creation of empathy maps https://www.interaction-design.org/literature/topics/empathy-mapping			
3	**Define**		05	LO2, LO3
	3.1	Significance of defining a problem, Rules of prioritizing problem solving.		
	3.2	Conditions for robust problem framing, Problem statement and POV.		
	Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples https://uxpressia.com/blog/how-to-create-persona-guide-examples			
4	**Ideate**		05	LO3
	4.1	What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation		
	4.2	Multi-disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions		
	4.3	Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping		
	Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide https://uxplanet.org/how-to-run-an-effective-ideation-workshop-a-step-by-step-guide-d520e41b1b96			
5	**Prototype**		03	LO6
	5.1	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario prototype		
6	**Test**		03	LO4, LO5
	6.1	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing		

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

Online Resources:

Sr. No.	Website Name
3.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
4.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr. Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

List of Experiments.

The experiments are to be performed in groups. A practical batch may be divided into groups of 4-5 students.

Sr No	List of Experiments	Hrs
01	Customer Journey Mapping: Visualize the steps users take to interact with a product or service. Map out the customer journey from discovering a product to making a purchase and using the product. Identify pain points and opportunities for improvement.	2
02	Stakeholder mapping: Identify all relevant stakeholders in a project. Create a stakeholder map, categorizing stakeholders based on their influence and interest. Include management of relationships with key stakeholders.	2
03	"How Might We" Problem Framing: Transform user insights into actionable problem statements. After empathizing with users, turn challenges into "How Might We" statements that define the problem without prescribing a solution.	2
04	Brainstorming Session: Generate a pool of ideas in a creative, non-judgmental environment. Using ideation techniques like mind mapping and brainwriting, students brainstorm as many solutions as possible to their "How Might We" problem statements.	2
05	Affinity Diagramming: Organize group ideas to find patterns and insights. After brainstorming, students will categorize their ideas into themes by placing sticky notes on a wall and moving them into groups based on similarities.	2
06	Rapid Prototyping: Create quick, low-fidelity versions of solutions. Use materials like paper, cardboard, and markers to build a prototype of their solution within 30 minutes. The focus is on speed and functionality, not aesthetics.	2
07	Wireframing: Create a visual guide for digital interfaces for mobile app / web app for the problems identified in earlier lab sessions. Students will sketch wireframes of the user interface for their product or service. Use tools like Balsamiq or paper and pen for low-fidelity wireframes.	2
08	Role-Playing: Walk through a prototype from the user's perspective. Students act as both users and designers, role-playing scenarios where they interact with their prototype (Developed in earlier lab sessions). Gather feedback from participants on how to improve the experience.	2
09	Usability Testing: Evaluation of the effectiveness and user-friendliness of a prototype (developed in earlier lab sessions). Students will have peers or target users test their prototypes, observe how they interact with it, and collect feedback on any issues or improvements needed.	2
10	Feedback Loop and Iteration: Refine solutions based on user feedback. After usability testing, students will refine their prototypes. Document changes made based on feedback and discuss how continuous iteration improves the design.	2

Sr No	List of Assignments (Any two)	Hrs
01	Create an empathy map for a target user group. Break them into four sections: *Says, Thinks, Feels, and Does*. Interview users or research their experiences to fill in the map.	3
02	Based on research, students will create user personas including demographic details, motivations, pain points, and goals. Each group will present their persona to the class.	3
03	Consider 3 examples of real-life products which have good design and bad design. Write down reasons why do you think they are good or bad designs. May take user survey to support your work.	3
04	Study any open-source design thinking tool and write a brief report about it.	3

Assessment:
Term Work: Term Work shall consist of 08 to 10 lab activities based on the above list. Also, Term work journal must include any 2 to 4 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)+ 10 Marks (Report).

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

Sd/-

Dr. Rajendra B. Magar
BoS-Chairman-Civil Engineering
Faculty of Technology

Sd/-

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology