Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI COLLEGE OF ENGINEERING
An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

Shree Rahul Education Society's (Regd.)

Shree L.R. Tiwari College of Engineering

Shree L.R. Tiwari Educational Campus,

Mira Road–East, Thane-401107.

Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Civil Engineering

Curriculum SY A.Y 2026-27

Second Year Syllabus

Revision: R-2025

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class centre for socio- economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. **Curriculum Design:** Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-centric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socio-economic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2**. Purpose of Autonomy:** Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impactful solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. **Alignment with National Education Policy-2020:** Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. **Innovative Pedagogy Initiative by IQAC As part of its transformation strategy**, IQAC has introduced an innovative pedagogy model centred on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. **Empowering Faculty as Mentors and** Innovators: SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instil Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment**.**

Sincerely,

IQAC Chairperson
SLRTCE

COO
Rahul Education

PREFACE

Board of Studies – Civil Engineering
Shree L. R. Tiwari College of Engineering

Civil Engineering plays a vital role in the planning, design, construction, and maintenance of infrastructure that supports the growth and development of society. With the increasing use of digital technologies in engineering practice, the integration of computer applications has become essential for efficient analysis, design, project management, and decision-making. The Civil Engineering with Computer Applications (CECA) program at Shree L. R. Tiwari College of Engineering is designed to develop skills of students to meet the evolving needs of the civil engineering profession.

The Board of Studies (BoS) in Civil Engineering is committed to ensuring that the curriculum remains relevant, industry-oriented, and aligned with contemporary technological advancements. The program provides a strong foundation in core civil engineering disciplines while incorporating computer-based tools and applications that are widely used in engineering practice. The curriculum focuses on developing technical competence, analytical skills, problem-solving abilities, and professional ethics among students.

The Board regularly reviews and updates the syllabus in accordance with guidelines of regulatory bodies, industry expectations, emerging technologies, and societal needs. Emphasis is placed on practical learning through laboratory work, software-based applications, field visits, internships, mini-projects, and project-based learning activities. Students are encouraged to apply engineering concepts using modern tools and technologies to address real-world challenges in infrastructure development.

In alignment with the vision and mission of the Department and the Institute, the program promotes sustainable engineering practices, innovation, lifelong learning, and professional responsibility. The curriculum aims to develop graduates who are capable of contributing effectively to the planning, design, execution, and management of civil engineering projects while adapting to technological changes in the profession.

The Board of Studies remains dedicated to fostering an academic environment that supports quality education, skill development, research orientation, and industry interaction. Through continuous improvement of the curriculum and teaching-learning processes, the Board strives to prepare competent civil engineers equipped with modern technological skills to serve society and contribute to the nation's infrastructure development.

Ms. Prajakta V. Mukadam
Chairperson, Board of Studies
Civil Engineering
Shree L. R. Tiwari College of Engineering

A. Abbreviations

AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
EMC	Entrepreneurship/economics/management courses
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
OE	Open Elective
OJT	On Job Training
P	Practical
PROJ	Project
PCC	Program Core Course
PCCL	Program Core Course Lab
PEC	Program Elective Course
RM	Research Methodology
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

1. Curriculum Structure and Examination Scheme for B. Tech. in Civil Engineering with Computer Applications

(**FY with Effect from AY 2025-2026** Curriculum Structure – FY Semester-I)

Curriculum Structure – FY Semester-I

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
11111101	BSC	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
11111102	BSC	Applied Physics	2	--	--	30	--	--	30	60	2
11121103	ESC	Engineering Mechanics	3	--	--	45	--	--	45	90	3
11121104	ESC	Basic Electrical and Electronics Engineering	2	--	--	30	--	--	30	60	2
11121105	ESC	C& C++ Programming	3	--	--	45	--	--	45	90	3
11112106	BSCL	Applied Physics Lab	--	--	1	--	--	15	--	15	0.5
11122107	ESCL	Engineering Mechanics Lab	--	--	2	--	--	30	--	30	1
11122108	ESCL	Basic Electrical and Electronics Engineering Lab	--	--	2	--	--	30	--	30	1
11122109	ESCL	C& C++ Programming Lab	--	--	2	--	--	30	--	30	1
11122110	ESCL	IDEA LAB - 1(Innovation Design Engineering and Apply)	1	--	2*	15		30	15	60	2
11412111	VSEC	Engineering Workshop -1	--	--	2	--	--	30	15	45	1.5
98461112	CC	Universal Human Values	2	--	--	30	--	--	30	60	2

11421113	**AEC**	**Strategic Communication and Management Skills**	**1**	**–**	**--**	**15**	**--**	**--**	**15**	**30**	**1**
11422114	**AECL**	**Strategic Communication and Management Skills Lab**	**–**	**–**	**2**	**–**	**–**	**30**	**–**	**30**	**1**
Total			**16**	**1**	**13**	**240**	**15**	**195**	**270**	**720**	**24**

Note:

1) CC will be common to all Branches. AEC will be group specific.
2) BSC , ESC and corresponding lab is Department Specific
3) Questions based on self-learning must not be asked in internal assessment and End semester Exam
4) *IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.
5) Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. The subject with no term work and practical will have no assessment on self-learning topics. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – FY Semester-I

Course Code	Course Type	Course Name	Examination Scheme							
			IAT-1	IAT-2	IAT-1 + IAT-2	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
11111101	BSC	Linear Algebra and Calculus	20	20	40	60	2.5	25	–	125
11111102	BSC	Applied Physics	20	20	40	60	2.5	–	–	100
11121103	ESC	Engineering Mechanics	20	20	40	60	2.5	–	–	100
11121104	ESC	Basic Electrical and Electronics Engineering	20	20	40	60	2.5	–	–	100
11121105	ESC	C& C++ Programming	20	20	40	60	2.5	–	–	100
11112106	BSCL	Applied Physics Lab	–	–	–	–	–	25	–	25
11122107	ESCL	Engineering Mechanics Lab	–	–	–	–	–	25	25	50
11122108	ESCL	Basic Electrical and Electronics Engineering Lab	–	–	–	–	–	25	25	50
11122109	ESCL	C& C++ Programming Lab	–	–	--	–	--	25	25	50
11122110	ESCL	IDEA LAB - 1(Innovation Design Engineering and Apply)	–	–	--	–	--	50	50	100
11412111	VSEC	Engineering Workshop -1	–	–	--	--	--	25	--	25
98461112	CC	Universal Human Values	–	–	–	–	–	25	--	25
11421113	AEC	Strategic Communication and Management Skills	20	20	40	40	1.5	-	--	80
11422114	AECL	Strategic Communication and Management Skills Lab	--	--	--	--	--	25	--	25
Total			120	120	240	340	14	250	125	955

Curriculum Structure – FY Semester-II

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
11111201	BSC	Differential Equations and Integral Calculus	2	1	--	30	15	--	45	90	3
11111202	BSC	Engineering Chemistry	2	--	--	30	--	--	30	60	2
11121203	ESC	Engineering Graphics	2	--	--	30	--	--	30	60	2
11211204	PCC	Basic Fluid Mechanics	3	–	–	45	--	--	45	90	3
11112205	BSCL	Engineering Chemistry Lab	–	--	1	--	--	15	15	15	0.5
11122206	ESCL	Engineering Graphics Lab	–	--	2	--	--	30	30	30	1
11122207	ESCL	Programming Lab (Python)	2	--	2	30	--	30	-	60	2
11122208	ESCL	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
11212209	PCCL	Basic Fluid Mechanics Lab	–	--	2	--	--	30	--	30	1
11412210	VSEC	Engineering Workshop II	--	--	2	--	--	30	15	45	1.5
98441211	IKS	Indian Knowledge System	2	--	--	30	--	--	30	60	2
98462212	CC	NSS & Civil Defense	--	--	4#	--	--	60	--	60	2
98471213	Audit Course	Audit Course	3	–	–	45	--	--	--	--	--
Total			17	1	15	225	15	225	210	660	22

Note:

1) IKS and CC will be common to all Branch

2) BSC , ESC and corresponding lab is Department Specific
3) Questions based on self-learning must not be asked in internal assessment and End semester Exam
4) *IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.
5) # Students need to complete 60 hours throughout the semester as it is not possible to get 4hours per week due to the dynamic schedule of Govt. agencies. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module.

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Exanimation Scheme – FY Semester-II

Course Code	Course Type	Course Name	Examination Scheme							
			IAT -1	IAT-2	IAT-1+IAT-2	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
11111201	BSC	Differential Equations and Integral Calculus	20	20	40	60	2.5	25	–	125
11111202	BSC	Engineering Chemistry	20	20	40	60	2.5	--	--	100
11121203	ESC	Engineering Graphics	20	20	40	60	2.5	--	--	100
11211204	PCC	Basic Fluid Mechanics	20	20	40	60	2.5	--	--	100
11112205	BSCL	Engineering Chemistry Lab	--	--	--	--	--	25		25
11122206	ESCL	Engineering Graphics Lab	--	--	--	--	--	25	25	50
11122207	ESCL	Programming Lab (Python)						25	25	50
11122208	ESCL	IDEA LAB - 2(Innovation Design Engineering and Apply			--		--	50	50	100
11212209	PCCL	Basic Fluid Mechanics Lab			--		--	25	25	50
11412210	VSEC	Engineering Workshop II			--	--	--	25	--	25
98441211	IKS	Indian Knowledge System	20	20	40	60	2.5	--	--	100
98462212	CC	NSS/Civil Defense	--	--	--	--	--	25	–	25
Total			100	100	200	300	12.5	225	125	850

Note:

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3) Questions based on self-learning must not be asked in internal assessment and End Semester Exam

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5) # Students need to complete 60 hours throughout the semester as it is not possible to get 4hours per week due to the dynamic schedule of Govt. agencies. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module.

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1. Curriculum Structure and Examination Scheme for B.Tech. in Civil Engineering with Computer Applications

(**SY with Effect from AY 2026-2027** Curriculum Structure – SY Semester-III)

Curriculum Structure – SY Semester-III

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/ 30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
21211301	PCC	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3
21211302	PCC	Surveying and Geomatics	3		--	45	--	–	45	90	3
21211303	PCC	Mechanics of Solids	3	–	--	45	--	–	45	90	3
21211304	PCC	Applied Hydraulics	3	–	–	45	–	--	45	90	3
21212305	PCCL	Surveying and Geomatics Lab	–	–	2	–		30	--	30	1
21212306	PCCL	Computer Applications Lab I	–	--	2	–		30	--	30	1
9951137WW	OE-I	Open Elective - I	2	–	–	30	–	–	30	60	2
98431308	Entrepreneurship	Entrepreneurship Development	2	–	–	30	–	–	30	60	2
98451309	Value education course	Environmental Science	2	–	–	30	–	–	30	60	2
21612310	Community Engagement Project	IDEA LAB -3 (Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
Total			18	01	06	270	15	90	285	660	22

Sr. No.	Course code	Name of course
1	**995113701**	Introduction to Urban Planning
2	**995113702**	Foundations of Accounting & Finance
3	**995113703**	Gender Justice and Workplace Security
4	**995113704**	Modern Indian Architecture
5	**995113705**	Conflict Management through Mediation
6	**995113706**	Biodiversity Protection, Farmers and Breeders Rights
7	**995113707**	Constitution of India and Environmental Governance: Administrative and Adjudicatory Process
8	**995113708**	Literature, Culture and Media

Note:

1) Entrepreneurship and Value education course will be common to all Branch

2) BSC, ESC, PCC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End semester Exam

4) * IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation.

5) Open Elective: To be selected from the bucket proposed by other institute of Rahul Education

6) Lecture should be conducted for the full class. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical's, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SY Semester-III

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1+IAT-2		End- Sem			
21211301	PCC	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	–	125
21211302	PCC	Surveying and Geomatics	20	20	40	60	2.5	–	–	100
21211303	PCC	Mechanics of Solids	20	20	40	60	2.5	–	–	100
21211304	PCC	Applied Hydraulics	20	20	40	60	2.5	–	–	100
21212305	PCCL	Surveying and Geomatics Lab	–	–	–	–	–	25	25 (PR)	50
21212306	PCCL	Computer Applications Lab I						25	25 (PR)	50
9951137WW	OE-I	Open Elective - I						25	–	25
98431308	Entrepreneurship	Entrepreneurship Development						25	–	25
98451309	Value education course	Environmental Science	20	20	40	60	2.5	–	–	100
21612310	Community Engagement Project	IDEA LAB -3 (Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
Total			100	100	200	300	12.5	175	100	775

1. Curriculum Structure and Examination Scheme for B. Tech. in Civil Engineering with Computer Applications

(**SY with Effect from AY 2026-2027** Curriculum Structure – SY Semester-IV)

Curriculum Structure – SY Semester-IV

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
21211401	PCC	Sampling Theory and Optimization	2	1	–	30	15	--	45	90	3
21211402	PCC	Sustainable Construction Material and Concrete Technology	3	–	--	45	--	--	45	90	3
21211403	PCC	Structural analysis	3	--		45	--	--	45	90	3
21212404	PCCL	Sustainable Construction Material and Concrete Technology Lab	–	–	2	--	--	30	--	30	1
21212405	PCCL	IDEA LAB -4 (Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
21412406	VSEC	Computer Applications Lab II	–	--	2	--	--	30	--	30	1
9931147ww	MDM	Multidisciplinary Minor Course	3	–	–	45	--	--	45	90	3
9931248WW	MDML	Multidisciplinary Minor Course Lab	3	–	2	--	--	30	--	30	1
9951149WW	OE-II	Open Elective - II	2	–	–	30	--	--	30	60	2

98451410	**VEC**	**Design Thinking**	**2**	**–**	**–**	**30**	**--**	**--**	**30**	**60**	**2**
98431411	**Entrepreneurship**	**Business Model Development**	**2**	**–**	**–**	**30**	**--**	**--**	**30**	**60**	**2**
98471412	**AU**	**Audit Course**	**3**	**--**	**–**	**45**	**--**	**--**			
Total			**21**	**1**	**8**	**315**	**15**	**120**	**285**	**690**	**23**

Sr. No.	Course code	Name of course
1	**995114901**	Modern World Architecture
2	**995114902**	Introduction to history of architecture in India
3	**995114903**	Introduction to Cognitive Psychology
4	**995114904**	Constitution Law & Public Administration in India
5	**995114905**	International Trade Law
6	**995114906**	Marketing Analytics
7	**995114907**	Business Forecasting
8	**995114908**	Introduction to Film Studies

Note:

1) Entrepreneurship and VEC will be common to all Branch

2) BSC, ESC, PCC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End Semester Exam

4) * IDEA Lab: The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

5)*Lecture should be conducted for the full class. Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

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Examination Scheme – SY Semester-IV

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment			End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
21211401	PCC	Sampling Theory and Optimization	20	20	40	60	2.5	25	–	125
21211402	PCC	Sustainable Construction Material and Concrete Technology	20	20	40	60	2.5	–	–	100
21211403	PCC	Structural analysis	20	20	40	60	2.5	–	–	100
21212404	PCCL	Sustainable Construction Material and Concrete Technology Lab	–	–	–	–	–	25	25 (OR)	50
21212405	PCCL	IDEA LAB -4 (Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
21412406	VSEC	Computer Applications Lab II	–	–	–	–	–	25	25 (PR)	50
9931147ww	MDM	Multidisciplinary Minor Course	20	20	40	60	2.5	–	–	100
9931248WW	MDML	Multidisciplinary Minor Course Lab	–	–	–	–	–	25	25	50
9951149WW	OE-II	Open Elective II	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business Model Development	–	--	–	–	--	25	–	25
98471412	AU	Audit Course	–	–	–	–	–	–	–	–
Total			100	100	200	300	12.5	200	125	825

* Recommended that OE, IKS, VSEC, CC to be offered in the form of MOOCs(NPTEL/Swayam)

Indicative list of Multidisciplinary Minors:

Course Category of Multidisciplinary Minor	**Course Code**	**MDM-I (Semester IV)**
Communication Engineering	993114701	Introduction to Telecommuni cation Systems
	993124802	Introduction to Telecommuni cation Systems Lab
Internet of Technology	993114703	IOT Sensor Technology
	993124804	IOT Sensor Technology Lab
Electronics Engineering	993114705	Basic Electronics Circuits
	993124806	Basic Electronics Circuits Lab
Sustainability & Environment	993114709	Renewable and Non Renewable Energy System
	993124810	Renewable and Non Renewable Energy System Lab
Information Technology	993114711	Agentic AI
	993124812	Intelligent Agents Lab
Cyber Security	993114713	Information Security
	993124714	Information Security Lab

Computer Engineering	993114715	Computationa l Thinking.
	993124716	Data Structure Lab
Artificial Intelligence	993114717	Foundations of Artificial Intelligence
	993124818	Artificial Intelligence Lab

MDM Sequels Applicable:

	CS	IT	EXTC	ECS	MECH	CIVIL
Communication Engineering	✓	✓	--	✓	✓	✓
Internet of Technology	✓	✓	✓	✓	✓	✓
Electronics Engineering	✓	✓	✓	--	✓	
Mechanical Engineering					--	
Sustainability & Environment						--
Information Technology		--				
Cyber Security						
Computer Engineering	--					
Artificial Intelligence						

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Semester –III

Theme: Agriculture

Aligned with UNSDG: UNSDG 12 – Responsible Consumption and Production, and UNSDG 13 – Climate Action through sustainable and efficient agricultural practices.

Problem Statement 1:

To observe agricultural practices and demonstrate a very basic system to support farming activities.

Problem Statement 2:

To study challenges in agriculture and demonstrate a very basic system for improved resource utilization.

Problem Statement 3:

To study challenges affecting agricultural productivity and explore approaches for improving farming outcomes.

Problem Statement 4:

To investigate the utilization of agricultural resources and identify opportunities for enhancing efficiency and sustainability.

Problem Statement 5:

To study post-harvest practices and explore solutions that reduce losses and improve value generation.

Problem Statement 6:

To examine factors influencing agricultural decision-making and develop approaches that support farm management.

Problem Statement 7:

To analyze farming processes and demonstrate a very basic system to enhance agricultural efficiency.

Problem Statement 8:

To observe crop cultivation practices and demonstrate a very basic system for better farm management.

Problem Statement 9:

To study agricultural needs and demonstrate a very basic system to support sustainable farming.

Problem Statement 10:

To observe agricultural resource usage and demonstrate a very basic system to reduce wastage.

Problem Statement 11:

To study field-level agricultural problems and demonstrate a very basic system to assist farmers.

SEMESTER-III

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211301	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21211301	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	--	125

Rationale:

In second-year Civil Engineering, mathematical tools like transforms, statistics, and numerical methods are essential for solving complex engineering problems. The Laplace Transform is widely used to analyze systems such as structural vibrations or fluid dynamics by converting differential equations into algebraic forms. The Inverse Laplace Transform helps retrieve time-domain responses, useful for interpreting how structures respond to dynamic loads. Fourier Series allow engineers to analyze periodic forces, such as vibrations caused by machinery on floors or traffic on bridges. The Z-Transform is applied in analyzing and designing discrete-time systems, such as digital controllers used in water treatment or structural monitoring. Statistical Techniques are key for quality control and data analysis—for example, evaluating material test results or analyzing environmental data like rainfall patterns. Finally, Numerical Solutions of PDEs are critical for modeling phenomena such as groundwater flow or heat transfer in soil, where analytical solutions are not feasible. These tools provide students with a strong analytical foundation for real-world civil engineering applications.

Course Objectives:

1. To introduce the Laplace transform and its application in solving linear differential equations in civil engineering systems.
2. To demonstrate how to retrieve time-domain responses from Laplace-transformed functions in engineering problems.
3. To explain the use of Fourier series in representing periodic functions in structural and environmental systems.
4. To introduce the Z-transform as a tool for analyzing discrete-time civil engineering systems, such as digitally controlled irrigation systems.
5. To teach fundamental statistical methods for interpreting field and lab data in civil engineering projects.
6. To present numerical techniques for solving partial differential equations encountered in geotechnical and environmental engineering.

Course Outcomes:

1. Students will be able to apply Laplace transforms to analyze structural systems under dynamic loading, such as damping in bridge vibrations.
2. Students will solve real-time responses of civil systems like water flow in pipes by computing inverse Laplace transforms.
3. Students will construct Fourier series to analyze periodic loads on structures, such as those caused by rotating machinery on floors.
4. Students will use Z-transform techniques to evaluate discrete system responses, such as water level control in reservoirs.
5. Students will apply statistical tools to analyze data from material testing, such as concrete strength variability or soil compaction results.
6. Students will solve PDEs using methods like finite difference to simulate groundwater flow or temperature distribution in soil layers.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basics of integration and its properties. Partial differentiation.		
I	Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform.	05	CO1
		Laplace Transform (L) of Standard Functions like e^{at}, $sin(at), cos(at), sinh(at), cosh(at)$ and $t^n, n \geq 0$.		
		Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof).		
		Evaluation of integrals by using Laplace Transformation.		
		Self-learning Topics: Heaviside's Unit Step function. Laplace Transform. of Periodic functions. Dirac Delta Function.	08	
II	Inverse Laplace Transform	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.	05	CO2
		Partial fractions method to find inverse Laplace transform		
		Inverse Laplace transform using Convolution theorem (without proof).		
		Self-learning Topics: Applications of Laplace Transforms for solutions to ODE to electrical & electronics circuit problems. Applications to solve initial and boundary value problems involving ordinary differential equations.	07	

III	Fourier Series	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	05	CO3
		Fourier series of periodic function with period 2π and $2l$.		
		Fourier series of even and odd functions.		
		Self-learning Topics: Half range Sine and Cosine Series. Complex form of Fourier Series. Fourier Integral	08	
IV	Z-Transform	Definition and Region of Convergence,	05	CO4
		Transform of Standard Functions: $\{k^n a^k\}$, $\{a^k\}$, $\{c^k \sin(\alpha k+\beta)\}$,$\{c^k sinh\alpha k\}$,$\{c^k \cos(\alpha k+\beta)\}$, $\{c^k cosh\alpha k\}$		
		Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k.		
		Convolution theorem.		
		Inverse Z transform: Partial Fraction Method		
		Self-learning Topics: Initial value theorem. Final value theorem. Inverse Using Convolution Theorem. Inverse using Binominal expansion. Inverse using long division.	07	
V	Statistical Techniques	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	05	CO5
		Lines of regression		
		Fitting of first- and second-degree curves.		
		Self-learning Topics: 1. Karl Pearson's Coefficient of correlation(r). 2. Fitting of exponential curve. 3. Fitting of logarithmic curve. 4. Covariance	07	

VI	Numerical methods for PDE	Introduction of Partial Differential equations, method of separation of variables. Vibrations of string.	05	CO6
		Analytical method for one dimensional heat and wave equations. (only problems)		
		Crank Nicholson method		
		Bender Schmidt method		
		Self-learning Topics: 1. Analytical methods of solving two- and three-dimensional problems. 2. Partial differential equations with constant coefficients 3. Classifications of second order linear partial differential equations.	08	

Text Books:

1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.
2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.
3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.
4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.

References:

1. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.
2. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
3. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.
4. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
5. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/111/106/111106139
2.	https://www.youtube.com/watch?v=LGxE_yZYigI
3.	https://www.youtube.com/watch?v=lkAvgVUvYvY
4.	https://www.youtube.com/watch?v=XfmbrUBrs5Q

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write **at least 10** 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.

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. Regularity and active involvement (Theory and Tutorial) 05 marks.
2. Class Tutorials on entire syllabus 10 marks.
3. MiniProject 10 marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211302	Surveying and Geomatics	3	--	--	45	--		45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21211302	Surveying and Geomatics	20	20	40	60	2.5		--	100

Rationale:

Surveying and Geomatics is a fundamental civil engineering course that provides knowledge of measurement, mapping, and positioning techniques required for planning, design, and execution of engineering projects. The course develops skills in determining distances, elevations, angles, and contours using conventional and modern surveying instruments. It also introduces advanced technologies such as total station, GPS, remote sensing, and GIS for accurate spatial data collection and analysis. The subject enables students to apply computer-based tools for digital mapping, contouring, and survey data processing in infrastructure development projects.

Course Objectives:

1. To introduce the principles and methods of determining relative positions and elevations of natural and man-made features on the Earth's surface.
2. To provide knowledge on the use and operation of theodolites and related instruments for
3. angular measurements and preparation of topographical maps.
4. To familiarize students with advanced surveying techniques including total station, GPS, remote sensing, and GIS technologies.
5. To equip students with skills for performing hydrographic surveys and layout works essential in water resource and marine projects.
6. To develop skills in applying computer-based tools for survey data processing, mapping, and analysis using software like AutoCAD, ArcGIS, and Microsoft Excel.

Course Outcomes:

1. Describe the use of magnetic property of earth to find the directions.
2. Determine the elevations of objects on earth surface.
3. Use theodolite observations for mapping.
4. Get acquainted to advance methods of surveying.
5. Set out of curves for highways and railways.
6. Apply computer applications to process survey data, generate maps, and perform digital contouring using appropriate software tools.

DETAILED SYLLABUS

Sr. No.	**Name of Module**	**Detailed Content**	**Hours**	**CO Mapping**
0	**Prerequisite**	Basic Geometry and Physics, Leveling procedure.		
I	**Compass and Plane Table Surveying.**	Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Concept of bearing, meridian and their types, construction and use of prismatic compass, local attraction and correction for local attraction, dip, declination and calculation of true bearings. Equipment required for plane table surveying and their uses, advantages and disadvantages, methods of plane table survey: Radiation, intersection, traversing.	07	CO1
		Self-learning topics:- Students can explore advanced concepts such as correction of bearings using magnetic declination charts, and digital compass applications in modern surveying.	07	
II	**Levelling and Contouring**	Introduction to leveling, Types of leveling, Types of bench marks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, testing and permanent adjustments,	08	CO2

		reciprocal leveling, curvature and refraction corrections, distance to the visible horizon. Contouring – Direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications.		
		Self-learning topics: - Students can explore the use of drone-based LiDAR and GPS-integrated levels for high-precision contour mapping and Elevation data collection. They can also study modern software applications for generating contour maps and profiles from field data, and learn real-life use cases like road alignment and flood modeling.	08	
III	**Theodolite Surveying.**	Study of vernier transit 20" theodolite, uses of Theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite. Theodolite traversing – Computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table. Checks, omitted Measurements, area calculation by independent co-ordinates.	08	CO3
		Self-learning Topics: Students can explore digital theodolites, error sources, and modern methods of angle measurement using advanced instruments and software tools. They can also study traverse balancing techniques, applications	08	

		in complex construction projects, and comparisons between Traditional and modern surveying equipment.		
IV	**Tacheometry & Electronic Measurement Techniques**	Tacheometry – application and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring.Surveying using total station – Study and use of Electronic Tacheometer (Total station) types, functions (remote elevation measurements, remote distance measurements, area measurement).	08	CO4
		Self-learning Topics: Students can explore advanced topics such as the tangential method, error corrections, and digital mapping using tachometric data, along with real-life applications in topographical surveys. For total station, they can learn types, field setup, integration with GPS/GIS, terrain modeling, and compare it with modern methods like drone.	08	
V	**Curves**	Introduction to horizontal and vertical curves (no numerical and derivations to be asked on vertical curves and reverse curves), different types and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be	07	CO5

		asked), Transition curves: necessity and types.		
		Self-learning Topics: Students can explore the design and application of transition and reverse curves in highways and railways using modern CAD software.	07	
VI	**Computer Applications in Surveying**	Surveying software basics Data processing and plotting AutoCAD / GIS applications Digital mapping and contouring	07	CO6
		Self-learning Topics: Excel for survey calculations, Basics of drone surveying ,Introduction to modern survey software.	07	

Text Books:

1. Duggal, S. K. (2019). *Surveying* (Vol. 2, 5th ed.). McGraw Hill Education.
2. Punmia, B. C., Jain, A. K., & Jain, A. K. (2016). *Surveying* (Vol. 2, 17th ed.). Laxmi Publications.
3. Arora, K. R. (2018). *Surveying* (Vol. 2, 16th ed.). Standard Publishers Distributors.

References:

1. Wolf, P. R., & Ghilani, C. D. (2020). *Elementary Surveying: An Introduction to Geomatics* (16th ed.). Pearson.
2. Gopi, S., Madhu, N., & Sathikumar, R. (2017). *Advanced Surveying: Total Station, GIS and Remote Sensing* (2nd ed.). Pearson Education India.
3. Joseph, G. (2018). *Fundamentals of Remote Sensing* (3rd ed.). Universities Press.
4. Chang, K. T. (2019). *Introduction to Geographic Information Systems* (9th ed.). McGraw Hill Education.

Online References:

Sr. No.	Website Name
1.	NPTEL https://nptel.ac.in
2.	SWAYAM https://swayam.gov.in

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.

- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

3. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
4. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211303	**Mechanics of Solids**	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21211303	**Mechanics of Solids**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale :

Civil & Infrastructure engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting in axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads is prerequisite for an economical and safe design. In this course, learners will understand the behavior; determine the internal forces and analyses the stresses of various structural elements under action of different type of force systems. The knowledge of Mechanics of Solids will be the foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design.

Course Objectives:

1. To compute area moments of inertia and to learn stress - strain behavior and physical properties of materials and to compute the stresses developed and estimate deformation of Elastic members under the action of axial forces and temperature change.

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

Course Outcomes:

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

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Understanding of force systems, support reactions, moments, and free body diagrams. Essential for analyzing equilibrium of structural members. Basic calculus (differentiation & integration) and algebra. Required for stress–strain calculations and deriving structural equations. Knowledge of material properties like elasticity, plasticity, and stress–strain behavior. Important for understanding how structures deform and carry loads.		
I	Stress and Strain	Concept of stress and strain Types of stresses and strains Hooke's Law and elastic constants Stress-strain diagram (ductile and brittle materials) Axially loaded members Thermal stresses	08	CO1
		Self-learning Topics: Real-life applications (columns, rods) & Poisson's ratio application	08	
II	Shear Force and Bending Moment	Types of beams and loads Shear force and bending moment Relation between load, shear force, and bending moment SFD and BMD for simply supported and cantilever beams	08	CO2
		Self-learning Topics: Real Overhanging beams, bridge load analysis	08	
III	Bending Stress in Beams	Theory of simple bending Bending equation Section modulus Bending stress distribution	07	CO3

		Flitched beams and composite sections		
		Self-learning Topics: Design-oriented problems Case studies of beam failures	07	
IV	Torsion	Torsion theory Torsion equation Power transmission Solid and hollow shafts Combined loading (basic concepts)	07	CO4
		Self-learning Topics: Springs and torsion applications in real application	07	
V	Deflection of Beams	Slope and deflection Double integration method Macaulay's method Moment area method Applications in structural analysis	07	CO5
		Self-learning Topics: Application in real structures	07	
VI	Computer Application	Introduction to computational tools Basics of numerical methods in solid mechanics Beam analysis using software (e.g., Excel / Python / MATLAB) SFD and BMD plotting using software Introduction to FEM concepts (basic) Practical case studies	08	CO6
		Self-learning Topics: Beam analysis using software	08	

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
8. Daryl L. Logan, A First Course in the Finite Element Method, Cengage Learning.

References:

1. Mechanics of Materials: James, M. and Barry J.; Cengage Learning.
2. Mechanics of Materials: Andrew Pytel and Jaan Kiusalaas, Cengage Learning.
3. Mechanics of Materials: Timoshenko and Gere, Tata 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.
9. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, McGraw-Hill.
10. Surajit Bhattacharjee, Engineering Computation and Programming using MATLAB, Oxford University Press.
11. R.C. Hibbeler, Structural Analysis, Pearson Education.
12. Saeed Moaveni, Finite Element Analysis: Theory and Application with ANSYS, Pearson.
13. Svein Linge and Hans Petter Langtangen, Programming for Computations – Python, Springer.
14. IS 456:2000, “Indian Standard: PLAIN AND REINFORCED CONCRETE - CODE OF PRACTICE”.

Online References:

Sr. No.	Website Name
1.	NPTEL (National Program on Technology Enhanced Learning) https://nptel.ac.in/
2.	MIT Open Course Ware – Mechanics and Materials https://ocw.mit.edu
3.	Engineering Mechanics Portal – efunda.com https://www.efunda.com

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO’s and **IAT-II** will cover the remaining three CO’s (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211304	Applied Hydraulics	3	-	-	45	-	-	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21211304	Applied Hydraulics	20	20	40	60	2.5	--	--	100

Rationale:

The knowledge of this course is essential to understand facts, concepts of impact of jets, Miscellaneous Hydraulic Machinery. Further it helps to understand the design aspects, components, function and uses of centrifugal pump, turbines. It also helps to study the concept of uniform Flow Through Open Channels, Non-Uniform Flow Through Open Channels.

Course Objectives:

1. To develop an understanding of the principles of jet impact and their application in hydraulic machines.
2. To study the construction, working, performance characteristics, and selection of hydraulic turbines.
3. To understand the operating principles, performance analysis, and applications of centrifugal pumps.
4. To familiarize students with various hydraulic machines and their applications in civil engineering projects.

5. To analyze uniform flow conditions in open channels using hydraulic equations and design concepts.
6. To understand non-uniform flow phenomena in open channels and their engineering applications.

Course Outcomes:

1. Apply the impulse-momentum principle to analyze the impact of jets on stationary and moving surfaces and construct velocity triangles.
2. Evaluate the performance of hydraulic turbines and select appropriate turbines based on head, discharge, and site conditions.
3. Analyze the operation and performance characteristics of centrifugal pumps, including cavitation, priming, and pump selection.
4. Explain the working principles and practical applications of various hydraulic machines used in civil engineering works.
5. Design and analyze uniform flow in open channels using Chezy's and Manning's equations and determine economical channel sections.
6. Apply concepts of specific energy, specific force, gradually varied flow, hydraulic jump, and backwater curves to solve open channel flow problems.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic knowledge of fluid properties, fluid statics, fluid kinematics, continuity equation, Bernoulli's theorem, momentum principle, pipe flow, pressure concepts, energy equation, and types of flow is required. These fundamentals help in understanding hydraulic machines, impact of jets, and open channel flow concepts.		
I	Impact of Jets	Impulse momentum principle, Jet striking flat plates, stationary and moving vertical, inclined plates, hinged plates, curved vanes, series of plates and vanes mounted on wheel, concept of velocity triangles.	07	CO1
		Self-Learning Topics : Applications of jet	07	

		propulsion in hydraulic structures, Performance analysis of jet impact on moving vanes in turbines, Use of impulse-momentum principle in design of hydraulic machines, Case studies on Pelton wheel installations in India, Numerical problems using velocity triangles in turbine design.		
II	Hydraulic Turbines	General layout of hydro-electric plant, heads, efficiencies of turbine, classification, concept of velocity triangles working of Impulse Turbine (Pelton Wheel), Reaction Turbine, Francis Turbine, Kaplan Turbine, draft tube theory, specific speed, unit quantities, Characteristic curves, Cavitation	08	CO2
		Self-Learning Topics: Layout planning of small hydroelectric power plants, Selection of turbines based on site conditions and head, Cavitation control techniques in turbines, Case study of major hydroelectric projects in India, Environmental impact of hydroelectric power generation.	08	
III	Centrifugal Pumps	Work done, heads, efficiencies, Minimum speed: series parallel operation, Multistage pumps, concept of velocity triangles, specific speed, model testing, priming, characteristic curves, NPSH, cavitation.	08	CO3
		Self-Learning Topics: Selection of pumps for water supply and irrigation systems, Energy efficiency in pumping systems, Causes and prevention of cavitation in pumps, Field problems related to priming and troubleshooting, Case study of municipal water pumping stations.	08	

IV	Miscellaneous Hydraulic Machinery	Hydraulic Ram, Hydraulic Press, Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift, Hydraulic Jack, Hydraulic Braking System, Applications of Hydraulic Systems in Civil Engineering.	07	CO4
		Self-Learning Topics : Hydraulic machinery applications in dam construction and spillway gates, Use of hydraulic jacks and lifts in bridge construction and maintenance, Role of hydraulic cranes in heavy construction and material handling, Application of hydraulic systems in tunneling and underground works, Maintenance and safety considerations of hydraulic equipment on construction sites.	07	
V	Uniform Flow Through Open Channels	Uniform Flow: Flow through open channel: Definition, types of channels, Prismatic, non-prismatic channels, Types of flows in channels, Uniform flow: steady flow and unsteady flow, laminar and turbulent flow, subcritical flow, supercritical flow, Chezy's formula, Manning's formula, hydraulically efficient channel cross-sections (most economical sections).	08	CO5
		Self-Learning Topics: Design of irrigation canals using Manning's equation, Comparison of Chezy's and Manning's formulas in field conditions, Case studies on canal lining and efficiency improvement, Design of most economical channel sections for different shapes, Field measurement techniques for open channel flow.	08	
VI	Non-Uniform Flow	Concept of specific energy and specific energy	07	CO 6

	Through Open Channels	curve, Dimensionless specific energy discharge curve, applications of specific energy and Momentum principle to open channel flow, specific force. Gradually varied flow, equation for gradually varied flow, back water curve and afflux, Introduction to surface profiles, Hydraulic jump and standing wave		
		Self-Learning Topics: Applications of hydraulic jump in energy dissipation structures, Analysis of flood routing using gradually varied flow concepts, Case study of backwater effect in rivers near bridges, Design of stilling basins using hydraulic jump theory, Numerical methods for solving GVF equations.	07	

Text Books:

1. Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi.

2. Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.

3. Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.

4. Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538.

5. Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons

6. Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.

7. Flow through open channels, K.G. Ranga Raju. (1993) : New Delhi : Tata McGrawHill, c1993.

8. Flow Through Open Channels. Rajesh Srivastava (2007): Oxford University Press, 2007, pbk, 432 p, ISBN: 0195690385.

References:

1. Fluid Mechanics: Frank M. White, Tata Mc-Graw Hill International Edition.

2. Fluid Mechanics: Streeter White Bedford, Tata Mc-Graw International Edition.

3. Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Finnemore, Tata Mc-Graw 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

6. Open channel Hydraulics: Chow, V.T., McGraw Hill International, New York.

7. Open Channel Flow: Henderson F.M., McGraw Hill International, New York.

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/105/105/105105203/
2	https://archive.nptel.ac.in/courses/105/107/105107059/
3	https://nptel.ac.in/courses/105103021

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
21212305	Surveying and Geomatics Lab	--	--	02	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21212305	Surveying and Geomatics Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. Measure magnetic bearings of sides of triangles or polygons using a prismatic compass.
2. Apply corrections for local attraction and calculate true bearings accurately.
3. Determine horizontal and vertical distances using a tachometer.
4. Perform simple and differential levelling with at least three change points using a digital level.
5. Measure horizontal angles using the repetition method with a Vernier Transit Theodolite.
6. Set out circular curves using Rankine's method based on deflection angles.

Lab Outcomes:

1. Demonstrate proficiency in measuring magnetic bearings of sides in triangles or polygons accurately using a prismatic compass.
2. Apply appropriate corrections for local attraction and compute true bearings with precision to ensure accurate survey results.
3. Calculate horizontal and vertical distances efficiently using tachometric methods, enabling reliable field measurements.

4. Execute simple and differential levelling procedures with multiple change points using digital levelling instruments to determine accurate elevation differences.

5. Measure horizontal angles precisely by employing the repetition method on a Vernier Transit Theodolite, ensuring angular accuracy in surveying.

6. Set out circular curves in the field accurately using Rankine's method of deflection angles, facilitating precise alignment in construction projects.

List of Experiments. (Any Six)

Sr. No.	**List of Experiment**	**Hrs**	**LO mapping**
I	Measurement of magnetic bearings of sides of a triangle or polygon, correction for local attraction and calculations of true bearings using prismatic compass.	04	LO1, LO2
II	Finding horizontal and vertical distance using Tacheometer.	04	LO3
III	Measurement of horizontal angles (by repetition method) using Vernier Transit Theodolite.	04	LO5
IV	Setting out a circular curve by Rankine's method of deflection angles.	04	LO6
V	Solution to three point problem by analytical method	04	LO2, LO5
VI	Distance and angle measurements using Total station.	04	LO3, LO5
VII	Measurement of included angles and bearings using Vernier Theodolite.	04	LO1, LO5
VIII	Determination of reduced levels by rise and fall method.	04	LO4
IX	Plane table surveying by radiation method.	04	LO2
X	Determination of height of inaccessible object using Theodolite.	04	LO5
	Project I: Road project using Auto level for a minimum length of 100 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-sections).	06	LO1, LO2

Sr No	List of Assignments
1	Study of Surveying Fundamentals: Classification (Plane & Geodetic), Scale, Ranging, Chaining, Offsetting and Traversing.
2	Study of Compass Surveying: Prismatic Compass, Bearings, Meridian Types, Local Attraction and Corrections.
3	Study of Plane Table Surveying: Equipment), Methods (Radiation, Intersection, Traversing) and Applications.
4	Study of Levelling and Contouring: Types of Levelling, Bench Marks, Dumpy Level, Contour Maps and Applications.
5	Study of Theodolite Surveying: Measurement of Angles, Traversing, Adjustments and Computation Methods.
6	Write a short report on modern surveying instruments such as GPS, DGPS, GIS, and drone surveying techniques.

Text Books:

1. T. P. Kanetkar and Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune Vidyarthi Griha Prakashan.
2. Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain , Surveying, Vol. I & II, Laxmi Publications.

Reference Books:

1. R1. Surveying by C. Venkatramaiah , University Press.
2. R2. Surveying, Vol. I & II by S. K. Duggal, Tata Mc-Graw Hill.
3. R3. Surveying and Levelling by Subramanian, Oxford University Press.

Online References:

Sr. No.	Website Name
1.	https://www.vlab.co.in
2.	www.geogebra.org
3.	https://nptel.ac.in

Assessment:

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

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

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

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credit (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21212306	Computer Applications Lab I	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21212306	Computer Applications Lab I	--	--	--	--	--	25	25	50

Lab Objectives:

1. To develop programming skills for solving basic civil engineering problems.
2. To apply computational techniques for engineering calculations and analysis.
3. To understand the use of Python and Excel in civil engineering applications.
4. To perform calculations related to surveying, mechanics, fluid mechanics, and structures.
5. To analyze engineering data and represent results graphically.
6. To enhance problem-solving and logical thinking abilities through programming.

Lab Outcomes:

1. Calculate geometric properties such as area and volume using programming tools.
2. Analyze force systems and determine equilibrium conditions in engineering problems.
3. Perform surveying computations including RL calculations and traverse adjustments.
4. Compute stress, strain, deformation, and material properties using programs.
5. Solve fluid mechanics and pipe flow problems using computational methods.
6. Apply numerical methods and software tools for engineering calculations and graph plotting.

LIST OF EXPERIMENTS.

Sr No	List of Experiments (Any 10)	Hrs	LO
01	Develop a program to calculate area of basic civil engineering shapes (rectangle, triangle, circle).	3	LO1
02	Develop a program to calculate volume of basic structures (cube, cylinder, prism) and prepare an Excel sheet for basic engineering calculations.	3	LO6
03	Write a program to calculate the resultant of coplanar force system.	3	LO1
04	Develop a program to verify equilibrium of forces and compute support reactions of a simply supported beam using Python.	3	LO1
05	Develop a program to calculate Reduced Levels (RL) using HI method.	3	LO2
06	Develop a program for Rise & Fall method and perform traverse adjustment using Bowditch rule. Plot survey data using Excel/AutoCAD.	3	LO2
07	Write a program for stress-strain calculation and plot the stress-strain curve.	3	LO3
08	Develop a program to calculate axial deformation of a bar and determine Young's Modulus.	3	LO3
09	Write a program to calculate pressure at a given depth in fluid.	3	LO4
10	Develop a Bernoulli's equation solver and calculate discharge in pipes using Excel/software.	3	LO4
11	Write a program to solve linear equations using matrix method.	3	LO5
12	Perform graph plotting and solve equations using numerical methods (Bisection method).	3	LO5, LO6
13	Develop a program to calculate Shear Force and Bending Moment at different sections of a simply supported beam and plot SFD and BMD.	3	LO1, LO6
14	Write a program to calculate flow through pipes using Darcy–Weisbach equation and determine head loss.	3	LO4
15	Develop a program to perform numerical integration (Trapezoidal Rule) and apply it to estimate areas and engineering quantities.	3	LO5, LO6

Sr No	List of Assignments / Tutorials (Any 4)
01	Develop algorithms and Excel sheets for area, volume, and basic engineering calculations.
02	Analyze coplanar force systems and verify equilibrium using programming tools.
03	Compute and validate support reactions of simply supported beams using Python/Excel.
04	Perform RL calculations (HI and Rise & Fall methods) and compare manual and program results.
05	Solve traverse adjustment using Bowditch rule and plot survey data using software.
06	Analyze stress-strain behavior and axial deformation using computational tools.

Text Books:

1. Python for Engineers: A Practical Approach, Jim Ledin and engineers' community contributors, Engineering applications of Python programming
2. Microsoft Excel 2019 Step by Step, Curtis D. Frye, 1st Edition, Microsoft Press, 2018.
3. Excel Basics In 30 Minutes, Ian Lamont, (Latest Edition), i30 Media Corporation.
4. Engineering with Excel, Ronald W. Larsen, (Latest Edition), Pearson Education.
5. AutoCAD for Engineers and Designers, Sham Tickoo, (Latest Edition), CADCIM Technologies.

References:

1. Introductory Methods of Numerical Analysis, S. S. Sastry, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Engineering Mechanics: Statics and Dynamics, R. C. Hibbeler, Pearson Education, India.
3. Introduction to Fluid Mechanics, Robert W. Fox, Alan T. McDonald, and Philip J. Pritchard, Wiley India Pvt. Ltd.
4. Strength of Materials, R. K. Bansal, Laxmi Publications, New Delhi.

Online Resources:

Sr. No.	Website Name
1.	NPTEL – Free video lectures for core civil engineering subjects. https://nptel.ac.in
2.	W3Schools – Easy tutorials for Python, C, and basic programming. https://www.w3schools.com
3.	Google Colab – Free platform to run Python programs online. https://colab.research.google.com
4.	Google Sheets – Free tool for calculations, data analysis, and graph plotting. https://www.google.com/sheets/

Assessment:

Term Work: Term Work shall consist of at least 8 to 10 practical's based on the above list. Also, Term work Jonal must include at least 2 assignments.

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

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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431308	Entrepreneurship Development	2	-	-	30		-	30	60	2

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total	IAT-I	IAT-II			
98431308	Entrepreneurship Development	--	--	--	--	--	25	--	25

Rationale:

Entrepreneurship is a crucial skill in the 21st century, fostering innovation, self-employment, and economic development. This course is designed to equip students with practical entrepreneurial competencies such as ideation, business model development, financial planning, legal frameworks, and pitching.

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.
3. Develop comprehensive business plans and financial strategies.
4. Explore legal and funding options for startups in India.
5. Apply marketing, digital tools, and CRM for business growth.
6. Design prototypes and present business pitches to stakeholders.

Course Outcomes:

1. Explain entrepreneurial concepts and analyze types and traits of entrepreneurs.
2. Apply ideation techniques and validate business ideas using customer discovery tools.

3. Create business plans with financial projections and risk analysis.
4. Evaluate funding sources and legal requirements for a startup.
5. Implement digital marketing and branding strategies effectively.
6. Prepare and deliver compelling business pitches with basic prototyping.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.		
I	**Introduction to Entrepreneurship**	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	04	CO1
		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 **Case Study**: Nirma – A middle-class entrepreneur revolutionizing detergents.	04	
II	**Business Idea Generation & Validation**	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	05	CO2
		Self-learning Topics: Lean Canvas, Persona Creation **Case Study:** Airbnb – Validating the concept with MVP	05	

III	**Business Planning & Strategy**	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management.	05	CO3
		Self-learning Topics: Financial forecasting using Excel/Google Sheets. **Case Study:** Zomato – Expansion through mergers & strategic pivots	05	
IV	**Funding and Legal Framework**	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Intellectual Property Rights (IPR) & Patents	06	CO4
		Self-learning Topics: DPIIT recognition process and types of funding **Case Study: Paytm –** From Wallet to IPO: Funding journey	06	
V	**Marketing & Digital Presence**	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship management (CRM).E-commerce & Online Business Models.	05	CO5
		Self-learning Topics: Use of Canva, Google Analytics	05	
		Case Study: Lenskart Omni channel e-commerce marketing		

VI	**Business Pitching & Prototype Development**	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch.	05	CO6
		Self-learning Topics: Canva for pitch deck or Successful Start-ups. **Case Study:** Dunzo – MVP to final app evolution	05	

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 References:

Sr. No.	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

Assessment:

Term Work: Term Work shall consist of at least 8 to 10 practical's based on the above list. Also, Term work Jonal must include at least 2 assignments.

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

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451309	Environmental Science	2	-	-	30		-	30	60	2

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
98451309	Environmental Science	20	20	40	60	2.5	--	--	100

Rationale:

Environmental Science provides a multidisciplinary perspective to understand, analyze, and solve ecological challenges. With growing global concern over climate change, pollution, and sustainable development, it is essential to equip students with the knowledge, skills, and values needed to contribute to sustainable solutions.

Course Objectives:

1. To understand the interrelationship between human activities and the environment.
2. To explore natural ecosystems and biodiversity conservation techniques.
3. To identify causes, effects, and mitigation strategies for various types of environmental pollution.
4. To analyze key environmental policies, laws, and sustainability practices.
5. To develop awareness, ethics, and responsibility towards environmental protection.
6. To promote sustainable development through informed decision-making and community participation.

Course Outcomes:

1. Explain core concepts of environmental science and ecological balance.
2. Identify sources and impacts of pollution on ecosystems and human health
3. Evaluate biodiversity importance and conservation strategies.

4. Analyze climate change, global warming, and their mitigation approaches.
5. Interpret government policies and sustainable practices for environment management.
6. Propose solutions for environmental issues at local and global levels.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.		
I	**The Multidisciplinary Nature of Environmental Studies**	Definition, scope and importance. Need for public awareness. Role of information technology in environment and human health. Human population and the Environment. Population growth, variation among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare.	05	CO1
		Self-learning Topics: Environmental ethics **Case Study**: Chipko Movement (India) – Grassroot conservation.	05	

II	**Natural Resources**	Renewable and non-renewable resources. Natural resources & associated problems: a. Forest resources: b. Water resources: Natural resources & associated problems c. Mineral resources: d. Food resources: e. Energy resources: Role of an c. Mineral resources: d. Food resources: e. Energy resources: Role of an individual in conservation of natural resources: f. Equitable use of resources for sustainable lifestyles.	05	CO2
		Self-learning Topics: Carbon footprint calculators **Case Study:** Rainwater Harvesting	05	
III	**Ecosystems**	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem	05	CO3
		c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, Oceans, estuaries).Case study on various ecosystems in India.		

		Self-learning Topics: Biodiversity in Indian context **Case Study:** various ecosystems in India.	05	
IV	**Biodiversity and its Conservation**	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	05	CO4
		Self-learning Topics: Indoor pollution sources	05	
V	**Environmental Pollution Definition**	Causes of Pollution, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes.	05	CO5
		Role of an individual in prevention of pollution.		
		Self-learning Topics: Greenhouse gases **Case study:** Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	05	

VI	**Social Issues and Environment**	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Consumerism and waste products. Environment protection act. Public awareness.	05	CO6
		Self-learning Topics: Environmental audit methods. **Case Study:** Environmental Ethics.	05	

Text Books:

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spool man, 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 1, 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

References:

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, Earth 2009.
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press, 1999.

Online References:

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

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
21612310	IDEA LAB 3 -(Innovation Design Engineering and Apply)	1	-	2*	15	-	30	15	60	2

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21612310	IDEA LAB - 3 (Innovation Design Engineering and Apply)	--	--	--	--	--	50	50	100

Rationale:

Aligned with the National Education Policy (NEP) 2020, the institution promotes experiential and project-based learning through the IDEA Lab. A theme-based academic model aligned with the UN SDGs is implemented, where each semester includes six problem statements based on local needs and linked to core subjects. Students select one problem and develop an individual, subject-integrated solution, encouraging the application of classroom knowledge to real-world challenges.

The IDEA Lab supports students in design thinking, prototyping, and product development, while project logbooks are maintained to document progress. Assessment is carried out using standardized IDEA Lab rubrics, including Engineering Subject-Based Assessment to evaluate the effective integration of same-semester subject knowledge into project work.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world

problem-solving.

2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme..
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Students must ensure that their IDEA Lab project meaningfully incorporates concepts from all core subjects of the current semester and maintain a project logbook as evidence of subject-wise application.

- Faculty in-charge must guide students to apply concepts from subjects studied in the same semester to their IDEA Lab projects.
- The term work evaluation will partially reflect the effective application of subject-specific knowledge.
- Faculty should regularly review the integration of academic content within the project work.

2) Implementation Strategy – IDEA Lab Learning Model

- A theme-based learning structure shall be implemented where each semester is anchored to a broad contextual domain such as Healthcare, Smart Cities, Energy, Agriculture, or Governance, providing the overall learning direction.
- From the identified theme, a system-level, open-ended problem statement shall be defined, serving as a solution-neutral framework that enables interdisciplinary thinking and innovation.
- The learning sequence shall follow a structured flow:
  Theme → Problem Statement → Same Semester Subject Application → Design–Implementation Experience, ensuring progressive transformation from context to solution.
- Themes shall provide the context (defining the domain of work), while problem statements shall provide the purpose, enabling students to identify meaningful real-world challenges.
- Subjects shall be treated as engineering tools, where each subject contributes specific knowledge components to solve different aspects of the problem.
- Students shall be encouraged to take ownership of their learning and projects, fostering curiosity, exploration, social relevance, and a mindset of creative risk-taking.
- Structured brainstorming and ideation sessions shall be conducted at the beginning of the semester to guide students in problem identification and development of solution pathways through collaborative and interdisciplinary thinking.
- Guest lectures and expert talks shall be organized by inviting industry experts, researchers, and innovators aligned with the semester theme and subject areas to provide exposure to real-world challenges, trends, and opportunities.
- A mechanism shall be implemented to ensure uniqueness and originality of projects by systematically reviewing ideas to avoid duplication and encouraging novel, technology-driven solutions.

- Platforms shall be created for collaborative learning and discussion, enabling students to present ideas, receive peer and mentor feedback, and refine solutions through iterative engagement.
- Content beyond syllabus for as subject shall be integrated with IDEA Lab themes and problem statements to ensure deeper interdisciplinary application and enhanced conceptual understanding.
- Preference shall be given to ensuring same-semester academic alignment, where subject faculty contribute to effective contextual integration of project-based learning.
- Continuous monitoring and documentation shall be ensured through logbooks, milestone tracking, and periodic progress reviews to maintain academic rigor and outcome alignment.
- Coordination with subject faculty shall be ensured for effective mapping of theoretical concepts into project execution and for evidence-based term work assessment.
- The IDEA Lab shall function as an institutional mechanism for implementing the CDIO (Conceive–Design–Implement–Operate) framework, promoting experiential and outcome-based learning through structured mini-projects.

Implementation Notes:

- Guide will assess subject's contribution using specific evidence such as:
    - Logbooks
    - Subject-specific outputs (e.g., simulations, designs)
    - Paper publications or review presentations

3) Guidelines for Assessment

Assessment Month	Marks
Month 1 (Formative 1)	50 marks
Month 2 (Formative 2)	50 marks
Month 3 (Formative 3)	50 marks

Total Assessment Structure

Component	Marks	Assessed By
Term work – Project Execution	50 Marks	Project Guide – Average of all innovation
Viva Voce (Final Evaluation)	50 Marks	External Examiner

Criteria	**Excellent (10)**	**Good (8)**	**Satisfactory (6)**	**Needs Improvement (4)**
1. Innovation	Highly original and disruptive idea solving a real-world or futuristic problem	Novel idea with a creative approach to a known problem	Moderately innovative; adapts existing solutions	Common or repetitive idea with minimal novelty
2. Design	User-centric, systematic design with professional-level tools, prototyping, or simulations	Logical structure; clearly presented using standard tools	Functional design but limited user perspective or refinement	Poor or confusing design with lack of user consideration
3. Engineering	Applies concepts from all same-semester subjects with clear integration and interdisciplinary depth	Applies knowledge from 4 or more subjects with relevance	Applies 2–3 subjects with moderate clarity	Applies 1 subject with weak or shallow connection
4. Implementation	Complete, fully functional prototype with rigorous testing	Working model with minor errors; partially tested	Prototype is incomplete; basic testing or debug attempt	Poorly implemented; fails to function properly

	and real-world validation			
5. Application	Strong real-world relevance with alignment to SDGs/National Missions; impact clearly identified	Clear practical use-case with user/market relevance	Some practical value but limited clarity on impact	Vague or irrelevant application; weak user connect

SEMESTER-IV

Semester –IV

Theme: Infrastructure

Aligned with UNSDG: UNSDG 9 – Industry, Innovation and Infrastructure, UNSDG 11 – Sustainable Cities and Communities, and UNSDG 12 – Responsible Consumption and Production through sustainable infrastructure development and efficient resource management.

Problem Statement 1:

To study challenges in infrastructure systems and demonstrate a very basic system for improved resource utilization.

Problem Statement 2:

To study challenges related to infrastructure accessibility and explore approaches that improve usability for diverse users

Problem Statement 3:

To investigate infrastructure maintenance practices and identify opportunities for enhancing service life and reliability.

Problem Statement 4:

To study safety-related challenges in infrastructure environments and explore solutions that improve user well-being.

Problem Statement 5:

To examine resource utilization within infrastructure systems and develop approaches that support sustainable operations

Problem Statement 6:

To analyze infrastructure processes and demonstrate a very basic system to enhance operational efficiency.

Problem Statement 7:

To observe infrastructure usage patterns and demonstrate a very basic system for better infrastructure management.

Problem Statement 8:

To study infrastructure needs and demonstrate a very basic system to support sustainable development.

Problem Statement 9:

To observe infrastructure resource usage and demonstrate a very basic system to reduce wastage.

Problem Statement 10:

To study field-level infrastructure problems and demonstrate a very basic system to assist infrastructure management.

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211401	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21211401	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In a second-year Civil Engineering curriculum, statistical and optimization tools play a vital role in solving practical engineering problems. Probability and normal distributions are used to model uncertainties in material properties, loads, and environmental factors—key for risk assessment in structural and geotechnical design. Large and small sample tests support decision-making in quality control, such as determining whether a batch of concrete meets strength specifications. Chi-square and F-tests are applied to compare variability in materials or construction techniques, ensuring consistency and reliability. Linear programming and the Simplex method help optimize project planning—such as minimizing construction costs or scheduling tasks efficiently—while Duality offers insights into how changing constraints affects the outcome. Nonlinear problems, like slope stability or optimizing foundation designs under complex conditions, are addressed using Kuhn-Tucker conditions. Transportation and Assignment Models are essential for logistics, such as determining the most efficient way to move construction materials or assigning equipment and workers to tasks. These techniques equip students with practical, analytical tools to manage resources, ensure safety, and optimize performance in real-world civil engineering projects.

Course Objectives:

1. To explain probability distributions, especially normal distribution, to model variability in civil engineering data.
2. To describe hypothesis testing procedures for validating sample data reliability in civil engineering.
3. To understand statistical tests for assessing independence and variance in construction data.
4. To understand linear optimization techniques for efficient resource allocation in civil projects.
5. To explain nonlinear constrained optimization methods for civil engineering design.
6. To describe transportation and assignment models for optimizing logistics and workforce.

Course Outcomes:

1. Students will be able to apply normal distribution concepts to analyze uncertainties in material properties and loads.
2. Students will be able to evaluate soil bearing capacity or other parameters using Z-tests and t-tests.
3. Students will be able to analyze variability in construction materials using Chi-square and F-tests.
4. Students will be able to solve resource allocation problems using simplex and duality methods.
5. Students will be able to apply Kuhn-Tucker conditions to solve nonlinear constrained optimization problems.
6. Students will be able to optimize transportation and assignment problems to reduce cost and improve efficiency.

Prerequisite:

Definition of probability, Exhaustive events, Pair wise independent events, Multiplicative law of probability, Conditional probability, Baye’s theorem.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Probability Distribution	Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables	05	CO1
		Normal distribution.		
		Expectation, Variance, Moment generating function, Raw and central moments up to 4^{th} order.		
		Central limit theorem.		
		Self-learning Topics: 1. Skewness and Kurtosis of distribution (data). 2. Discrete distribution: Bernoulli, Binomial, Poisson.	07	
I	Sampling theory-I	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two tailed test, Degree of freedom.	05	CO2
		Test significance for large samples. Test the significance of mean.		
		Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)		
		Self-learning Topics: 1. Estimate parameters of a population. 2. Test of significance of large samples, Proportion test. 3. Difference between the means of two large samples.	07	
III	Sampling theory-II	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction.	05	CO3
		Analysis of variance: F-test (significant difference between variances of two samples).		

		Self-learning Topics: 1. ANOVA**:** One way classification, 2 . ANOVA**:** Two-way classification (short-cut method).	08	
IV	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables.	05	CO4
		Simplex method.		
		Duality, Dual of LPP.		
		Dual Simplex Method.		
		Self-learning Topics: Artificial variable method, Big M method. Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	07	
V	Nonlinear Programming Problems	NLPP with one equality constraint (two variables) using the method of Lagrange's multipliers	05	CO5
		NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions		
		Self-learning Topics: 1. NLPP with one equality constraint (three variables) using the method of Lagrange's multipliers 2. NLPP with one inequality constraint (three variables): Kuhn-Tucker conditions	08	
VI	Transportation and Assignment Models	Transportation Problem Basics & Formulation	05	CO6
		North-West Corner Rule		
		Least Cost Method		
		Vogel's Approximation Method (VAM), Optimality Check (MODI Method)		
		Assignment Problem Basics, Hungarian Method		
		Self-learning Topics: 1. Introduction & Concepts of PERT and CPM	08	

		2. Earliest Start (ES) and Earliest Finish (EF). 3. CPM Backward Pass & Critical Path 4. PERT Expected Time & Variance. 5. PERT Network Forward and Backward Pass. 6. Probability Calculations.		

Text Books:

1. Operations Research, Hira and Gupta, S. Chand Publication.
2. Fundamentals of Statistics, S. C. Gupta.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
4. Murray Spiegel, "Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Operations Research: An Introduction, Hamdy A Taha, Pearson.
4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.
5. S. D. Sharma, "Operations Research", Kedarnath Ramnath Publishing, Meerut, 8th Edition, 2015.

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write **at least 10** 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.

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. Regularity and active involvement (Theory and Tutorial) 05 marks.

2. Class Tutorials on entire syllabus 10 marks.

3. Mini Project 10 marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)				Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211402	Sustainable Construction Materials and Concrete Technology	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
21211402	Sustainable Construction Materials and Concrete Technology	20	20	40	60	2.5	--	--	100

Rationale:

This course imparts foundational knowledge of concrete materials and modern practices in sustainable construction. It introduces eco-friendly alternatives such as green concrete, recycled materials, and low-carbon technologies, aligning with global sustainability goals and SDGs. The integration of climate-responsive engineering, innovative materials, and performance-based design prepares students to develop durable, resource-efficient, and future-ready infrastructure solutions.

Course Objectives:

1. To Understand the composition, properties, and behavior of concrete as a construction material.
2. To understand the fundamental behavior of concrete in its fresh and hardened states, and to perform relevant tests or evaluating performance, strength, and durability aligned with sustainable infrastructure practices.
3. To impart knowledge of concrete mix design principles using IS codes, enabling students to develop durable and sustainable concrete mixes through lab trials.
4. To introduce students to sustainable construction materials and their role in reducing the environmental footprint of infrastructure development.
5. To introduce the principles, materials, and performance benefits of green concrete as a sustainable alternative in construction.
6. To equip students with knowledge of innovative materials and technologies for developing sustainable and climate-resilient infrastructure using concrete.

Course Outcomes:

After completing this course, students will be able to:

1. Describe the physical and chemical properties of concrete ingredients and their significance.
2. Evaluate the properties and behavior of fresh and hardened concrete using standard laboratory and non-destructive testing methods.
3. Perform concrete mix design for different grades using IS standards and apply statistical quality control techniques for optimizing mix performance and sustainability.
4. Identify and classify various sustainable construction materials and assess their benefits over conventional materials.
5. Apply the principles of green concrete technology to design and assess sustainable and climate-responsive concrete mixes.
6. Propose and evaluate innovative, low-carbon, and climate-responsive concrete strategies for sustainable infrastructure projects.

Prerequisite: Basics of construction materials, Sustainability in Civil Engineering, UNSDG

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Definition of sustainability in civil engineering, Triple bottom line (economic, environmental, social), Sustainable Development Goals (SDGs) and their connection to infrastructure		
I	**Concrete Materials:** Cement, Aggregates, Water, Lime, and Admixtures	Cement: Grades, Manufacturing, Chemical composition, Hydration of cement, Physical properties as per BIS code. Effects of chemical constituents on the properties of cement; Different types of cement: properties as per relevant IS codes and their applications. Fine and Coarse Aggregates: Classification, physical and mechanical properties and their influence on the	08	CO1

		properties of concrete, gradation, Alkali aggregate reaction. Properties of manufacturing sand. Water: Desired Quality of water for concrete Lime: Types and their usages Admixtures – Definition, purpose, types, Influence on workability, strength, and durability, IS standards and selection criteria		
		Self-learning Topics: Review of IS Codes, Green alternatives to traditional cement, Role of recycled aggregates in sustainable construction	08	
II	**Behavior and Testing of Fresh and Hardened Concrete for Sustainable Performance**	Concrete: Grades, manufacturing process, Duff Abram's W/C ratio law & its significance Fresh concrete: Properties, Workability – factors affecting workability, cohesion and segregation, Bleeding, Laitance, Various Test on fresh concrete Hardened Concrete: Properties, Strength of concrete, factors affecting strength, Various Test on hardened concrete Ready Mixed Concrete: Advantages of RMC, Components and Lay-out of RMC plant, Codes recommendations. Nondestructive testing on Concrete (NDT): Need, application and limitation	07	CO2
		Self-learning Topics: Influence of curing conditions on concrete	07	

		durability, Use of smart sensors for in-situ monitoring of concrete strength		
III	**Concrete Mix Design for Sustainable Construction**	Concepts of Mix Design, Factors to be considered, Statistical quality control, Laboratory trial mixes and guidelines to improve mix, methods of Mix Design by IS (10262, IS 456), Curing of concrete, Basics of Computerized mix design using Excel templates	08	CO3
		Self-learning Topics: Use of mix design software, Sustainability considerations in mix design	08	
IV	**Sustainable Construction Materials**	Overview of Sustainable Construction Materials: Fly ash, GGBS, silica fume, metakaolin, Geopolymer cement and alkali-activated binders, Recycled concrete aggregates (RCA) and manufactured sand (M-sand), Agro-waste-based materials (rice husk ash, coconut shell, etc.), Bamboo, stabilized soil blocks, and bio-based composites Applications: Practical applications in roads, buildings, and rural housing	08	CO4
		Self-learning Topics: Case studies of sustainable buildings and infrastructure in India, Carbon-neutral and carbon-negative material innovations	08	
V	**Green Concrete Technology**	Performance Characteristics of Green Concrete: Workability, strength, durability comparison with traditional concrete Mix Design Considerations: Modifying traditional IS mix design approach for green concrete, Challenges in achieving workability and strength	07	CO5

		with waste materials Case examples: Low-carbon M25/M30 mixes with 40–60% SCM replacement		
		Self-learning Topics: Global innovations: CO_2-injected concrete, self-healing green concrete	07	
VI	**Innovative and Climate-Responsive Concrete Solutions for Sustainable Infrastructure**	Environmental Impact of Traditional Materials: Carbon footprint of cement, steel, and bricks Low-Carbon Concrete Technologies: Carbon footprint of OPC-based concrete, Introduction to low-carbon alternatives: Geo polymer concrete, High-volume fly ash concrete Innovative Concrete Solutions: Photocatalytic concrete, Phase-change materials (PCMs) in thermal-responsive concrete, Nano concrete technology.	07	CO6
		Self-learning Topics: Infrastructure Resilience Index (IRI), IS 16415, Success stories from India's Smart Cities Mission and AMRUT projects	07	

Text Books:

1. A Building Construction: S.C. Rangwala, Charotar Publications, Gujarat, India.
2. Building Construction: S.P. Arora, Dr.S.P. Bindra,DhanpatRai Publication, New Delhi.
3. Building Construction: Dr. B.C. Punmia, A.K.Jain, A.R.Jain,Laxmi Publication., 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, McGraw Hill Publications.

6. Properties of concrete: Neville, Isaac Pitman, London.

7. IS 10262:2009, Mix Design, "Guidelines for proportioning materials in concrete mix Concrete Technology".

Online References:

Sr. No.	Website Name
1.	Updates on construction materials and innovations in India www.nbmcw.com
2.	Indian Green Building Council – resources and rating systems www.igbc.in
3..	Building Research Establishment Environmental Assessment Method www.breeam.com

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.

- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21211403	**Structural Analysis**	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
21211403	**Structural Analysis**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale:

This syllabus outlines a comprehensive course on structural analysis, covering various aspects related to the behavior 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 behaviors, and methods to assess determinacy and indeterminacy.
4. To equip students with the ability to analyses indeterminate structures using displacement & force

methods.

5. To provide knowledge of plastic analysis techniques and enable students to determine collapse loads for beams using static and kinematic methods.

6. To link structural behavior and design decisions with real-world sustainability and inclusive development outcomes. To promote use of modern tools and innovative techniques aligned with global development goals.

Course Outcomes:

1. Classify structures into determinate and indeterminate categories, considering their static and kinematic behavior, material properties (linear and non-linear), and geometric nonlinearity.
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. Evaluate the collapse load of single and multiple-span beams by applying plastic analysis techniques
4. Analyze and design three-hinged arches under various loading conditions by calculating internal forces (horizontal thrust, radial shear, and normal thrust).
5. Analyze indeterminate structures by applying force methods to evaluate structural behavior. Apply displacement methods to analyze indeterminate structures and evaluate their internal forces and deformations under various loading conditions.
6. Evaluate smart structural systems and infrastructure using advanced materials, adaptive behavior, and digital tools like STAAD.Pro and ETABS for sustainable, modular design solutions.

Prerequisite: Applied Mathematics, Engineering Mechanics and Mechanics of solids.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Understanding force systems, support reactions, free-body diagrams (FBDs), and equilibrium equations. Essential for formulating and solving static problems in beams, frames, and trusses. Knowledge of stress-strain relationships, bending moments, shear forces, and deformation in structural members. Critical for analyzing internal forces and calculating deflections. Skills in solving simultaneous equations, matrix operations, and		

		calculus (integration/differentiation).		
I	**Analysis of Beams**	Type of structure. Static and Kinematic indeterminacy and indertminanccy of structure. Analysis of Propped cantilever and fixed beams by Castigliano's theorem. Analysis of continuous beams by three moment theorem (Clapeyron theorem) up to three indeterminacies. Analysis of Indeterminate beams by Enegry methods & Castigliano's theorem (Propped Cantilever & Fixed beam)	07	CO1
		Self-learning Topics: Identify structural forms and their purpose. Understand support behavior and analyse loading system with degree of static & dynamic indeterminacy. Mixed practice + self-assessment test.	07	
II	**Deflection Analysis of Statically Determinate Structures**	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. Macaulay's Method, Moment Area Method, Application of Unit Load Method for calculating slope and deflection for rigid jointed frames and Pin jointed truss. Analysis of redundant trusses, lack of fit, sinking of support, temperature changes (indeterminacy up to second degrees).	08	CO2
		Self-learning Topics: Apply strain energy concepts to calculate deflections. Step-wise analysis of beam and frame problems. Checking structural analysis consistency. Mixed practice + self-assessment test.	08	
III	**Influence Line Diagram and**	Influence line diagrams for reactions, shear force and bending moment for cantilever, simply	08	CO3

	Plastic Analysis	supported and overhang beams, Trusses. Maximum shear force and bending moment and absolute maximum shear force and bending moment under rolling loads for simply supported girder True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, static and kinematic method of analysis, upper, lower bound and uniqueness theorem, concepts and determination of shape factor Plastic moment of resistance and collapse load of determinate and indeterminate beams and frames.		
		Self-learning Topics: Study common trusses like Pratt, Warren, and Howe for typical ILDs. Apply **influence line method** to identify **critical load positions and evaluate Shear force & Bending Moment**. Learn the concept of **plastic hinge formation** and how it leads to **collapse mechanism** in statically indeterminate structures. Determine **plastic moment of resistance** and **collapse load** for Simply supported and fixed beams, Propped cantilevers, Portal frames with 1–2 degrees of redundancy.	08	
IV	**Analyse and Design of Three hinge Arches**	Three hinged arches – Concepts, types of arches, analysis of parabolic arch with supports at same and different levels, semi-circular arches with support at same level, determination of horizontal thrust, radial shear and normal thrust for parabolic and circular arch. Analysis of parabolic and semi-circular arches with supports at same level, determination of horizontal thrust, radial shear and normal thrust, temperature effect and rib shorting.	07	CO4

		Self-learning Topics: Bending Moment Diagram, Thrust Line, Axial force distribution in Arches Visualize and draw real-world arch structures (bridges, roofs).	07	
V	**Analysis of Indeterminate Structures**	Introduction to concept of Force Method (Flexibility Method) & Displacement methods 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). 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)	08	CO5
		Self-learning Topics: Understand and apply **Flexibility Method** and **Direct Stiffness Method** to analyze beams and simple frames (degree of indeterminacy $\leq$ 3). Flexibility Coefficients & Compatibility Equations. Stiffness Method Application & Settlements.	08	
VI	**Innovation in Structural Systems and Smart Infrastructure**	Advanced structural systems: High-rise frames, composite structures, and smart materials. Structural optimization techniques to reduce cost and increase sustainability. Role of structural analysis in modular construction and prefabrication. Introduction to structural analysis software (e.g., STAAD.Pro, ETABS)	07	CO6
		Self-learning Topics: Case Study: Basic structure of **Burj Khalifa** or **One World Trade Center (high-rise structures** and typical height thresholds,	07	

		load-resisting systems, load paths under gravity, wind, and seismic actions). Study **composite (Steel + concrete) beams**, slabs, and columns. Basics of **shear connectors** and interface behavior. Learn basic modelling and performance analysis to explore structural code compliance (IS 456, IS 1893) within software. Compare Indian Codes with International Codes.		

Text Books:

1. S. Ramamrutham,S. Narayan " Theory of structures" , DhanapatRai Publications.
2. S S. Bhavikatti , Structural Analysis Vol-1, third edition, Vikas publishing House, Pvt, Ltd.
3. Basic Structural Analysis: C.S. Reddy, Tata McGraw Hill New Delhi.
4. Mechanics of Structures: Vol-I and II: S. B. Junnarkar and H.J. Shah, Charotar Publishers, Anand.
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: 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. B C Punmia, Jain, " Mechanics of Materials: Vol I & II", Laxmi Publications.
2. R.C. Hibbeler, "Structural Analysis", Pearson Education Asia Pub. (5thEdition).
3. L. S. Negi and R. S. Jangjid, Structural Analysis, Tata Mc. Graw, New Delhi, 1997.
4. Junnarkar S. B., Mechanics of Structure, Volume I and II
5. G.S. Pandit and S. P. Gupta, Structural Analysis: A matrix approach, Tata McGraw Hill.
6. Structural Analysis: Chajes, ElBS, London.

7. Theory of Structures: Timoshenko and Young, Tata McGraw Hill New Delhi.
8. Element of Structural Analysis: Norris and Wilbur, McGraw Hill.
9. Structural Analysis: Laursen H.I, McGraw Hill Publishing Co.
10. Fundamentals of structural Analysis: K.M. Leet, C. M. Uang and A.M. Gilbert, Tata McGraw Hill, New Delhi.

Online References:

Sr. No.	**Website Name**
1.	NPTEL Structural Analysis by Prof. Devdas Menon: https://nptel.ac.in/courses/105105109
0.	YouTube Channels: *Gate Academy, Unacademy Civil, CivilGuruji*

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21212404	Sustainable Construction Materials and Concrete Technology Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21212404	Sustainable Construction Materials and Concrete Technology Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the physical and mechanical properties of cement, fine aggregate, and coarse aggregate through standard laboratory tests.
2. To determine the quality and suitability of construction materials based on IS code specifications.
3. To assess the workability of fresh concrete using different test methods (slump, compaction factor, Vee Bee).
4. To evaluate the strength characteristics of hardened concrete (compressive, tensile, flexural) using destructive and non-destructive tests.
5. To design concrete mixes using IS and DOE methods for different grades and exposure conditions.
6. To observe and analyze real-time concrete production by visiting a Ready-Mix Concrete (RMC) plant and understanding QA/QC practices.

Lab Outcomes:

1. To identify and test cement and aggregates for properties like fineness, setting time, specific gravity, and gradation as per IS codes.

2. To evaluate the effect of moisture content and admixtures on the setting and workability of concrete.
3. To conduct and interpret workability tests to determine concrete's suitability for placement and compaction.
4. To determine the compressive, tensile, and flexural strength of concrete specimens and relate them to design requirements.
5. To apply standard mix design methods (IS 10262 and DOE) to prepare concrete mix proportions manually and via software tools.
6. To demonstrate practical understanding of concrete production processes and quality control through field exposure at an RMC plant.

List of Experiments: (Any 10)

Sr No	List of Experiments	Hrs	LO
01	Fineness and standard consistency of cement.	02	LO1
02	Initial and final setting time and soundness of cement.	02	LO1
03	Compressive strength of cement.	02	LO1
04	Moisture content, silt content, and Specific gravity of fine aggregate	02	LO1
05	Fineness modulus by sieve analysis of fine aggregate.	02	LO1
06	Moisture content, water absorption, and Specific gravity of coarse aggregate	02	LO1
07	Density of coarse aggregate and Fine Aggregate	02	LO1
08	Fineness modulus by sieve analysis and gradation of fine aggregates.	02	LO1
09	Workability of concrete by slump test, compaction factor, Vee Bee test, effect of admixture and retarders on setting time concrete.	02	LO2, LO3
10	Compressive strength test of concrete by crushing and Rebound hammer.	04	LO4
11	Indirect tensile strength and flexural strength of hardened concrete	04	LO4
12	Concrete Mix Design by IS 10262 Method Using Conventional Calculations and Excel Spreadsheet	04	LO5
13	Site visit to RMC plant	02	LO6

Sr No	List of Assignments / Tutorials
01	Question Based on Concrete Materials Cement, Aggregates, Water, Lime, and Admixtures and create ppt or poster on self-learning topics of module one.
02	Question Based Behavior and Testing of Fresh and Hardened Concrete for and create ppt or poster on self-learning topics of module one.
03	Question Based on Concrete Mix Design for Sustainable Construction and create ppt or poster on self-learning topics of module one.

04	Question Based on Sustainable Construction Materials and create ppt or poster on self-learning topics of module one.
05	Question Based on Green Concrete Technology and create ppt or poster on self-learning topics of module one.
06	Question Based on Innovative and Climate-Responsive Concrete Solutions for Sustainable Infrastructure and create ppt or poster on self-learning topics of module one.

Text Books:

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

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

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

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, McGraw Hill Publications.

6. Properties of concrete: Neville, Isaac Pitman, London.

Online References:

Sr. No.	Website Name
1.	Updates on construction materials and innovations in India www.nbmcw.com
2.	Indian Green Building Council – resources and rating systems www.igbc.in
3.	Building Research Establishment Environmental Assessment Method www.breeam.com

Assessment:

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

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

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

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
21212405	**IDEA LAB 4- (Innovation Design Engineering and Apply)**	1	-	2*	15	-	30	15	60	2

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21212405	**IDEA LAB 4- (Innovation Design Engineering and Apply)**	--	--	--	--	--	50	50	100

Rationale:

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a structured assessment framework is implemented.

1. Project assessment is carried out using standardized IDEA Lab rubrics with multiple evaluation parameters.

2. One of the key parameters is **Engineering Subject-Based Assessment**, which focuses on the effective application of same-semester subject knowledge in project work, ensuring integration of theoretical learning with practical implementation.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their

domain areas and demonstrate.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Students must ensure that their IDEA Lab project meaningfully incorporates concepts from all core subjects of the current semester and maintain a project logbook as evidence of subject-wise application.
- Faculty in-charge must guide students to apply concepts from subjects studied in the same semester to their IDEA Lab projects.
- The term work evaluation will partially reflect the effective application of subject-specific knowledge.
- Faculty should regularly review the integration of academic content within the project work.

2) Implementation Strategy – IDEA Lab Learning Model

- A theme-based learning structure shall be implemented where each semester is anchored to a broad contextual domain such as Healthcare, Smart Cities, Energy, Agriculture, or Governance, providing the overall learning direction.
- From the identified theme, a system-level, open-ended problem statement shall be defined, serving as a solution-neutral framework that enables interdisciplinary thinking and innovation.
- The learning sequence shall follow a structured flow:
  Theme → Problem Statement → Same Semester Subject Application → Design–Implementation Experience, ensuring progressive transformation from context to solution.
- Themes shall provide the context (defining the domain of work), while problem statements shall provide the purpose, enabling students to identify meaningful real-world challenges.
- Subjects shall be treated as engineering tools, where each subject contributes specific knowledge components to solve different aspects of the problem.
- Students shall be encouraged to take ownership of their learning and projects, fostering curiosity, exploration, social relevance, and a mindset of creative risk-taking.
- Structured brainstorming and ideation sessions shall be conducted at the beginning of the semester to guide students in problem identification and development of solution pathways through collaborative and interdisciplinary thinking.
- Guest lectures and expert talks shall be organized by inviting industry experts, researchers, and innovators aligned with the semester theme and subject areas to provide exposure to real-world challenges, trends, and opportunities.
- A mechanism shall be implemented to ensure uniqueness and originality of projects by systematically reviewing ideas to avoid duplication and encouraging novel, technology-driven solutions.

- Platforms shall be created for collaborative learning and discussion, enabling students to present ideas, receive peer and mentor feedback, and refine solutions through iterative engagement.
- Content beyond syllabus for as subject shall be integrated with IDEA Lab themes and problem statements to ensure deeper interdisciplinary application and enhanced conceptual understanding.
- Preference shall be given to ensuring same-semester academic alignment, where subject faculty contribute to effective contextual integration of project-based learning.
- Continuous monitoring and documentation shall be ensured through logbooks, milestone tracking, and periodic progress reviews to maintain academic rigor and outcome alignment.
- Coordination with subject faculty shall be ensured for effective mapping of theoretical concepts into project execution and for evidence-based term work assessment.
- The IDEA Lab shall function as an institutional mechanism for implementing the CDIO (Conceive–Design–Implement–Operate) framework, promoting experiential and outcome-based learning through structured mini-projects.

Implementation Notes:

- Guide will assess subject's contribution using specific evidence such as:
    - Logbooks
    - Subject-specific outputs (e.g., simulations, designs)
    - Paper publications or review presentations

3) Guidelines for Assessment

Assessment Month	Marks
Month 1 (Formative 1)	50 marks
Month 2 (Formative 2)	50 marks
Month 3 (Formative 3)	50 marks

Total Assessment Structure

Component	Marks	Assessed By
Term work – Project Execution	50 Marks	Project Guide – Average of all innovation
Viva Voce (Final Evaluation)	50 Marks	External Examiner

Criteria	**Excellent (10)**	**Good (8)**	**Satisfactory (6)**	**Needs Improvement (4)**
1. Innovation	Highly original and disruptive idea solving a real-world or futuristic problem	Novel idea with a creative approach to a known problem	Moderately innovative; adapts existing solutions	Common or repetitive idea with minimal novelty
2. Design	User-centric, systematic design with professional-level tools, prototyping, or simulations	Logical structure; clearly presented using standard tools	Functional design but limited user perspective or refinement	Poor or confusing design with lack of user consideration
3. Engineering	Applies concepts from all same-semester subjects with clear integration and interdisciplinary depth	Applies knowledge from 4 or more subjects with relevance	Applies 2–3 subjects with moderate clarity	Applies 1 subject with weak or shallow connection
4. Implementation	Complete, fully functional prototype with rigorous testing and real-world validation	Working model with minor errors; partially tested	Prototype is incomplete; basic testing or debug attempt	Poorly implemented; fails to function properly
5. Application	Strong real-world relevance with alignment to SDGs/National Missions; impact clearly identified	Clear practical use-case with user/market relevance	Some practical value but limited clarity on impact	Vague or irrelevant application; weak user connect

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
21412406	Computer Applications Lab II	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Practical	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
21412406	Computer Applications Lab II	--	--	--	--	--	25	25	50

Lab Objectives:

1. To develop proficiency in computer-aided drafting and preparation of 2D engineering drawings using CAD software.
2. To enable students to prepare site plans, utility layouts, and working drawings as per standard drafting practices.
3. To apply CAD tools for preparation of architectural, structural, plumbing, and electrical drawings.
4. To develop skills in preparing sectional elevations, staircase details, and building service layouts.
5. To introduce 3D modeling and visualization techniques using Sketch Up or equivalent software.
6. To develop competency in preparation of digital project reports, quantity estimation, and bar bending schedules using computer applications.

LAB Outcomes:

1. The students shall be able to:
2. Prepare 2D drafting layouts and engineering drawings using CAD software tools and commands.
3. Develop site plans and utility layouts incorporating standard symbols, scales, and annotations.
4. Create detailed working drawings including plans, elevations, sections, and service layouts for buildings.
5. Apply CAD and visualization software to generate 3D models and perspective views of building components.
6. Prepare digital project reports, quantity estimation sheets, and bar bending schedules using computer applications.

List of Experiments.

Sr. No.	List of Experiment	Hrs	LO mapping
I	Introduction to computer-aided drafting using AutoCAD: Basic commands, coordinate systems, drawing tools, modify tools, layers, dimensioning, and plotting. Preparation of simple 2D drawings.	03	LO1
II	Preparation of Layout / Site Plan using CAD software including area statement, water supply lines, and drainage layout with proper symbols and scale.	03	LO2
III	Development of detailed Working Drawings using CAD tools: Floor Plan, Parking Plan, Foundation Plan / Centre Line Plan, Terrace Plan, Electrical Layout, and Plumbing/Sanitation Plan (with schedule of openings and construction notes).	03	LO3
IV	Preparation of Elevation and Sectional Elevation of the same building using AutoCAD or Bentley Micro Station with proper annotation and detailing.	03	LO3
V	3D Modeling and Perspective View of building elements using Sketch Up (or equivalent software) for visualization and presentation.	03	LO4
VI	Preparation of Digital Project Report including planning data, line plans, and basic design calculations using Microsoft Excel and documentation tools (Word/PDF).	03	LO5
VII	Preparation of detailed staircase drawing with plan, elevation, and sectional details using AutoCAD.	03	LO6
VIII	Drafting of rainwater harvesting system and septic tank layout using CAD software.	03	LO6
IX	Creation of 3D interior model of residential building with furniture layout using Sketch Up.	03	LO4
X	Preparation of bar bending schedule (BBS) and quantity estimation sheet using Microsoft Excel integrated with CAD drawings.	03	LO5

Sr No	List of Assignments
1	Prepare a complete 2D residential building plan in AutoCAD showing dimensions, layers, symbols, and annotations as per standard drafting practice.
2	Draft a site plan including area statement, water supply system, drainage layout, and road connectivity using proper scale and symbols.
3	Develop detailed working drawings of a residential building including floor plan, foundation plan, electrical layout, and plumbing layout with schedule of openings.
4	Create a 3D model and interior perspective view of a residential building using Sketch Up with basic rendering and furniture arrangement.
5	Prepare a digital project report consisting of CAD drawings, staircase details, rainwater harvesting system, bar bending schedule (BBS), and quantity estimation using Microsoft Excel and Word/PDF tools.

Text Books:

1. M. G. Shah, C.M. Kale and S. Y. Patki, Building drawings with an integrated Approach to Built-Environment, Tata McGraw Hill, New Delhi (5^{th} Edition or Latest edition)
2. .Dr. S.V. Deodhar , Building Science and planning, Khanna Publishers.
3. .David V. Chadderton , Building Services Engineering (sixth edition or latest edition), London and New York.
4. Jan A. Van Der Westhuizen , Drawing for Civil Engineering.

Reference Books:

1. National Building Code -2016 (Latest)
2. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
3. Times Saver Standards of Architectural Design Data by Callender, Tata McGraw Hill.
4. I.S. 962-1989 Code for practice for Architectural and Building Drawings.
5. Development plan and DCP Rules of urban local body, Volume 12, New Delhi.
6. Model Building bye laws by MoUD, GoI.

Online References:

Sr. No.	Website Name
1.	https://libguides.scu.edu/civilengineering
2.	https://guides.lib.purdue.edu/civeng
3.	https://ncbc.nic.in

Assessment:

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

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

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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451410	Design Thinking	2	-	-	30		-	30	60	2

Course Code	Course Name	Examination Scheme					Term work	Practical	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
98451410	Design Thinking	20	20	40	60	2.5	--	--	100

Rationale:

Design Thinking is a human-centered approach that fosters creativity, empathy, and problem solving. This course equips students with tools to understand user needs, generate innovative ideas, and develop practical solutions for real-world challenges.

Course Objectives:

1. Introduce the core principles and stages of the Design Thinking process.
2. Develop an empathetic mindset to understand user needs.
3. Frame clear problem statements using user-centered tools.
4. Apply ideation techniques to generate creative solutions.
5. Understand various types of prototypes and their role in product development.
6. Learn the process of testing and refining ideas based on feedback.

Course Outcomes: On successful completion of the course learner will be able to:

1. Compare traditional and design thinking-based approaches to problem solving.
2. Define user personas using empathy and mapping techniques.
3. Frame actionable problem statements using POV and problem definition tools.
4. Apply ideation techniques to develop diverse solution sets.
5. Differentiate between low and high-fidelity prototypes and understand their usage.
6. Explain how to test prototypes based on desirability, feasibility, and usability.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Fundamentals of communication and leadership skills		
I	**Introduction to Design Thinking**	**Introduction to Design Thinking:** Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)	04	CO1
		Self-learning Topics: Design thinking case studies from various domains. **Link:** https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index	04	
II	**Empathy**	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.	05	CO2
		Self-learning Topics: Creation of empathy maps **Link:** https://www.interaction-design.org/literature/topics/empathy-mapping **Case Study:** Designing MRI for Children – GE Healthcare	05	
III	**Define**	**S**ignificance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV	05	CO3

		Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples **Link:** https://uxpressia.com/blog/how-to-create- persona-guide-examples	05	
IV	I**Ideate**	What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi- disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping	06	CO4
		Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide **Link:** https://uxplanet.org/how-to-run-an-effective- ideation-workshop-a-step-by-step-guide- d520e41b1b96	06	
V	**Prototype**	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario Prototype.	04	CO5
		Self-learning Topics: IDEO Prototyping Toolkit	04	
VI	**Test**	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	06	CO6
		Self-learning Topics: Real-world Testing Examples from Stanford d.school or IDEO **Case Study:** IDEO's Shopping Cart Redesign – A classic innovation sprint (All stages)	06	

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 References:

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

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.

- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431411	Business Model Development	2	-	-	30		-	30	60	2

Course Code	Course Name	Examination Scheme					Term work	Practical	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
98431411	Business Model Development	--	--	--	--	--	25	--	25

Rationale:

Entrepreneurship is the backbone of innovation and economic growth. In the 21st-century knowledge economy, students must be equipped not just with employment-ready skills but with a problem-solving and innovation mindset to become job creators. This course blends core entrepreneurship principles with business model design, startup financing, and digital business strategies.

Course Objectives:

1. To introduce students to entrepreneurship and its socio-economic relevance.
2. To enable understanding of different business structures and MSME significance.
3. To familiarize learners with funding mechanisms for startups.
4. To introduce the basics of IPR and ethical innovation practices.
5. To equip students with tools for building business models and MVPs.
6. To explore digital marketing and disruption in online business ecosystems.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Define and explain entrepreneurship and its key types.
2. Analyze the legal and operational structure of business ownership.
3. Identify and compare startup funding models and sources.

4. Apply the fundamentals of IPR to protect entrepreneurial innovations.
5. Create comprehensive business models using BMC tools.
6. Evaluate and apply digital marketing techniques for online business models.

Prerequisite: Basic Design Thinking principles.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic Design Thinking principles		
I	**Introduction to Entrepreneurship**	Definition, the role of entrepreneurship in the economic development, The entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset.	05	CO1
		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.	05	
II	**Entrepreneurship Development**	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development.	04	CO2
		Self-learning Topics:MSME Act and Udyam Registration portal	04	

		Case Study: Amul – Co-operative innovation in dairy sector		
III	**Start-up financing**	**Start-up financing:** Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes funding(e.g., SIDBI, Startup India).	05	CO3
		Self-learning Topics: Successful business pitching. **Case Study:** Shark Tank pitch breakdown.	05	
IV	**Intellectual Property Rights (IPR)**	Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation.	05	CO4
		Self-learning Topics: Case Study: WIPO Patent Search Exercise	05	
V	**Business Model Development**	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.	06	CO5
		Self-learning Topics: The Art of the Start 2.0: The Time-Tested, Battle- Hardened Guide for Anyone Starting Anything by Guy Kawasaki **Case Study:** The Rise of Zomato – A Disruptive Food Delivery Platform	06	
VI	**Digital Business Management**	Digital Business models (Subscription, Freemium *etc*), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing,	05	CO6

		Disruption and innovation in digital business.		
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	05	

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

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 References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
3.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
4.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/
5.	WIPO Patent Search https://www.wipo.int/portal/en/index.html
6.	Airbnb Business Model Case https://www.prismetric.com/airbnb-business-model/
7.	BMC Tool https://www.strategyzer.com/canvas/business-model-canvas

Assessment:

- **Term Work:** Term Work shall consist of at least 4 to 5 **Case Study Analysis, Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.
- **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Case Study report) + 5 Marks (Assignments) + 5 Marks (Attendance).