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)

Department of Civil Engineering with Computer Applications

Curriculum FE to BE for A.Y 2025-26

First Year to Final Year Syllabus

Prepared by: Board of Studies for Civil Engineering with Computer Applications

Approved By: Academic Council of Shree L.R. Tiwari College of Engineering

R-2025

Preface

"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 center 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 centered 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 instill 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
Shree L. R. Tiwari College of Engineering

Chief Operating Officer
Rahul Education

Preface

Board of Studies – Civil Engineering Department

Shree L R Tiwari college of Engineering

Civil Engineering forms the foundation of infrastructure development and plays a crucial role in building resilient, sustainable, and smart communities. At SLTCE, the Civil Engineering curriculum is designed to equip students with the knowledge, technical skills, and ethical values required to meet the ever-evolving challenges of the profession.

The Board of Studies (BOS) in Civil Engineering is committed to maintaining academic excellence by continuously updating the syllabus in alignment with national standards, technological advancements, industry requirements, and global trends. The curriculum focuses on developing a strong foundation in core civil engineering areas, while also introducing students to emerging fields such as sustainable development, smart infrastructure, disaster risk reduction, and digital technologies in construction.

In line with the theme and the problem statement of the SLRTCE, our programs aim to nurture competent engineers who can contribute to societal progress with a sense of responsibility towards the environment and community which is align with the vision and mission of Civil Department. Emphasis is placed on practical learning through IDEA Lab, field Visit, External internships, and project-based learning to develop critical thinking, innovation, and leadership qualities.

The Board of Studies remains dedicated to creating a dynamic learning environment that fosters technical excellence, research orientation, and holistic development. Through this approach, we strive to produce graduates who are well-prepared to contribute effectively to the civil engineering profession and to the sustainable growth of the nation.

Sincerely,

Dr. Ajit Patil

Chairman, Board of Studies (Civil Engineering)

SLRTCE

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1. Abbreviations

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
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
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

2. Curriculum Structure and Examination Scheme for B.E. in Civil Engineering with Computer Application

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

Curriculum Structure – FE 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	
BSC	11111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
BSC	11111102	Applied Physics	2	--	--	30	--	--	30	60	2
ESC	11121103	Engineering Mechanics	3	--	--	45	--	--	45	90	3
ESC	11121104	Basic Electrical and Electronics Engineering	2	--	--	30	--	--	30	60	2
ESC	11121105	C& C++ Programming	3	--	--	45	--	--	45	90	3
BSCL	11112106	Applied Physics Lab	--	--	1	--	--	15	--	15	0.5
ESCL	11122107	Engineering Mechanics Lab	--	--	2	--	--	30	--	30	1
ESCL	11122108	Basic Electrical and Electronics Engineering Lab	--	--	2	--	--	30	--	30	1
ESCL	11122109	C& C++ Programming Lab	--	--	2	--	--	30	--	30	1
ESCL	11122110	IDEA LAB - 1(Innovation Design Engineering and Apply)	1	--	2*	15		30	15	60	2

VSEC	**11412111**	**Engineering Workshop -1**	**--**	**--**	**2**	**--**	**--**	**30**	**15**	**45**	**1.5**
CC	**11461112**	**Universal Human Values**	**2**	**--**	**--**	**30**	**--**	**--**	**30**	**60**	**2**
AEC	**11421113**	**Strategic Communication and Management Skills**	**1**	**–**	**--**	**15**	**--**	**--**	**15**	**30**	**1**
AECL	**11422114**	**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 – FE 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
11461112	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 – FE 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	
BSC	11111201	Differential Equations and Integral Calculus	2	1	--	30	15	--	45	90	3
BSC	11111202	Engineering Chemistry	2	--	--	30	--	--	30	60	2
ESC	11121203	Engineering Graphics	2	--	--	30	--	--	30	60	2
PCC	11211204	Basic Fluid Mechanics	3	–	–	45	--	--	45	90	3
BSCL	11111205	Engineering Chemistry Lab	–	--	1	--	--	15	15	15	0.5
ESCL	11122206	Engineering Graphics Lab	–	--	2	--	--	30	30	30	1
ESCL	11122207	Programming Lab (Python)	2	--	2	30	--	30	-	60	2
ESCL	11122208	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
PCCL	11212209	Basic Fluid Mechanics Lab	–	--	2	--	--	30	--	30	1
VSEC	11412210	Engineering Workshop II	--	--	2	--	--	30	15	45	1.5
IKS	11441211	Indian Knowledge System	2	--	--	30	--	--	30	60	2
CC	11461212	NSS & Civil Defense	--	--	4#	--	--	60	--	60	2
Audit Course	11471213	Audit Course	3	–	–	45	--	--	--	--	--
Total			14	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 – FE Semester-II

Course Code	Course Type	Course Name	Examination Scheme							
			IAT -1	IAT-2	IAT-1+IAT-2	End SemExam (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
11111205	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
11441211	IKS	Indian Knowledge System	20	20	40	60	2.5	--	--	100
11461212	CC	NSS/Civil Defense	--	--	--	--	--	25	–	25
Total			100	100	200	300	12.5	225	125	850

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.

Curriculum Structure – SE Semester-III

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
			L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/ 30)
11111301	PCC	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3
11211302	PCC	Applied fluid mechanics	3		--	45	--	–	45	90	3
11211303	PCC	Sustainable Construction Materials and Concrete Technology	3	–	--	45	--	–	45	90	3
11211304	PCC	Mechanics of Solids	3	–	–	45	–	--	45	90	3
11212305	PCCL	Applied fluid mechanics Lab	–	–	2	–	30	–	--	30	1
11212306	PCCL	Sustainable Construction Materials and Concrete Technology Lab	–	--	2	–	30	--	--	30	1
9951137WW	OE-I	(To be fill from OE bucket)	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
11612310	Community Engagement Project	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
Total			18	01	06	270	60	45	285	660	22

Open Elective Course (OE)

Every student is required to take one **Open Elective** Course for Semester III, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

9951137WW	**Open Elective - I (Common for all branches will be notified)**
995113701	Product Lifecycle Management
995113702	Reliability Engineering
995113703	Management Information System
995113704	Design of Experiments
995113705	Operation Research
995113706	Cyber Security and Laws
995113707	Disaster Management and Mitigation Measures
995113708	Energy Audit and Management
995113709	Development Engineering

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 – SE 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			
11111301	PCC	Integral Transform and Statistical Techniques	20	20	40	60	2.5	25	–	125
11211302	PCC	Applied fluid mechanics	20	20	40	60	2.5	–	–	100
11211303	PCC	Sustainable Construction Materials and Concrete Technology	20	20	40	60	2.5	–	–	100
11211304	PCC	Mechanics of Solids	20	20	40	60	2.5	–	–	100
11212305	PCCL	Applied fluid mechanics Lab	–	–	–	–	–	25	25	50
11212306	PCCL	Sustainable Construction Materials and Concrete Technology Lab						25	25	50
9951137 WW	OE-I	(To be fill from OE bucket)						25	–	25
98431308	Entrepreneurship	Entrepreneurship Development						25	–	25
98451309	Value education course	Environmental Science	20	20	40	60	2.5	–	–	100
11612310	Community Engagement Project	IDEA LAB - 2(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
Total			100	100	200	300	12.5	175	100	775

Curriculum Structure – SE Semester-IV

Course Type	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	
11111401	PCC	Sampling Theory and Optimization	2	1	–	30	15	--	45	90	3
11211402	PCC	Surveying & Geomatics Engineering	3	–	--	45	--	--	45	90	3
11211403	PCC	Structural analysis	3	--		45	--	--	45	90	3
11212404	PCCL	Surveying & Geomatics Engineering Lab	–	–	2	--	--	30	--	30	1
11212405	PCCL	IDEA LAB - 2(Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
11212406	VSEC	Construction Practices (Site management, safety, concrete work, scaffolding)	–	--	2	--	--	30	--	30	1
9 931147WW	MDM	Renewable and Non-Renewable Energy	3	–	–	45	--	--	45	90	3

		Sources									
9931248WW	**MDML**	**Renewable and Non-Renewable Energy Sources Lab**	**--**	**–**	**2**	**--**	**--**	**30**	**--**	**30**	**1**
99511149WW	**OE-II**	**(To be fill from OE bucket)**	**2**	**–**	**–**	**30**	**--**	**--**	**30**	**60**	**2**
98451410	**VEC**	**Design Thinking**	**2**	**–**	**–**	**30**	**--**	**--**	**30**	**60**	**2**
98431411	**Entrepreneurship**	**Business model thinking**	**2**	**–**	**–**	**30**	**--**	**--**	**30**	**60**	**2**
98472412	**PCC**	**Audit Course**	**3**	**--**	**–**	**45**	**--**	**--**			
Total			**21**	**1**	**8**	**315**	**15**	**120**	**285**	**690**	**23**

Open Elective Course (OE)

Every student is required to take one Open Elective Course for Semester IV, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

99511149WW	**Open Elective –II (Common for all branches will be notified)**
9951114901	Project Management
9951114902	Finance Management
9951114903	Entrepreneurship Development and Management
9951114904	Human Resource Management
9951114905	Professional Ethics and CSR
9951114906	Research Methodology
9951114907	IPR and Patenting
9951114908	Digital Business Management
9951114909	Environmental Management

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 – SE Semester-IV

Course Type	Course Code	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment			End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
11111401	PCC	Sampling Theory and Optimization	20	20	40	60	2.5	25	–	125
11211402	PCC	Surveying & Geomatics Engineering	20	20	40	60	2.5	–	–	100
11211403	PCC	Structural analysis	20	20	40	60	2.5	–	–	100
11212404	PCCL	Surveying & Geomatics Engineering Lab	–	–	–	–	–	25	25	50
11212405	PCCL	IDEA LAB - 2(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
11212406	VSEC	Construction Practices (Site management, safety, concrete work, scaffolding)	–	–	–	–	–	25	25	50
9 931147WW	MDM	Renewable and Non-Renewable Energy Sources	20	20	40	60	2.5	–	–	100
9931248WW	MDML	Renewable and Non-Renewable Energy Sources Lab	–	–	–	–	–	25	25	50
99511149WW	OE-II	(To be fill from OE bucket)	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business model thinking	–	--	–	–	--	25	–	25
98472412		Audit Course								
Total			100	100	200	300	12.5	200	125	825

Curriculum Structure – TE Semester-V

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	CEC501	Theory of Reinforced Concrete Structures	03	-	-	03	-	-	03
PCC	CEC502	Applied Hydraulics	03	-	-	03	-	-	03
PCC	CEC503	Geotechnical Engineering-I	03	-	-	03	-	-	03
PCC	CEC504	Transportation Engineering	04	-	-	04	-	-	04
PEC	CEC55X	Professional Elective Course – 1	03	-	-	03	-	-	03
PCCL	CEL506	Theory of Reinforced Concrete Structures	-	02	-	-	01	-	01
PCCL	CEL507	Applied Hydraulics	-	02	-	-	01	-	01
PCCL	CEL508	Geotechnical Engineering-I	-	02	-	-	01	-	01
PCCL	CEL509	Transportation Engineering	-	02	-	-	01	-	01
PCCL	CEL510	Professional Communication and Ethics	-	*02 +2	-	-	02	-	02
PCCL	CEL511	Mini Project – 2A	-	04$	-	-	02	-	02
Total			16	16	-	16	08	-	24

*Theory class to be conducted for full class.

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

Professional Elective Course – 1

Course Code	Department Level Optional Course –I
CEC5501	Modern Surveying Instruments and Techniques
CEC5502	Building Services & Repairs
CEC5503	Sustainable Building Materials
CEC5504	Advanced Structural Mechanics
CEC5505	Air and Noise Pollution & Control
CEC5506	Transportation Planning & Economics
CEC5507	Advanced Concrete Technology

Examination Scheme – TE Semester-V

Course Code	Course Type	Course Name	Examination Scheme							
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	CEC501	Theory of Reinforced Concrete Structures	20	20	40	60	2.5			100
PCC	CEC502	Applied Hydraulics	20	20	40	60	2.5			100
PCC	CEC503	Geotechnical Engineering-I	20	20	40	60	2.5			100
PCC	CEC504	Transportation Engineering	20	20	40	60	2.5			100
PEC	CEC55X	Professional Elective Course – 1	20	20	40	60	2.5			100
PCCL	CEL506	Theory of Reinforced Concrete Structures						25	25	50
PCCL	CEL507	Applied Hydraulics						25	25	50
PCCL	CEL508	Geotechnical Engineering-I						25	25	50
PCCL	CEL509	Transportation Engineering						25	25	50
PCCL	CEL510	Professional Communication and Ethics						25	25	50
Total			100	100	200	300	12.5	125	100	750

Curriculum Structure – TE Semester-VI

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	CEC601	Design & Drawing of Steel Structures	03	-	-	03	-	-	03
PCC	CEC602	Water Resources Engineering	03	-	-	03	-	-	03
PCC	CEC603	Geotechnical Engineering-II	03	-	-	03	-	-	03
PCC	CEC604	Environmental Engineering	04	-	-	04	-	-	04
PEC	CEC65X	Professional Elective Course – 2	03	-	-	03	-	-	03
PCCL	CEL606	Design & Drawing of Steel Structures	-	02	-	-	01	-	01
PCCL	CEL607	Water Resources Engineering	-	02	-	-	01	-	01
PCCL	CEL608	Geotechnical Engineering-II	-	02	-	-	01	-	01
PCCL	CEL609	Environmental Engineering	-	02	-	-	01	-	01
PCCL	CEL610	Skill Based Lab Course – III	-	03	-	-	1.5	-	1.5
PCCL	CEL611	Mini Project – 2B	-	03$	-	-	1.5	-	1.5
Total			16	14	-	16	07	-	23

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

Professional Elective Course – 2

Course Code	**Professional Elective Course – 2**
CEC6501	Rock Mechanics
CEC6502	Biological Processes & Contaminant Removal
CEC6503	Construction Equipment & Techniques
CEC6504	Urban Infrastructure Planning
CEC6505	Open Channel Flow
CEC6506	Computational Structural Analysis
CEC6507	Traffic Engineering and Management
CEC6508	Introduction to Offshore Engineering

Examination Scheme – TE Semester-VI

Course Code	Course Type	Course Name	Examination Scheme							
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
			IAT-1	IAT-2	IAT-1+IAT-2		End-Sem			
PCC	CEC601	Design & Drawing of Steel Structures	20	20	40	60	2.5			100
PCC	CEC602	Water Resources Engineering	20	20	40	60	2.5			100
PCC	CEC603	Geotechnical Engineering-II	20	20	40	60	2.5			100
PCC	CEC604	Environmental Engineering	20	20	40	60	2.5			100
PEC	CEC65X	Professional Elective Course – 2	20	20	40	60	2.5			100
PCCL	CEL606	Design & Drawing of Steel Structures						25	25	50
PCCL	CEL607	Water Resources Engineering						25	25	50
PCCL	CEL608	Geotechnical Engineering-II						25	25	50
PCCL	CEL609	Environmental Engineering						25	25	50
PCCL	CEL610	Skill Based Lab Course – III						25	25	50
PCCL	CEL611	Mini Project – 2B						25	25	50
Total			100	100	200	300	12.5	150	150	800

Curriculum Structure – BE Semester-VII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	CEC701	Design & Drawing of Reinforced Concrete Structures	03	-	-	03	-	-	03
PCC	CEC702	Quantity Survey, Estimation and Valuation	03	-	-	03	-	-	03
PEC	CEC73X	Professional Elective Course – 3	03	-	-	03	-	-	03
PEC	CEC74X	Professional Elective Course – 4	03	-	-	03	-	-	03
OE	CEC75X	Open Elective – 1	03	-	-	03	-	-	03
PCCL	CEL701	Design & Drawing of Reinforced Concrete Structures	-	02	-	-	01	-	01
PCCL	CEL702	Quantity Survey, Estimation and Valuation	-	02	-	-	01	-	01
PCCL	CEL703	Major Project – I	-	06#	-	-	03	-	04
Total			15	10	-	15	05	-	21

 # indicates work load of Learner (Not Faculty), for Major Project

Professional Elective Course – 3

Sr. No.	Course Code CEDLO701X	Professional Elective Course – 3
1	CEDLO7011	Pre-stressed Concrete
2	CEDLO7012	Applied Hydrology and Flood Control
3	CEDLO7013	Appraisal and Implementation of Infra Projects
4	CEDLO7014	Analysis of Offshore Structures
5	CEDLO7015	Advanced Construction Technology
6	CEDLO7016	Pavement Materials Construction and Maintenance

Professional Elective Course – 4

Sr. No.	Course Code CEDLO702X	Professional Elective Course – 4
1	CEDLO7021	Foundation Analysis and Design
2	CEDLO7022	Solid and Hazardous Waste Management
3	CEDLO7023	Ground Improvement techniques
4	CEDLO7024	Green building constructions
5	CEDLO7025	Legal Aspects in constructions
6	CEDLO7026	Environmental impact assessment
7	CEDLO7027	Advanced Design of Steel Structures

Open Elective – 1

Sr. No.	Course Code CEILO701X	Open Elective – 1
1	ILO7011	Product Life-cycle Management
2	ILO7012	Reliability Engineering
3	ILO7013	Management Information Systems
4	ILO7014	Design of Experiments
5	ILO7015	Operations Research
6	ILO7016	Cyber Security and Laws
7	ILO7017	Disaster Management and Mitigation Measures
8	ILO7018	Energy Audit and Management
9	ILO7019	Development Engineering

Examination Scheme – BE Semester-VII

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			
PCC	CEC701	Design & Drawing of Reinforced Concrete Structures	20	20	40	60	2.5			100
PCC	CEC702	Quantity Survey, Estimation and Valuation	20	20	40	60	2.5			100
PEC	CEC73X	Professional Elective Course – 3	20	20	40	60	2.5			100
PEC	CEC74X	Professional Elective Course – 4	20	20	40	60	2.5			100
OE	CEC75X	Open Elective – 1	20	20	40	60	2.5			100
PCCL	CEL701	Design & Drawing of Reinforced Concrete Structures						25	25	50
PCCL	CEL702	Quantity Survey, Estimation and Valuation						25	25	50
PCCL	CEL703	Major Project – I						50	--	50
Total			100	100	200	300	12.5	100	50	650

Curriculum Structure – BE Semester-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	CEC801	Construction Management	03	-	-	03	-	-	03
PCC	CEC82X	Professional Elective Course – 5	03	-	-	03	-	-	03
PCC	CEC83X	Professional Elective Course – 6	03	-	-	03	-	-	03
OE	CEC84X	Open Elective – 2	03	-	-	03	-	-	03
PCCL	CEL801	Construction Management	-	02	-	-	01	-	01
PCCL	CEL802	Major Project – II	-	8#	-	-	04	-	02
	OJT899	Internship /On Job training					4		04
Total			12	14	-	12	07	-	19

 # indicates work load of Learner (Not Faculty), for Major Project

Course Code	Professional Elective Course –5
CEC8201	Bridge Engineering
CEC8202	Design of Hydraulics Structures
CEC8203	Construction Safety
CEC8204	Pavement Design
CEC8205	Industrial Waste Treatment
CEC8206	Soil Dynamics

Course Code	Professional Elective Course –6
CEC8301	Repairs, Rehabilitation and Retrofitting of structures
CEC8302	Physico-Chemical Treatment of Water and Waste Water
CEC8303	Transportation System Engineering
CEC8304	Smart Building Materials
CEC8305	Structural Dynamics
CEC8306	Ground Water Engineering

Course Code	Institute Level Optional Course –2
OEC8501	Project Management
OEC8502	Finance Management
OEC8503	Human Resources Management
OEC8504	Research Methodology
OEC8505	Environmental Management

Examination Scheme – BE Semester-VIII

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			
PCC	CEC801	Construction Management	20	20	40	60	2.5			100
PEC	CEC82X	Professional Elective Course – 5	20	20	40	60	2.5			100
PEC	CEC83X	Professional Elective Course – 6	20	20	40	60	2.5			100
OE	CEC84X	Open Elective – 2	20	20	40	60	2.5			100
PCCL	CEL801	Construction Management					2.5	25	25	50
PCCL	CEL802	Major Project – II						50	100	150
	OJT899	Internship /On Job training						25		
Total			80	80	160	240	12.5	100	125	600

Indicative list of Multidisciplinary Minors:

Course Category of Multidisciplinary Minor	Course Code	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VI)
Communication Engineering	993114701	Introduction to Telecommunication Systems	Mobile & Wireless Technology for Defense Communication	Telecommunication for Defense Sector	Multidisciplinary Project
	993124802	Introduction to Telecommunication Systems Lab	Mobile & Wireless Technology for Defense Communication Lab	Telecommunication for Defense Sector Lab	Multidisciplinary Project Lab
Internet of Technology	993114703	IOT Sensor Technology	IOT System Design	Dynamic Paradigm in IOT Project	Multidisciplinary Project
	993124804	IOT Sensor Technology Lab	IOT System Design Lab	Dynamic Paradigm in IOT Project Lab	Multidisciplinary Project Lab
Electronics Engineering	993114705	Basic Electronics Circuits	Analog & Digital IC	VLSI and Embedded systems	Multidisciplinary Project
	993124806	Basic Electronics Circuits Lab	Analog & Digital IC Lab	Analog VLSI Lab	Multidisciplinary Project
Mechanical Engineering	993114707	Smart Manufacturing in Assembly Line	Industrial Automation	Cyber Physical System	Multidisciplinary Project
	993124808	Smart Manufacturing Lab	Industrial Automation Lab	Cyber Physical System Lab	Multidisciplinary Project

Sustainability & Environment	993114709	Renewable and Non Renewable Energy System	Sustainable urban planning development	Geo Informatics	Multidisciplinary Project
	993124810	Renewable and Non Renewable Energy System Lab	Sustainable urban planning development Lab	Geo Informatics Lab	Multidisciplinary Project

Information Technology	993114711	Agentic AI	Data Engineering	Web Engineering	Multidisciplinary Project
	993124812	Intelligent Agents Lab	Data Engineering Lab	Web Engineering Lab	Multidisciplinary Project
Cyber Security	993114713	Information Security	Cyber Security	Open Source Intelligence	Multidisciplinary Project
	993124714	Information Security Lab	Cyber Security Lab	Open Source Intelligence Lab	Multidisciplinary Project
Computer Engineering	993114715	Computational Thinking.	Applied Cryptography	Decentralized technology	Multidisciplinary Project
	993124716	Data Structure Lab	Data Security Lab	Blockchain Lab	Multidisciplinary Project
Artificial Intelligence	993114717	Foundations of Artificial Intelligence	Machine Learning for Engineers	Applied Deep Learning	Multidisciplinary Project
	993124818	Artificial Intelligence Lab	Machine Learning Lab	Deep Learning Lab	Multidisciplinary Project

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						

OE to be taken from basket Rahul Education which is already mentioned.

Internal Assessment and End Semester Exam Question Paper Structure

Internal Assessment for 20 Marks Each:

Internal Assessment (IA) will consists of two compulsory Internal Assessment Test of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour.
Summation of the two tests will be considered as IA marks.

End Semester Examination (60-Marks):

1. Question paper will comprise of total 06 questions, each carrying 10 marks
2. The questions for 10M will be based on each module of the syllabus.
3. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
4. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B Remaining questions will be in similar nature and selected from the respective module.
5. Total 06 questions need to be attempted.

Mrs.Zainab Mizwan	Dr.Umesh Bhadade	Dr. Deven Shah
COE	Vice Principal	Principal

R-2025- FE Civil Engineering with Computer Applications

F.E SEM-I Syllabus

SEM I

Theme: "**Engineering Foundations for Sustainable Futures**"

Aligned with **UNSDG 4 – Quality Education, UNSDG 7: Affordable and Clean Energy, UNSDG 9: Industry, Innovation, and Infrastructure**. **UNSDG 12 – Responsible Consumption and Production**

The theme "Engineering Foundations for Sustainable Futures" is a powerful and relevant framework for engineering education, deeply intertwined with the United Nations Sustainable Development Goals.

Problem Statement 1: Simple Greywater Recycling for Gardens

Redirect and treat wastewater from sinks or bathrooms for gardening. Reduce freshwater use in urban homes and colleges..

Problem Statement 2: Composting Machine for College Canteen

Challenges with waste collection and disposal. Build a Prototype mechanical composter that processes daily food waste into fertilizer.

Problem Statement 3: Low-Cost Modular Bridge for Rural Roads

Design a scalable bridge model using bamboo or recycled plastic.

Problem Statement 4: Mini Wind Turbine for Urban Homes

Design a compact wind turbine for use on balconies or rooftops.

Problem Statement 5: Urban Vertical Farming Unit

Create a compact hydroponic or vertical garden for city apartments.

Problem Statement 6: Renewable Energy Air Purifier for smoking zones.

Monitor key air pollutants in smoking zones, providing clean air with a purification system based on renewable energy sources.

R-2025- FE Civil Engineering with Computer Applications

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	
11111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT -I	IAT -II	Total					
11111101	Linear Algebra and Calculus	20	20	40	60	2.5	25	--	125

Rationale:

In Civil Engineering, matrices and systems of linear equations are fundamental tools used in structural analysis, where they help model forces, displacements, and support reactions in beams, trusses, and frames. Eigenvalues and eigenvectors are essential for studying vibration modes and natural frequencies of structures like bridges and high-rise buildings, ensuring safety under dynamic loads such as wind or earthquakes. Similarity and diagonalization simplify complex matrix operations, which are particularly useful in structural dynamics and system modeling for efficient computation. Partial differentiation is crucial in analyzing how various physical quantities—such as stress, strain, and temperature—change with respect to multiple variables in soil mechanics, material science, and fluid flow. Finally, analytic functions in complex variables assist in solving boundary value problems in fluid mechanics and elasticity, especially in modeling seepage flow and stress distribution in structural elements. Together, these mathematical concepts provide a strong analytical foundation for solving real-world problems in Civil Engineering.

Course Objectives:

1. To introduce matrix concepts and operations useful in modeling civil engineering structures and networks.
2. To teach methods for solving systems of linear equations arising in statics, hydraulics, and structural analysis.
3. To understand eigenvalues and eigenvectors and their application in structural vibration and stability analysis.
4. To study similarity transformations and diagonalization to simplify analysis of complex civil engineering systems.
5. To learn partial derivatives for modeling multi-variable systems in soil mechanics, fluid flow, and heat transfer.
6. To introduce analytic functions and their applications in solving 2D potential flow and thermal conduction problems.

Course Outcomes:

1. Students will be able to perform matrix operations and use SCILAB to analyze and model structural systems and civil engineering networks.
2. Students will be able to solve linear equation systems and use SCILAB to evaluate forces, flows, and load distributions in civil systems.
3. Students will be able to compute eigenvalues/eigenvectors and use SCILAB to analyze natural frequencies and modes in civil structures.
4. Students will be able to diagonalize matrices and use SCILAB to simplify mechanical and structural system computations.
5. Students will be able to apply partial differentiation and use SCILAB for sensitivity and optimization problems in civil engineering.
6. Students will be able to apply analytic functions and use SCILAB to model groundwater flow, heat conduction, and potential flow problems.

Prerequisite:

1. Addition, multiplication, transpose, and inverse of a matrix**.**

2. Review of Complex Numbers-Algebra of Complex Numbers, Cartesian, polar and exponential form of complex number.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Matrices	Types of Matrices (Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, unitary, orthogonal matrices and properties of matrices).	05	CO1
		Rank of a matrix using Echelon form, reduction to normal form and PAQ form.		
		Application of matrices to Coding and De-coding		
		Self-learning Topics: 1. PAQ form for rectangular matrices. 2. Reduction to normal form. 3. Theorems on sum of symmetric and skew symmetric matrices and similar theorems. 4. Properties of transpose, conjugate of matrices	08	
II	System of Linear Equations	System of Linear homogeneous and non–homogeneous equations, their consistency and solutions using rank.	05	CO2
		Linear dependence and independence of vectors. Linear combination of vectors		
		Solution of a system of linear algebraic equations, by (i) Gauss Jacobi Iteration Method, (ii) Gauss Seidel Iteration Method.		

		Self-learning Topics: 1. Vector Spaces 2. Linear Transformations. 3. Rank -Nullity theorems.	08	
III	Eigen values and Eigen vectors	Eigenvalues & eigenvectors of all types of matrices (symmetric, skew symmetric, orthogonal, triangular) and its properties (without proof).	05	CO3
		Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		
		Self-learning Topics: 1. Quadratic forms. 2. Reduction to quadratic forms 3. Rank, signature and index of a quadratic forms	08	
IV	Similarity and diagonalization of matrix	Similar matrices, diagonalizable matrices, orthogonally diagonalizable matrices and functions of square matrix.	05	CO4
		Minimal polynomial, Derogatory and non-derogatory matrices.		
		Singular value decomposition (SVD)		
		Self-learning Topics: 1. Functions of Square Matrix 2. Orthogonally diagonalization.	07	
V	Partial Differentiation	Function of two and three variables, Partial derivatives of first and higher order. Differentiation of composite function.	05	CO5
		Maxima and Minima of a function of two independent variables.		
		Lagrange's Multiplier method with one condition.		

		Self-learning Topics: 1. Euler's Theorem on Homogeneous functions with two independent variables. 2. Euler's Theorem on Homogeneous functions with three independent variables. 3. Deductions from Euler's Theorem. 4. Total differentials 5. Implicit Functions	07	
VI	Complex Variables – Differentiation	Circular functions of complex number and Hyperbolic functions. Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof),		
		Cauchy-Riemann equations in Cartesian coordinates (without proof, Polar form not included)	05	CO6
		Milne-Thomson method to determine analytic function f(z) when real (u)or imaginary part (v) is given.		
		Harmonic function, Harmonic conjugate, and orthogonal trajectories.		
		Self-learning Topics: 1. Expansion of $\sin^n\theta$, $\cos^n\theta$ in terms of sines and cosines of multiples of θ and Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $\sin\theta$, $\cos\theta$. 2. Powers and Roots of a complex number. 3. Logarithm of Complex Number 4. Inverse Hyperbolic Functions. Separation of real and imaginary parts of all types of Functions.	07	

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. Strang G.: "Linear Algebra and its Applications", Cengage Publications, 4th Ed. 2022.
2. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.
3. Jain M.K., Iyengar SRK, Jain R K,: "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, 6th Ed., 2007.
4. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
5. Williams G.: "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
6. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.
7. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
8. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education, 2015.
9. Lay D. C: "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
10. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016

Online References:

Sr. No.	Website Name
1.	https://www.math.ucdavis.edu/~daddel/linear_algebra_appl/Applications/applications.html
2.	https://onlinelibrary.wiley.com/doi/10.1155/2016/4854759
3.	https://archive.nptel.ac.in/courses/111/108/111108066/
4.	https://archive.nptel.ac.in/courses/111/104/111104092/

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	
11111102	Applied Physics	2	--	--	--	30	–	30	60	2

Course Code	Course Name	Theory					Term work	Practical	Tutorial	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)				
		IAT I	IAT II	Total						
11111102	Applied Physics	20	20	40	60	2.5				100

Rationale:

1 Engineering Physics provides a strong grounding in fundamental concepts like mechanics, electromagnetism, thermodynamics, and optics, which are essential for understanding the scientific basis of all engineering disciplines.

2. The syllabus supports key subjects in all branches—such as strength of materials in civil and mechanical, circuits in electrical and electronics, and semiconductor physics in computer and IT—ensuring a smooth transition to branch-specific learning.

3. Physics fosters logical thinking, mathematical modelling, and problem-solving skills that are crucial for engineering analysis, system design, and innovation in every branch of engineering.

4. Topics like quantum mechanics, nanoscience, and wave phenomena prepare students for future technologies and interdisciplinary fields such as AI, robotics, renewable energy, and smart infrastructure, relevant across all engineering domains.

Course Objectives:

1. To build a foundation of quantum mechanics needed for modern technology.
2. To demonstrate principles of interference in thin film and diffraction.
3. To provide students with a basic understanding of laser operation basics of Optical fiber and its use in communication technology.
4. To familiarize students with the generation and applications of ultrasonic waves and the principles of architectural acoustics for effective sound control in engineering environments.
5. To introduce the basic principles of sensors and familiarize learners with their role and applications in modern technological systems.
6. To introduce the fundamental concepts of nanoscience and nanotechnology, enabling students to understand nanoscale phenomena

Course Outcomes: Student will be able to –

1. Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology
2. Learner will be able to DEVELOP understanding of interference and diffraction; connect it to few engineering applications.
3. Learners will be able to ILLUSTRATE and APPLY the use of laser and OFC in engineering applications
4. Learners will be able to EXPLAIN the working of ultrasonic wave generators and apply acoustic principles to analyze and design acoustically efficient spaces.
5. Learner will be able to IDENTIFY the fundamentals of sensors and their applications in Advanced Technology.
6. Learner will be able to DESCRIBE the significance of nanoscience and nanotechnology, its applications.

Prerequisite: (For Theory Course)

1. Basic concepts of optics, including reflection, refraction, and interference using wave front analysis.
2. Application of Huygens' Principle and Snell's law in understanding light propagation.
3. Introduction to modern physics: dual nature of radiation, photoelectric effect, and matter waves.
4. Davisson–Germer experiment demonstrating wave nature of electrons.
5. Fundamentals of semiconductors: intrinsic and extrinsic types, electrical conductivity and resistivity.
6. Essential mathematical tools: vector algebra and partial differentiation used in physical analysis.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping

I	QUANTUM PHYSICS	Introduction (Matter waves, De Broglie hypothesis, Wave Packet). Concept of Phase velocity and group velocity and relation with particle velocity. Heisenberg Uncertainty Principle. Wave function; Physical interpretation of wave function. Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well. Basics of Quantum Computing. Concept of Qubits, Quantum Superposition Quantum Entanglement.	06	CO 1
		Self-learning Topics: Quantum Tunneling and real-life examples Operators in Quantum Mechanics (basic idea) Quantum States and Measurement concept Basic Quantum Gates (NOT, Hadamard, CNOT) Quantum Teleportation (concept only) Quantum Cryptography and secure communication	06	
II	OPTICS FOR ENGINEERS	Thin Film Interference: Introduction (division of amplitude & Stoke's relation) Interference in thin film of constant thickness in reflected light, Formation of colors in thin film; Interference in Wedge shaped film in reflected light; Formation of Newton's rings; Applications (Anti Reflecting & High reflecting films) Diffraction: Introduction to Fraunhofer diffraction at single slit, Amplitude equation of double slit, Diffraction Grating (N slits), Determination of wavelength of light	05	CO 2

		using plane transmission grating and numerical.		
		Self-learning Topics: Concept of Antireflecting coating, Highly reflecting films, Uses of Thin films, Measurement of optical flatness. Determination of refractive index of liquids using interference, Determination of wavelength of light using plane transmission grating and numerical,.	05	
III	LASERS, AND FIBER OPTIC SYSTEM	Laser: Spontaneous emission and Stimulated emission; Metastable state, Resonant cavity, Population inversion, three & four level lasers, types of pumping, Semiconductor Laser. Fiber optics: Structure of an optical fiber, Types: Single mode & Multimode, Step index & Graded index.	06	CO 3
		Self-learning Topics: Attenuation, Losses in Optical fiber due to Physics structure and Transmission of signal Application: Optical fibre Transmission, Holography, Barcode reader, LiDAR, Memory reading and writing applications.	06	
IV	SOUND AND ACOUSTICS	Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator; Applications of ultrasonic: Eco sounding; NDT; ultrasonic cleaning(cavitation) ACOUSTICS: Conditions of good acoustics; Reflection of sound (reverberation and echo); absorption of sound; absorption coefficient; Sabine's formula;	05	CO 4
		Self-learning Topics: Medical Imaging using Ultrasound (basic concept)	05	

		Noise Pollution and Acoustic Insulation Application: Designing quiet spaces, sound proof rooms, urban noise control Design of Auditoriums (practical acoustic considerations) Application: Theater and hall design for clear sound quality		
V	PHYSICS OF SENSORS	Ultrasonic sensors: Ultrasonic transducer as distance meter, Strain gauges for stress measurement, LVDT for displacement sensing. Accelerometers for vibration and seismic monitoring.	03	CO 5
		Self-learning Topics: Thermocouples and RTDs (PT100) for temperature measurement.	03	
VI	NANOSCIENCE AND NANOTECHNOLOGY	Introduction to nano-science and nanotechnology, Surface to volume ratio, Two main approaches in nanotechnology -Bottom up technique and top down technique; Important tools in nanotechnology such as Scanning Electron Microscope, Transmission Electron Microscope, Atomic Force Microscope. Nano materials:	05	CO 6
		Self-learning Topics: Methods to synthesize nanomaterials (Ball milling, Sputtering, Vapour deposition, sol gel), properties and applications of nanomaterials. Application:Lithography, Single Electron Transfer (SET), Spin Valves.	05	

Text Books:

1. A Text book of Engineering Physics -Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, S. Chand, Revised Edition 2014

2. Modern Engineering Physics - A. S. Vasudeva, S. Chand, Revised Edition 2013

3. Engineering Physics D. K Bhattacharya,PoonamTandon, Oxford Higher Education, 1st Edition 2015-16

4. Engineering Physics -R. K. Gaur,S. L. Gupta, DhanpatRai Publications, 2012

5. Engineering Physics -V. Rajendran, McGraw Hill Educations, 2017

6. A Textbook of Nanoscience and Nanotechnology, T. Pradeep Tata McGraw Hill Education Pvt. Ltd., 2012

References:

1. Concepts of Modern Physics - ArtherBeiser, ShobhitMahajan, S. Choudhury, McGraw Hill, 7th Edition 2017

2. Fundamentals of optics - Francis A. Jenkins, Harvey E. White, McGraw Hill Publication, India, 4th Edition

3. Fundamentals of Physics, Halliday and Resnick, Wiley publication

4. Nanotechnology- Principles & Practices- Sulabha K. Kulkarni

Online References:

Sr. No.	Website Name
1.	1. https://archive.nptel.ac.in/courses/115/102/115102124/
2.	2. https://archive.nptel.ac.in/courses/115/102/115102025/
3.	3. https://archive.nptel.ac.in/courses/115/105/115105132/

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	

11121103	**Engineering Mechanics**	**3**	**-**	**-**	**45**	**-**	**-**	**45**	**90**	**3**

Rationale:

Engineering mechanics is a branch of science that deals with the behaviour of solid bodies when subjected to external forces or loads and the effects of these forces on the bodies. Though traditionally software-focused, Computer and IT engineers increasingly interact with physical systems through areas like robotics, virtual reality, gaming, digital twin technology, and simulation. Engineering Mechanics introduces the physical principles of force, motion, and equilibrium, which are essential for the development of realistic simulation engines, AI-based mechanical system models, and integration of software with hardware systems. This subject helps build computational models of mechanical phenomena and enhances interdisciplinary competence for modern applications.

Course Code	**Course Name**	**Theory**					**Term work**	**Pract / Oral**	**Total**
		Internal Assessment			**End Sem Exam**	**Exam Duration (in Hrs)**			
		IAT 1	**IAT 2**	**Total.**					
11121103	**Engineering Mechanics**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Course Objectives

1	To acquaint with basic principles of Centroid and Moment of Inertia and its real-life significance
2	To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.
3	To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.
4	To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.
5	To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.
6	To acquaint with the basics of Robot kinematics

Course Outcomes

1 Demonstrate the understanding of Centroid and MI and locate the same.

2 Determine the resultant and equivalent force-couple system for a given system of forces.

3 Illustrate the concept of loads, supports, beams, conditions of equilibrium and apply the same in real life application to specific type of friction, estimate required force to overcome friction, and apply the equilibrium for trusses.

4 Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear and general plane motion.

5 Apply the principles of force and acceleration, work-energy and impulse-momentum to particles in motion.

6 Establish the relation between robot joints and parameters

Prerequisite: Student shall have passed HSC (Higher Secondary Certificate) along with basic understanding of physics and mathematics in following topics:-

1. **Basic Vector Algebra**
   – Understanding of vector addition, subtraction, scalar and vector products.
   – Ability to resolve vectors into components.
2. **Fundamentals of Classical Physics**
   – Concepts of force, motion, Newton's laws, equilibrium, and gravity.
   – Understanding of mass, weight, friction, and types of motion.
3. **Basic Trigonometry and Geometry**
   – Familiarity with sine, cosine, tangent functions.
   – Knowledge of angles, triangles, and coordinate systems.
4. **Problem-Solving and Logical Reasoning Skills**
   – Ability to approach real-world physical problems logically.
   – Basic analytical thinking and spatial reasoning.

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
0	**Prerequisite**	Statics, Dynamics, Kinetics, Kinematics, Rigid body, Deformable body, applying trigonometric functions, resolution of a vector (Force vector), Law of triangle, Polygon law of forces, Newton's laws of motion Velocity, acceleration, displacement, Uniform velocity and accelerated motion, Law of	01	

		conservation of Energy, Law of conservation of Momentum, work-energy principle, impulse and momentum principle, and Coefficient of restitution		
1	**Centroid and Moment of Inertia**	i. Characteristics, and real-life significance for Centroid ii. Centroids of primary geometrical shapes and plane laminas iii. MI for primary geometrical shapes and plane laminas **Self-learning topic:** - Explore Center of gravity of simple solid objects - Apply parallel and perpendicular axis theorem for MI with simple geometrical shapes	06 06	CO1
2	**Force and System of Forces**	i. Principle of transmissibility, Moment of force about a point and concept of couple ii. Classification of force systems iii. Resultant of coplanar system of forces and Varignon's Theorem iv. Resultant of non-coplanar system of forces **Self-learning topic:** - Exploring force and a couple system and real-life application of a force and a couple system - Resultant of non-coplanar parallel and general system of forces	07 07	CO2
3	**Equilibrium and Application of Equilibrium**	i. Conditions of equilibrium for system of forces and free body diagrams, Types of beams, loads, and support and its reaction ii. Equilibrium of beams, rollers, and system of bodies iii. Fundamentals of truss structures, Laws of friction. Cone of friction. angle of repose, and angle of friction	15 15	CO3

		iv. Application of equilibrium with friction on blocks on horizontal and inclined planes and ladders v. Application of equilibrium with trusses structures (Numerical on Method of joints and Method of section) **Self-learning topic:** - Equilibrium of connected bodies (beam and sphere), two force and three force members - Equilibrium of non-coplanar system of forces - Application of equilibrium with friction - Wedge and block - Exploring the concepts of trusses and friction in real life problems		
4	**Kinematics of particles and rigid bodies**	i. Motion along plane curved path, Variable acceleration for rectilinear motion ii. Introduction to General plane motion, problem based on Instantaneous centre (ICR) method for general plane motion (up to 2 linkage mechanism and roller) **Self-learning topic:** - Application of motion graph for real-life problems - ICR for rollers, wheels and three links problems - ICR for system of rigid bodies	07 07	CO4
5	**Kinetics of particles**	- Introduction to D'Alembert's Principle (DAP), inertia force, dynamic equilibrium, Work done by active forces, impact and collision - Problems on DAP (single and double block), and WEP (single block) **Self-learning topic:**	06	CO5

		- Application of WEP to the real-life problems - Explore the concept of impact and collision for rigid bodies	06	
6	**Introduction to Robot Kinematics**	- Fundamental of Robot Mechanics, Degree of Freedom, D-H Parameters, robot kinematics (Forward) - Homogeneous transformation (limited to 2 DOF Serial robot) **Self-learning topic:** - Derive and Analyze - Manual derivation of forward kinematics using D-H parameters - Explore online simulation tools such as MATLAB Robotics Toolbox Online and refer https://kinematicsplayground.org/ - Solve 2 numerical problems involving: Assigning D-H parameters and finding of end-effector pose using transformation matrices	04 04	CO6

Text Books:

1. Engineering Mechanics by A K Tayal, Umesh Publication.
2. Engineering Mechanics by Kumar, Tata McGraw Hill
3. Engineering Mechanics by Beer &Johnston, Tata McGraw Hill

References:

1. Engineering Mechanics by R. C. Hibbeler.
2. Engineering Mechanics by F. L. Singer, Harper& Raw Publication
3. Engineering Mechanics by Macklin & Nelson, Tata McGraw Hill

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/106/112106286/
2	https://archive.nptel.ac.in/courses/112/106/112106180/

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	
11121104	Basic Electrical and Electronics Engineering	2		--	30	-	--	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11121104	Basic Electrical and Electronics Engineering	20	20	40	60	2.5	--	--	100

Rationale:

This course equips Mechanical and Civil Engineering students with essential knowledge of electrical and electronic systems that are increasingly integral to modern infrastructure. From energy-efficient HVAC and automated construction equipment to smart buildings and sustainable power systems, understanding electrical circuits, machines, and controls enables engineers to design, operate, and maintain advanced infrastructure. The subject aligns with NEP 2020 goals by fostering interdisciplinary skills and promoting sustainable and intelligent engineering practices in line with UNSDGs.

Course Objectives:

1. To provide a foundation in DC and AC electrical circuit behavior applied in industrial systems.

2. To introduce transformer operation and efficiency for energy management.

3. To understand electric motors used in construction, HVAC, automation, and tools.

4. To explain diode and transistor applications in sensors and smart infrastructure.

5. To foster engineering decision-making involving electrical safety and sustainable power use.

6. To encourage interdisciplinary learning and practical problem-solving aligned with NEP 2020 goals.

Course Outcomes:

By the end of the course, students will be able to:

1. **Apply** basic laws (Ohm's law, Kirchhoff's laws) and theorems (Thevenin, Norton, Superposition) to analyse electrical circuits used in buildings and machines.

2. **Analyze** the behaviour of AC circuits, resonance, and power factor to improve energy efficiency in infrastructure systems.

3. **Explain** the operation of transformers and their applications in power distribution systems used in construction sites, elevators, and HVAC systems.

4. **Illustrate** the working of electrical machines (DC/AC motors, BLDC) in elevators, cranes, pumps, and other mechanical equipment.

5. **Evaluate** the role of special purpose diodes (Zener, LED) and transistors in lighting, instrumentation, and automation in smart buildings and factories.

6. **Demonstrate** use of transistors in switching and monitoring systems.

Pre-requisite: Fundamentals of Physics and Mathematics

R-2025- FE Civil Engineering with Computer Applications

Sr. No.	Module Name	Detail Topics	Hours	CO Mapping
0	**Prerequisite**	Resistance, inductance, capacitance, series and parallel connections of resistance, concepts of Voltage, current, power and energy and its units Magnetic circuits, MMF, Magnetic field strengt Reluctance.		
1	**DC Circuits and Energy Optimization Techniques**	• Kirchhoff's Laws, Source transformation, Star-delta Transformation, • Mesh and Nodal Analysis, • Network theorems: Superposition, Thevenin's, Norton, Maximum Power Transfer	**10**	**CO1**
		Self-Learning: • **Application of Thevenin's & Norton's theorems** in troubleshooting electrical systems in cranes, pumps, and automated gates • **Mesh and Nodal Analysis** applications in renewable energy installations for buildings (solar + DC microgrids) • **Maximum Power Transfer applications** in solar panel circuits for mechanical ventilation and green buildings		
2	**AC Circuits and Power Quality in Infrastructure**	• AC signal characteristics: RMS, phasors • Series/Parallel RLC circuits • Real, reactive, apparent power and resonance • Introduction to three-phase voltages (only star/delta theory)	**12**	**CO2**
		Self-Learning: • **Power factor improvement techniques** used in HVAC systems and elevators • **Energy-efficient design** of electrical distribution in large mechanical workshops and construction sites • **Three-phase motor selection and balancing** in cranes, hoists, and conveyor systems • RLC circuit applications	12	
3	**Single-Phase Transformers in Building**	• Working principle, types, ideal vs practical transformer • Losses, efficiency, application in SMPS, UPS	**04**	**CO3**

	and Utility Systems	• **Self-Learning**: • **Safety codes and guidelines** for transformer installations at industrial and construction sites • Role of transformers in solar PV installations • **Isolation transformers** for sensitive instruments	04	
4	**Electric Machines in Construction and Mechanical Systems**	• Overview of DC Motors, 1-Φ & 3-Φ Induction motors • Introduction to **BLDC motors** used in robotics, drones, printers	**05**	**CO4**
		Self-Learning: • **Energy-efficient motor selection** for HVAC, lifts, and pumps (impact on operating costs) • Recent trends in smart motor monitoring • **Motor maintenance strategies** (predictive vs preventive maintenance)	05	
5	**Diodes in Energy Management and Smart Lighting**	• Zener Diode: Voltage regulation • LED: Principles and display usage • Clipping, clamping circuits (brief intro)	**04**	**CO5**
		Self-Learning: • Solar-powered LED lighting • **Low-voltage DC lighting systems** for sustainable buildings • **Zener diode-based voltage protection** for sensitive sensors	**04**	
6	**Transistors for Automation and Control in Engineering Systems**	• BJT and FET (intro only), Common emitter configuration • Transistors as switches and basic amplifiers • Applications in logic gates, switching regulators	**04**	**CO6**
		Self-Learning: • **Transistors in sensor interfacing** • Applications of BJTs and FETs in robotics and automation in mechanical workshops • **Design of basic logic circuits** for automation of construction machinery		

Text Books:

1. V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition)

2. Vincent Del Toro "Electrical Engineering Fundamentals", PHI Second edition, 2011

3. Edward Hughes "Hughes Electrical and Electronic Technology", Pearson Education (Tenth edition)

4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.

5. M. Naidu,S. Kamakshaiah "Introduction to Electrical Engineering" McGraw-Hill Education, 2004.

6. B.R Patil "Basic Electrical Engineering" Oxford Higher Education.

7. Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky

References:

1. B.L. Theraja "Electrical Engineering "Vol-I and II

2. S.N. Singh, "Basic Electrical Engineering" PHI , 2011Book

Online Resources:

Sr. No.	Website Name
1	https://www.allaboutcircuits.com/
2	https://nptel.ac.in/courses/108/105/108105053/
3	https://www.electronics-tutorials.ws/
4	https://www.edx.org/course/circuits-and-electronics-1-basic-circuit-analysis
5	https://www.falstad.com/circuit/

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	
11121105	C and C++ Programming	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration in Hrs.			
		IAT-I	IAT-II	IAT-I + IAT-II (Total)					
11121105	C and C++ Programming	20	20	40	60	2.5	--	--	100

Rationale:

The C and C++ Programming course serves as a foundational pillar for first-year engineering students across all branches by developing essential problem-solving and programming skills. It introduces students to both structured and object-oriented programming paradigms, fostering logical thinking and algorithmic design. As C is widely used in system-level programming and C++ forms the basis for modern software development, this course ensures students gain proficiency in writing efficient, modular, and scalable code. Its relevance spans all engineering disciplines, supporting applications in simulation, automation, modeling, and control systems. By laying the groundwork for advanced subjects like data structures, algorithms, and embedded systems, the course prepares students for future academic and professional challenges in an increasingly digital and automated world.

Course Objectives:

1 **To introduce** the fundamentals of programming using C and C++, focusing on syntax, semantics, and program structure for developing simple, efficient solutions.
2 **To develop** the ability to apply control structures, functions, arrays, and strings in solving computational and real-world engineering problems.
3 **To enable** students to understand and implement user-defined data types such as structures, unions, and enumerations for effective data management.
4 **To build** foundational knowledge of pointers, memory management, and file handling to facilitate low-level programming and system-level applications.
5 **To provide** a conceptual and practical understanding of object-oriented programming features in C++, including classes, objects, inheritance, polymorphism, and abstraction.
6 **To prepare** students for advanced computing courses by enhancing their analytical thinking, debugging skills, and ability to write modular, maintainable, and reusable code.

Course Outcomes:

Upon successful completion of the course, the learner will be able to:

1 **Understand and apply** the basic concepts of C programming, including algorithm development, structured programming, data types, operators, control structures, and input/output operations, to develop simple programs.
2 **Apply and analyze** the concepts of functions, arrays, and strings in C to solve computational problems using modular and structured programming techniques.
3 **Apply and analyze** the use of pointers, structures, and file handling techniques to manage memory efficiently and perform structured data operations in C programming.
4 **Understand and apply** the fundamental concepts of object-oriented programming in C++, including classes, objects, encapsulation, constructors, and member functions to design modular programs.
5 **Analyze and apply** advanced object-oriented programming concepts such as polymorphism, inheritance, virtual functions, and abstraction in C++ to develop flexible and reusable software components.
6 **Understand and evaluate** best programming practices, debugging techniques, and industry standards like MISRA guidelines, and **relate** C/C++ programming to real-world applications and emerging technologies.

Prerequisite: Nil.

Detailed Syllabus:

M. No.	Module Name	Detail Topics	Hours	CO Mapping
0	**Prerequisite**	● Basic familiarity with **fundamental mathematical** and **logical reasoning skills**. ● **Understanding of basic computer operations** – such as using a keyboard, mouse, operating systems, and file handling. ● **Logical thinking and problem-solving ability** – including flowcharting, algorithmic thinking, and basic decision-making. ● **Basic English comprehension skills** – to read and write code, understand syntax, and follow programming logic.	--	--
1	**Fundamentals of C Programming**	● Introduction to Programming, algorithms and Flowcharts ● Program Development Life Cycle (PDLC) - Structure of a C Program, Compilation, Execution ● Concepts of Structured Programming in C ● Data Types, Program Statements, Token, Identifiers, Keywords, Constants, Assignment, Declaration and Initialization, Variables, Operators and Expressions, Lvalue and Rvalues, ● Input/Output Functions, Type Conversion and Typecasting ● Control Structures: if, else, switch-case, loops (for, while, do-while), break, continue, goto	**8**	
		Self-Learning Topics: ● Write-up on history and evolution of programming languages ● Practicing Non-Formatted Input & Output functions – getchar( ), putchar( ), getch( ), getche( ), putch( ), gets( ), puts( ) ● Practicing Formatted Input & Output functions – printf( ) - % Format specifiers, formatting the output, escape sequences, Runtime adjustment and	**8**	

		precision – Input Function scanf() – format specifiers, formatted input. ● Preprocessor Directives in C ● Implement pattern generation programs and logic puzzles ● Research: Role of C in Embedded Systems ● Practicing program development logic using Combines Multiple Control Statements: Number guessing game, ATM simulation program, Login system with 3 attempts limit, **Magic** number finder, Menu-driven bank management functions		
2	**Functions, Arrays, and Strings**	● **Functions:** Prototype Declaration, Definition, Function Calling, Passing Parameters to the Function, Scope of Variables, Call by Value. ● **Storage Classes:** auto, static, register, extern ● Recursive Functions, Recursion Vs Iteration ● **Arrays**: 1D, 2D Arrays – Declaration, Initialization, Accessing Array Elements, Operations on Arrays, Applications ● **Strings**: Declaration, Initialization, String Operations, Array of Strings, String manipulation Functions in string.h	**8**	
		Self-Learning Topics: ● Sorting an array, Binary searching ● Declaration and Initialization of a Multidimensional Array ● Matrix addition, multiplication ● Arrays of strings: Two-dimensional character array ● Passing Arrays to Functions ● Character manipulation in the String using character functions in <ctype.h> ● Implement recursive solutions (e.g., Fibonacci, Tower of Hanoi) ● Comparison of recursion and iteration (mini presentation)	**8**	

		• Industry application: Use of arrays/strings in data processing		
3	**Pointers, and Structures**	• **Pointers:** Basics, address operator (&), Declaring & initializing Pointer Variables, Indirection Operator and Dereferencing, Pointer Expressions and Pointer Arithmetic, Types of Pointers, Pointer to Pointers, Pointers and Arrays, Call. by value vs Call by address. • **Dynamic Memory Allocation** (malloc, calloc, realloc, free) • **Structures and Unions**, Declaring Structures and Structure Variables, Accessing the members of a structure, Initialization of Structures, typedef, Nested Structures, Arrays of Structures,	**7**	
		Self-Learning Topics: • Call by address using pointers, returning more than one value from a function, returning pointer from a function, structures and pointers, passing structure to function • Structure versus Union, Enumeration types • Processing binary files • Write mini programs for file encryption/decryption • Technical write-up: Memory leaks and how to avoid them • Tools: Memory debugging using Valgrind (demonstration/presentation)	**7**	
4	**Introduction to Object-Oriented Programming (C++)**	• Differences between Procedural and Object-Oriented Programming • Introduction to C++, Structure of a C++ Program • Classes and Objects, Standard input and output stream objects, Access Specifiers, Data hiding and Encapsulation, Array of Objects • Constructors and Destructors • Friend Functions, Inline Functions	**7**	
		Self-Learning Topics: • Explore syntax differences between C and C++	**7**	

		• Implement class-based programs (Employee Management System, Account Management banking system, Addition of Complex Numbers, student management) • Defining the member functions outside the class • Research: Applications of OOP in industry tools (e.g., game development, simulations)		
5	**Advanced OOP Concepts (C++)**	• **Inheritance:** Creating a Parent-Child relationship between Classes, Types of Inheritance, Implementing Multilevel and Hybrid Inheritance • **Polymorphism:** Introduction of Polymorphism, Types of Polymorphism • **Compile time Polymorphism:** Function overloading, operator overloading, Rules for operator overloading • **Run time polymorphism:** Virtual functions, rules for virtual functions, pure virtual function.	**8**	
		Self-Learning Topics: • Working of Constructors with Multiple Inheritance Creating a "String" data type – An example using Operator and function overloading • Create inheritance-based applications (e.g., employee hierarchy system) • Mini project proposal based on OOP concepts • Read and summarize advanced topics like Templates or Exception Handling	**8**	
6	**Industry Applications and Programming Practices**	• Best Practices in Programming: Modularization, Comments, Code Reusability • Debugging Techniques, Error Handling • Applications in Embedded & Real-Time Systems • Introduction to Competitive Programming – Objectives, how it works, Benefits, platforms • Overview of Software Development Life Cycle (SDLC)	**7**	

		● MISRA C and MISRA C++ Safe Coding Rules ● Role of C/C++ in current technologies (AI, IoT, Game Development, System Software)		
		Self-Learning Topics: ● Research paper or technical write-up on advanced use of C/C++ (e.g., real-time systems, kernel dev) ● Online platform practice (e.g., HackerRank, Codeforces, CodeChef, etc.) ● Seminar/presentation on any emerging tech using C/C++	**7**	

Text Books

1 "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.
2 “Object Oriented Programming with C++” by E. Balagurusamy, McGraw Hill Education**.**
3 "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
4 "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
5 "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
6 "Let Us C", by Yashavant Kanetkar, BPB Publications.

Reference Books

1 "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie,Prentice Hall.
2 “Programming: Principles and Practice Using C++” by Bjarne Stroustrup, Addison-Wesley
3 "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
4 "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
5 "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

R-2025- FE Civil Engineering with Computer Applications

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	
11112106	Applied Physics Lab	--	--	1	--	--	1	–	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	IAT II	Total				
11112106	Applied Physics Lab	--	--	--	--	25	--	25

Lab Objectives:

1. To BUILD a foundation of quantum mechanics needed for understanding and developing modern technology.
2. To DEMONSTRATE the principles of interference in thin films and relate them to optical phenomena.
3. To INTRODUCE the fundamentals of lasers and optical fibers along with their applications in communication technology.
4. To UNDERSTAND the working principle of an ultrasonic distance meter and to MEASURE distances using ultrasonic wave propagation.
5. To UNDERSTAND the operation of a Linear Variable Differential Transformer (LVDT) and to USE it for linear displacement measurement.
6. To EXPLAIN the basic operating principles of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM), and to RECOGNIZE their applications in nanoscale material characterization.

Lab Outcomes:

LO1: Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology.

LO2: Learners will be able to DETERMINE the wavelength of light and EXPLAIN the

interference phenomenon.

LO3: Learners will be able to ILLUSTRATE the use of lasers in applications and APPLY the fundamentals of fiber optics in modern communication technology.

LO4: Learners will be able to OPERATE an ultrasonic sensor to measure distance accurately and EXPLAIN its working based on the time-of-flight principle of sound waves.

LO5: Students will be able to INTERPRET voltage variation from the LVDT in response to physical displacement.

LO6: Learners will be able to EXPLAIN the working mechanisms of SEM and TEM and INTERPRET their role in analyzing surface morphology and internal structure of nanomaterials.

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	Hrs	LO
01	Determination of Number of Lines in Diffraction Grating using He-Ne Laser	**01**	**LO2**
02	Determination of Radius of Curvature of Lens Using Newton's ring Set Up.	**01**	**LO2**
03	Determination of 'h' using LED/photocell	**01**	**LO1**
04	Determination of Divergence of LASER	**01**	**LO3**
05	Determination of Numerical of Aperture of OFC	**01**	**LO3**
06	Measurement LVDT for displacement sensing.	**01**	**LO5**
07	Determine RTDs (PT100) for temperature measurement.	**01**	**LO5**
08	Measurement of Distance using Ultrasonic Distance Meter.	**01**	**LO4**
09	Learning Basic operations of Scanning Electron Microscope and Transmission Electron Microscope	**01**	**LO6**

Text Books and References:

1. Ajoy Ghatak – *Optics*

Excellent explanation of diffraction, laser interference, and grating equations.

2. C.L. Arora – *B.Sc. Practical Physics*

Practical procedure and observation format for the experiment.

3. Jenkins & White – *Fundamentals of Optics*

4. Gerd Keiser – *Optical Fiber Communications*

5. R.S. Sedha – *Applied Electronics*

6. Digital CMOS Design by Sung-Mo Kang

Online Resources:

Sr. No.	Website Name
1.	IEEE Xplore / Research Gate
2.	https://www.electronics-tutorials.ws/diode/diode_2.html
3.	https://circuitdigest.com.
4.	https://www.vlab.co.in/
5.	https://www.AMRITHA.vlab.co.in/

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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	
11122107	Engineering Mechanics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IA T 1	IAT 2	Total.					
11122107	Engineering Mechanics Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1 To acquaint with basic principles of Centroid and its real-life significance

2 To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.

3 To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.

4 To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.

5 To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.

6 To acquaint with the basics of Robot kinematics

Lab Outcomes:

1 Demonstrate the understanding of Centroid locate the same.

2 Determine the resultant and equivalent force-couple system for a given system of forces.

3 Illustrate the concept of loads, supports, beams, conditions of equilibrium, and

	friction and apply the same in two dimensional systems with the help of FBD.
4	Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear, and general plane motion.
5	Apply the principles of force and acceleration, work-energy and impulse-momentum to particles in motion.
6	Establish the relation between robot joints and parameters

List of Experiments:

Minimum six experiments from the following list of which a minimum one should be from dynamics.

Sr. No.	List of Experiments	Hrs	CO mapping
1	Verification of Polygon law of coplanar forces (Universal force table apparatus)	02	CO2
2	Verification of the Principle of Moments (Bell crank lever)	02	CO2
3	Determination of Centroid of plane lamina made up of standard geometrical shapes	02	CO1
4	Determination of support reactions of a Simply Supported Beam.	02	CO3
5	Determination of coefficient of friction using inclined plane	02	CO3
6	Verification of the equations of equilibrium for non-concurrent non-parallel (General) force system.	02	CO3
7	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	02	CO4
8	Collision of elastic bodies (Law of conservation of momentum).	02	CO5
9	Kinetics of particles. (collision of bodies)	02	CO5

Sr No	List of Assignments / Tutorials	Hrs	CO mapping
01	Centroid and MI of composite plane laminas (6 Numerical)	01	CO1
02	Resultant of coplanar and non-coplanar system of forces (6 Numerical)	01	CO2
03	Equilibrium of beam, rollers, bodies on inclined plane with friction and ladders with friction (7 Numerical).	03	CO3
04	Kinematics of particles and rigid bodies (7 Numerical)	03	CO4
05	Kinetics of particles (5 Numerical)	01	CO5
06	Homogeneous transformation, and Direct Kinematics of robot (5 Numerical)	02	CO6

07	Resultant of Co-planar system of forces for concurrent system of forces using C programming language.	02	CO1
08	Equilibrium of beam for support reactions using C programming language	02	CO3

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	
11122108	Basic Electrical and Electronics Engineering Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT I	IAT II	Total.					
11122108	Basic Electrical and Electronics Engineering Lab	-	-	-	-	-	25	25	50

Pre-requisite: Fundamentals of Physics and Mathematics

Lab Objectives:

Lab course aims to:

1. To **demonstrate** safe handling and measurement of electrical quantities using real-world instruments (voltmeter, ammeter, multimeter).
2. To **experiment** with DC and AC circuits and evaluate their behavior in energy-efficient systems.
3. To **visualize** the construction and operation of transformers and motors used in smart infrastructure and mechanical systems.
4. To **analyze** the application of diodes and transistors in lighting, control, and automation systems.
5. To **develop** a practical understanding of electrical systems integrated into buildings,

machinery, and public infrastructure.

Lab Outcomes:

After successful completion of the course, students will be able to:

LO1: **Operate** and interpret electrical measuring instruments used in field applications and industry-grade machinery.

LO2: **Construct** and test basic DC and AC circuits and interpret the behavior of resistive, inductive, and capacitive loads..

LO3: **Demonstrate** the working of transformers and assess their role in decentralized and sustainable power distribution.

LO4: **Inspect** the construction and function of motors commonly used in HVAC, lifts, cranes, and water pumping systems.

LO5: **Use** diodes (Zener, LED) and transistors (BJT, FET) in control circuits for energy-efficient lighting and automation.

LO6: **Apply** safety protocols in handling and testing electrical systems in real-life civil/mechanical engineering contexts.

List of Experiments:

Sr No	List of Experiments	Hrs.	LO Mapping
1	Introduction to lab safety, measuring instruments (voltmeter, ammeter, DMM, oscilloscope).	2	**LO1**
2	Verification of mesh and nodal analysis using resistive networks.	2	**LO1**
3	Verification of Superposition, Thevenin's and Norton's theorems in DC circuits.	2	**LO1**
4	Analysis of single-phase RLC circuit to determine impedance and phase angle.	2	**LO2**
5	Observe three-phase voltage relationships in star and delta connections using simulation tools.	2	**LO2**
6	Demonstration of a cut-out section and working of a single-phase transformer.	2	**LO3**
7	To visualize and understand motor types used in mechanical systems	2	**LO4**
8	To study regulation capability of Zener diodes for stable power supply.	2	**LO5**
9	To explore LED behavior and suggest efficient lighting systems	2	**LO5**

10	To demonstrate transistor use in control and amplification.	2	**LO6**
11	Construct a common emitter amplifier and measure gain using a signal generator.	2	**LO6**
12	Optional: Design a Simple Relay-Based Automation Circuit	2	**LO6**

Online Resources:

Sr. No.	Website Name
1	All About Circuits (https://www.allaboutcircuits.com)
2	Circuit Lab (https://www.circuitlab.com)
3	Tinkercad (https://www.tinkercad.com)

Suggested assignments:

Sr. No.	List of Assignments(Any 6)	Hours
1	Solve numerical problems related to Mesh and Nodal analysis; include a task to simulate power-saving networks using simulation tools like Tinkercad/CircuitLab.	2
2	Assign real-world cases (like mobile chargers, IoT sensors) to relate theory with efficiency and power optimization.	2
3	Research and report on transformer use in smart grids and renewable energy systems. Include a simple design analysis of a power adapter.	2
4	Study use-cases of motors in electric vehicles, industry automation, and BLDC motors in smart homes. Include a comparative table of energy efficiency.	2
5	Assignment on Zener and LED diodes.	2
6	Explain BJT and FET in switching and amplification	2
7	**Case Study**: "Electrical Systems in Sustainable Campuses"	2
8	**Research Brief**: "Electronics Waste and Sustainability"	2

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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	
11122109	C and C++ Programming Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11122109	C and C++ Programming Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce students to the fundamental programming constructs of C and provide hands-on experience with writing, compiling, debugging, and executing simple programs using an IDE.
2. To enable students to develop modular and efficient C programs by exploring functions, recursion, and arrays, enhancing their understanding of data management.
3. To familiarize students with advanced C programming concepts such as structures, pointers, dynamic memory allocation, for effective data storage and manipulation.
4. To provide comprehensive exposure to object-oriented programming in C++ focusing on classes, objects, constructors, destructors.
5. To deepen understanding of advanced object-oriented concepts in C++ including inheritance, polymorphism, virtual functions, and abstract classes for designing flexible software solutions.
6. To guide students in designing and implementing an object-oriented system in C++ that integrates key programming concepts for practical application.

Lab Outcomes: At the end of the course, the student will be able to

1. **Analyze and apply** fundamental programming constructs in C using Code::Blocks IDE to develop, compile, debug, and execute programs that implement input/output operations, operators, and control flow structures such as branching, looping, and nested decisions.
2. **Apply and evaluate** the use of functions, recursion, and arrays (including strings) in C programming to design modular and efficient programs that demonstrate data management and manipulation.
3. **Analyze and implement** advanced C programming concepts including structures, pointers with dynamic memory allocation, manage complex data efficiently in real-world applications.
4. **Apply and analyze** core object-oriented programming concepts in C++ including classes, objects, constructors/destructors, and implement polymorphism to develop reusable and efficient code.
5. **Analyze and implement** advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions to create flexible and extensible software designs.
6. **Design, implement, and evaluate** a C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing.

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	To understand the structure and features of the Code::Blocks Integrated Development Environment (IDE) and to use it effectively for writing, compiling, debugging, and executing C and C++ programs, which will serve as the foundational tool for all further experiments in the lab.	2
02	a) Program to demonstrate operations of Data Input and Output – getchar( ), putchar( ), scanf( ), printf( ), gets( ), puts( ) b) Program to demonstrate Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators.	2
03	Program to demonstrate Branching - If statement, If-else Statement, Multiway decision.	2
04	Program to demonstrate Nested control structure- Switch statement, Continue statement, Break statement, goto statement	2
05	Program to demonstrate Looping – for and nested for loop	2
06	Program to demonstrate Looping – while, do-while	2
07	a) Implement an iterative function for factorial/ Fibonacci etc. b) Implement a recursive function for factorial/ Fibonacci etc.	2
08	Program to demonstrate Array 1D	2
09	Program to demonstrate Array 2D	2
10	Program to demonstrate String and arrays of string.	2
11	Program to demonstrate Structure: Write a program to store and display information of a student/employee etc. using structures a) Define a structure, b) Read and store details, c) Display the stored information.	2
12	Program to demonstrate call by value and call by reference.	2

13	Program to demonstrate the use of classes and objects, constructors and destructors in C++	2
14	Program to demonstrate Single, multilevel, and hybrid inheritance using classes	2
15	Create a system that stores and displays student records including name, roll number, marks for 3 subjects, and computes total marks, average, and grade. Implement the following: 1. A base class Person with attributes: name, roll_no 2. A derived class Student with: Subject marks (e.g., marks[3]) 3. Member functions to input and display data 4. Functions to calculate total, average, and assign grade 5. Use constructors for initialization and destructors to display a message upon object destruction. 6. Use function overloading for displaying summary (e.g., detailed vs short view). 7. Implement operator overloading (e.g., == to compare two students by roll number or marks). 8. Use virtual function in a base class ResultCalculator and override in Student class. 9. Use an array of objects to manage multiple student records.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Flowcharts for programs, input/output operations, operators, and control flow structures such as branching, looping, and nested decisions	2
02	Use of functions, recursion, storage classes, and arrays (including strings) in C programming	2
03	Structures, pointers with dynamic memory allocation	2
04	Core object-oriented programming concepts in C++	2
05	Advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions	2
06	C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing	2

Text Books

1. "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.

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	
11412111	Engineering Workshop I	--	--	2	--	--	30	15	45	1.5

2. “Object Oriented Programming with C++” by E. Balagurusamy, McGraw Hill Education**.**
3. "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
4. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
5. "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
6. "Let Us C", by Yashavant Kanetkar, BPB Publications.

Reference Books

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie,Prentice Hall.
2. “Programming: Principles and Practice Using C++” by Bjarne Stroustrup, Addison-Wesley
3. "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
4. "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
5. "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

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Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11412111	Engineering Workshop-I	--	--	--	--	25	--	25

Lab Objectives:

1. To understand and apply the fundamental safety practices, rules, and precautions necessary for working in an engineering workshop environment.
2. To Perform basic carpentry operations such as measuring, marking, cutting, chiseling, planning, and joining.
3. The objective is to enable students to understand the properties of sheet metal, practice precision in fabrication, and ensure adherence to safety procedures throughout the process.
4. To develop foundational skills in computer hardware assembly, maintenance, and troubleshooting, and managing computer networks.
5. To explore and develop proficiency in using Google Workspace tools and to create and publish a functional website using Google Sites.
6. To develop practical skills in using Microsoft Excel and to study and execute AI-powered features in Microsoft Excel.
7. To learn the basic concepts and perform steps of PCB fabrication in electronic circuits.

Lab Outcomes: At the end of the course, the student will be able to

1. Understand and follow standard safety rules and operating procedures for tools and machinery.
2. Able to Create basic carpentry joints (e.g., lap joint, mortise and tenon joint, dovetail joint) with proper fit and finish
3. Able to perform bending and folding operations to form the sides of a square tray with correct angles and dimensions.
4. Able to assembling and disassembling a personal computer and trouble shoot common hardware issues.
5. Able to navigate and utilize core google workspace and integrate google workspace tools into a google sites.
6. Able to use basic to advance excel function **and** to use AI-powered features in Excel
7. Able to understand basic components and demonstrate the process of PCB fabrication.

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
	Safety and Precautions	Lab safety rules and personal safety rules .	**1**	**LO1**

1	**Fabrications**	Introduction to carpentry sections ● Introduction to carpentry tools, types of woods etc. ● TEE LAP joint experiment Introduction to Sheet metal section ● Introduction to sheet metal, materials and procedure etc. ● Square Tray Experiments. Self Learning Tool Handling Techniques To study about the types of wood To study about different job in sheet metal To gain knowledge of tools and techniques used in Sheet metal process	**4** **4** **2**	**LO2** **LO3**
2	**Hardware and Networking**	Introduction to Computer Hardware ● Computer Fundamentals Introduction to computers Types of computer Components of computer Input/output devices Storage devices ● Computer Hardware Motherboard architecture Processor types and features RAM types and installation Power supply and units Assembling a computer BIOS/UEFI Configuration Common Troubleshooting issues Installation of LINUX/WIN 11 (DUAL) VM WARE (Installation) Bootable PD (Installation) Google Workspace and Google Sites ● Introduction to google Workspace ● Gmail, Email etiquette, labels, filters ● Google Drive : Upload, organize, share ● Google Docs/slides:Collaborate in real time, insert images, comments and tables. ● Google Forms ● Getting Start with Google Sites ● Building basic website ● Creating Multiple pages Microsoft Excel For Engineers and intregate with AI ● Excel interface, data entry, formatting	**2** **2** **2**	**LO4** **LO5** **LO6**

		basics ● Formulas and fabrication ● Charts and graphs ● Data sorting and filtering ● Getting started with Excel ● Data Analysis and visualization ● AI in Excel Self Learning **1.** Study and Report on Motherboard Components and Layout **2.** Create a Maintenance Plan for a Personal Computer **3.** Research BIOS/UEFI Functions and Configuration Options (Provide screenshots and describe real-world use cases0 **4.** Design a Small Office/Home Office **5.** Create and Share a Collaborative Google Doc **6.** Organize Files and Folders in Google Drive Design a Mini-Website for a School Club, Event, or Business Idea	**2** **6**	
3	**Introduction to PCB**	Electronic Components and tools for measuring and debugging electronics circuits. ● Active and Passive components ● Breadboard to built simple circuits. ● Soldering Practices. ● Reading and interpreting circuit diagrams ● Multimeter ● Oscilloscope 8050 and DS0 ● Function generator ● Logic Probe/logic analyzer (demo) PCB Design and fabrication ● Wiring system ● Go-down wiring ● House Wiring ● Staircase wiring ● Introduction To PCB design Software ● Drawing a simple schematic PCB layout and routing techniques Self learning 1. Component Identification and	**8** **8**	**LO7**

		Research (real –life example). 2. Resistor Color Code Practice (learn the resistor color code system) 3. Datasheet Study (Download the datasheet for any 1 component and identify write configuration) 4. Breadboard Familiarization (Watch a tutorial or read a guide on how a breadboard works.)	**6**	

Reference Books

1. A Course in Workshop Technology Vol. 1: Manufacturing Processes by B. S. Raghuwanshi
2. Elements of Workshop Technology Vol. 1: Manufacturing Processes by S. K. Hajra Choudhury & A. K. Hajra Choudhury
3. Complete PCB Design using or CAD Capture and PCB Editor by Kraig Mitzner.
4. Computer Hardware and Networking by Rajiv Chopra.
5. Google Sheets for Beginners: A Practical Guide to Mastering Google Sheets by Nathan George.
6. Google Workspace User Guide by Oliver Kent.

Online Resources

Sr No	Reference
1	https://onlinecourses.swayam2.ac.in/cec25_cs10/preview Computer Fundamentals, By Prof. Sanjay Tanwani.
2	https://onlinecourses.swayam2.ac.in/nou25_cs01/preview -CIT-001: Fundamentals of Computer Systems, By Dr. Mangala Prasad Mishra
3	https://onlinecourses.swayam2.ac.in/aic20_sp59/preview -ESim - EDA tool for circuit design, simulation, analysis and PCB design, By Prof Kannan Moudgalya
4	https://onlinecourses.nptel.ac.in/noc25_ee163/preview -Electronic Systems Design: Hands-on Circuits and PCB Design with CAD, By Prof. Ankur Gupta
5	https://onlinecourses.swayam2.ac.in/imb25_mg206/preview Excel for Finance - From Basics to Advanced, By Dr. Premalatha K P

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	Safety and precaution	1
02	TEE LAP Joint	4
03	Square tray	4
04	PCB Design and Fabrication	8

05	Assembling and dissembling of computer .(Demonstration)	2
06	To solve Common Troubleshooting problem solving.	2
07	Installation of LINUX/WIN 11 (DUAL) (Demonstration)	2
08	To create a google form for simple survey or quiz.	2
09	To create grade sheets or expense tracker	2

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	
11461112	Universal Human Values	2	-	-	30		-	30	60	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
11461112	Universal Human Values	-	-	-	-	-	25	-	25

Rationale: The goal of the education system is to cultivate well-rounded individuals who are capable of rational thinking and action, as well as empathy and compassion. It strives to nurture ethical values and principles, shaping responsible citizens who can contribute to creating an inclusive, equitable, and diverse society, as envisioned by our Constitution. Education should focus not only on intellectual growth but also on developing social, ethical, and emotional intelligence. Ultimately, education is essential for unlocking human potential and fostering a just and fair society. A fair combination of holistic and multidisciplinary education would develop human beings wide intellectual, deep aesthetic, social, physical, emotional, and moral in an integrated manner. UHV courses are intended to help students to develop a holistic, humane world vision for adopting fair technological advancements. The modules structured to be discussed are universal, rational, and verifiable, hence leads to harmony.

Course Objectives:

1. To develop a holistic perspective based on self-exploration about them (human being),

2. To understand the meaning of harmony in relationship family with reverence and compassion

3. To explore a wide range of social networking ensuring mutual happiness and prosperity

4. To identify the urge to establish global peace and harmony to make the world a better place to live.

5. To understand the threats posed by human activities to biodiversity, and provide solutions

6. To develop understanding in implementing technologies to serve mankind.

Course Outcomes:

After successful completion of the course learner will be able:

1. Identify innate humanistic virtues and abilities as fundamentals to work as an individual.
2. Explore solutions to behavioral conflicts through family, a society in miniature with empathy.
3. Develop understanding to maintain human-human relationship for mutual happiness for building great teams.
4. Adapt for global pursuits in a peaceful co-existence with the entire mankind for global society uplift.
5. Acquire awareness of maintenance and conservation of biodiversity to provide sustainable solutions.
6. Evaluate the knowledge of 'Real Self ' augmenting universal human order to develop holistic technologies and creating congenial work environments.

Prerequisite: There is no prerequisite for this course.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	There is no prerequisite for this course.		
I	Holistic Growth of Individual	Understanding the Human Being: Body, mind, and self – their roles and needs, Distinction between the self (conscious entity) and the body, Importance of self-reflection and self-awareness Developing clarity about personal goals and values, Emotional intelligence: managing thoughts and feelings. Lifestyle choices that support well-being Integrating knowledge with ethics and values **Self-Learning Topics**: Analyze yourself thoroughly and discover your personality traits: Behavioral, Habitual and Acquired traits and record the significance of the traits in handling diverse situations in your past and present life.	4 4	CO1
II	Self-Harmony & Family Values	Prosperity - a right identification of needs and fulfillment through right means What is *naturally acceptable* (permanent, universal) vs. what is acquired or conditioned. Family - a space for value cultivation and emotional support, Mutual fulfillment addressing Common Family Issues: Balancing individuality and togetherness, Misunderstandings due to Assumptions, Generational gaps and communication barriers. Trust empathy, and open communication in family relationships. Family as a Basic Unit of Society, Joint versus nuclear family structures and their social impact. **Self-learning Topics**: Importance of Respect and. Compassion in families, relations, neighborhood, how family harmony helps to progress and attain a worthy and respectable social and financial status. Togetherness and advancement, Conflict and resolution	4 4	CO2
		Human-Human relationship, Respecting others and their perspectives, Understanding		

III	Social Equilibrium	the difference between *intention* and *competence.* Vision of a universal human order (Sarvabhauma Vyavastha) based on trust and mutual prosperity. Promotion of dialogue, cooperation, and peaceful coexistence. Individuals and groups work together for common goals and shared well-being. Visualizing a universal harmonious order in society- Undivided Society, Universal Order from self to community Mutual Prosperity. Support and Empower marginalized communities **Self-Learning Topic:** A positive and unbiased Mediation and dialogue, and its importance Different communities' views for creating better communities & societies. Incidents happening around you which urgently require social equilibrium as a vision.	5 5	CO3
IV	Shared Values of Mankind	Values accepted and upheld by all human beings regardless of background, peaceful coexistence and global harmony. Role in addressing global challenges like conflict, inequality, and environmental crises, Philosophical and spiritual traditions worldwide. Human rights frameworks (e.g., Universal Declaration of Human Rights). Sensitizing individual towards Contemporary World Issues **Self Learning Topic:** India's relationships with other countries. Promoting peace and harmony hence preventing conflict situations. Conflict situations throughout the world where India as a one who maintained its integrity by following its traditional, philosophical and ethical standard.	6 6	CO4
IV	Human-Nature Relationship	Humans as caretakers of the Earth, not conquerors. Ethical choices like wildlife conservation, habitat preservation, and reducing pollution. Promoting humane treatment in agriculture, research, entertainment, and daily life. Sustainable living: reducing waste, recycling, and using renewable energy. Educating communities	6	CO5

		about the importance of biodiversity and ecosystem health. **Self-Learning Topics**: Practices adopted in ancient India for preserving the environment, Importance of rivers, trees, water mentioned in Indian scriptures and culture. Modern technologies/practices favoring ecosystem preservation. (Past Practices Vs, Present Practice)	6	
VI	Integrating universal human values in the workplace	Meaningful and Purposeful Work: Encouraging dignity in all types of jobs. Human creativity and contribution to society. Equal opportunities without discrimination. Prioritizing human well-being over mere profit. Technical education is enriched with ethics and human-centric values. Ethical behavior includes not exploiting others for personal gain—whether as employers or consumers. Ability to identify and develop appropriate technologies and management patterns for production systems. Case studies of typical holistic technologies, management models and production systems. **Self-Learning Topics:** Contemporary workplace scenario Confronting challenges like globalization, technological advancement/disruption cultural diversity, workplace prejudice .unconscious bias. Hampering output and how universal human values helps erasing these complexities.	5 5	CO6

References:

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2009). A Foundation Course in Human Values and Professional Ethics. New Delhi: Excel Books.
2. Ravindran, P. S. (2007). Essence of Human Values and Professional Ethics. Chennai: Sri Ramakrishna Math.
3. Gaur, R. R. (2011). Human Values and Professional Ethics. New Delhi: Dhanpat Rai Publishing Company.
4. Chitkara, M. G. (2002). Education and Human Values. New Delhi: A.P.H. Publishing

Corporation.
5. Martin, M. W., & Schinzinger, R. (2005). Ethics in Engineering (4th ed.). New York: McGraw-Hill.
6. Gandhi, M. K. (1927). The Story of My Experiments with Truth. Ahmedabad: Navajivan Publishing House.
7. Vivekananda, S. (Compilation). (2001). I and My Nation. Kolkata: Advaita Ashrama.
8. AICTE (2020). Towards a Holistic Development: A Collection of Good Practices in UHV. New Delhi: All India Council for Technical Education.

Online References:

Sr. No.	**Website Name**
1.	https://uhv.org.in/

List of Assignments (Answer the questions about in 500 words)

1. Explain the process, content, and natural outcome of self-exploration with a neat diagram and two examples from your life.

2. Analyze the impact of compassion on mental health. Describe the role of family in the development of an individual.

3. Describe the concept of an undivided society and the universal order and explain how both these can help to create a world family.

4. What do we mean by holistic technologies, management models, and production systems? How are these useful for mankind?

5. Explain the concept of co-existence in nature. How can this understanding help in addressing environmental issues?

6. Design a program to promote respect in the workplace where people treat each other with respect and have equal opportunities for growth.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
11421113	Strategic Communication & Management Skills	1	--	--	15	--	--	15	30	1

		Theory					Term Work	Pract Exam	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
11421113	Strategic Communication and Management Skills	20	20	40	40	1.5	-	-	80

Rationale:

The course has been redesigned specifically for mechanical and civil engineering students, equipping them with strategic oral and written communication skills necessary for today's enterprise and entrepreneurial environment. Students will learn to simplify complex engineering concepts and messages, understand key communication models.These skills are essential for mechanically and civilly focused professionals to confidently interact with project stakeholders, clients, and public audiences, while also reinforcing their organization's brand image and reputation through transparent and effective communication. The curriculum

strengthens all four LSRW competencies—Listening, Speaking, Reading, and Writing—ensuring engineers communicate with clarity, confidence, and flair in professional contexts.

Course Objectives - The learners should be able to:

1. Effectively explore the dynamics of communication and navigate professional arenas
2. Competently acquire active listening skills by comprehending physical and digital content
3. Critically analyse communication barriers, audience and purpose to speak proficiently
4. Minutely comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Efficiently organize and create purposeful technical writing for professional transactions
6. Impactfully relate with other agencies with ethical standards to deliver synergistic solutions.

Course Outcomes - The learners will be able to:

1. Explore and adapt the dynamics of communication to navigate diverse professional arenas.
2. Acquire active listening skills by practicing different Speech Acts physically and digitally.
3. Analyze communication barriers, methods, audience and purposes for mastering eloquent and persuasive speaking.
4. Synthesize extensive technical and non-technical texts for reflective learning through reading and summarization.
5. Design digital, ethical technical and business content for professional transactions.
6. Advocate technical excellence and interpersonal acumen to disseminate relevant sustainable community solutions.

Prerequisite: Basic knowledge of English language

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of English language.		
I	Communication Dynamics	Foundations of Communication Dynamics: Objectives Linear vs. Transactional Models Encoding, Decoding, and Feedback, Interpersonal Communication in Groups: Verba interaction : Meetings & Presentations, Teleconferences & Calls and Non-Verba Interactions: Proxemics,	5	CO1

		Haptics Oculesics Kinesics Digital Interaction: virtual teams, vide calls Formal and Informal communication Communication Channels . Barriers: Physical Semantic Psychological & Emotional Barriers Cultural & Contextual Barriers Silos mentality Hierarchical layers, Rigid policies, unclear channels, and outdated tech. **Self Learning Topics** Communication at Workplace &Outer Agencies Internal communications Regular email updates, Video conferencing and face to face sessions External Communication craft compelling narratives, multichannel fluency,Open dialogues, Trust and Transparency	5	
II	Active Listening	Active Listening: Discussions, and note-taking techniques. -book listening, Understanding colleagues' and clients during meetings Types of Listening Comprehensive Listening , Critical Listening and Reflective /Empathetic **Self Learning Topics:** Listening kryptonite : Thought Distractions Semantic Jargons information overload, speaker pace, Pseudo listening & Interruptions Time Pressure, Fatigue/Emotions	2 2	CO2

III	Conversational Proficiencies	Technical Communication Skills Technical Discussion, delivering technical oral presentations inside and outside organizations Q&A, Design Review meetings, team coordination, troubleshooting and site visits **Self Learning Topics:** Mentoring and peer support , conflict resolutions and feedback conversations Grooming and Self Development: Interpersonal Engagement, Field and site interaction, Foster collaborations	2 2	CO3
IV	Text Interpretation Expertise	Reading Proficiency Intensive Reading, ExtensiveReadingSkimming,Scanning,SQ5R Method *(Survey, Question, Reading, Recording,Recall, Review and Revise)*Industry Related Articles and Report, .Summarizing text to Graphic Organizers (GO) Cause and effect diagram, sequence chart and flow charts, Hierarchy or Tree Diagrams Problem–Solution Charts , Mind Maps Leveraging Online Resources Technical Reports ,Articles, Manuals, Product design specifications ,Tender documents, Infrastructure project reports **Self-Learning**: Manufacturing process flow descriptions, Technical proposals and feasibility reports, Professional and Industry News	2 2	CO4
V	Technical & Managerial Skills	Seven Cs of Business Writing Completeness, Conciseness, Consideration, Concreteness, Clarity, Courtesy, Correctness. Format & Types of Formal Letters : Cover Letter, Inquiry Letter Quotation/Order Letters Grievance Letter Short And Long Reports/ Proposals and	3	CO5

		business Cases Technical Manuals & Operating Guide Standard Operating Procedures (SOP) Tender notices **Self Learning** : Studio Activities Content Creation for Social Media and e-Commerce Platforms Blogs, Vlog Keynote speeches Podcast titles Landing pages	3	
V I	Community Communication and Ethics	Communicating clearly with non-technical users and stakeholders Building supportive networks Promoting innovation and problem-solving Participating in user groups or tech meetups Gain encouragement and advice on technical or career challenges. Disaster management , Training of local public ,Rural Tech Projects Communication Transparency and Honesty Accountability Avoiding Misuse of Information Uphold **ethical standards** in all written, verbal, and digital communication. **Self-Learning** ethical decisions in materials sourcing or manufacturing, Client demo, Communicating during production failures, safety incidents, or delays	1 1	C O 6

References:

1. Communication Skills by Sanjay Kumar & Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick &Hemphill

3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online References:

Sr. No.	**Website Name**
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/
4.	https://venngage.com/blog/white-paper-examples/

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
11422114	Strategic Communication and Management Skills LAB	-	-	2		-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
11422114	Strategic Communication and Management Skills LAB	-	-	-	-	-	25	-	25

Lab Objectives: The learners should be able to:

1. Effectively explore the dynamics of communication for academic and professional excellence in diverse settings .
2. Positively acquire active listening skills through Speech Acts in different modes.
3. Thoroughly analyse communication barriers, audience and purpose to speak effectively at the workplace.
4. Minutely demonstrate technical and non-technical text to comprehend and discern the exact purposes.
5. Minutely demonstrate technical and non-technical text to comprehend and discern the exact purposes.
6. Efficiently organize and create purposeful technical and business writings
7. Successfully manage teams and individual tasks by applying ethical standards to execute the tasks.

Lab Outcomes: The learners will be able to:

1. Apply communication principles for excellence in academic and professional excellence in diverse setting .
2. Test listening capabilities for advanced listening strategies in physical and digital mode.
3. Evaluate and present ideas precisely to the audience in a confident way.
4. Demonstrate reflective learning through practicing extensive technical and non-technical

texts.

5. Design digital technical and business write ups for professional and business transactions
6. Implement technical and managerial skills for future entrepreneurial prospects by confronting local communities and industries problems.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic knowledge of English language and ICT enabled media		
I	Communication Dynamics	Application of Communication Dynamics .Key Components of Strategic Communication, Shannon-Weaver Model at workplace. Strategic communication: Project Collaboration Platforms,Industry Reports, and Articles ,News Letter, Brand messaging paid media	4	LO1
II	Active Listening	Comprehensive Listening and Applications: Technical or Business podcasts, Youtube lecture on academic stuff/ processes/ procedures/ Development Plans Critical Listening: Cross disciplinary Listening (manufacturing, quality control marketing), Listening for safety: safety instructions and protocols. Warnings or risk factors Listening in Team Meetings: team updates and deadlines.	4	LO2

III	Conversational Proficiencies	Conversational Activities -I Self Introduction, Prepared Speech on Technical Topics and Impromptu Speech on General Topics Conversational Activities-II Simulation in communication:Role Play Activity for Client Interaction, Negotiation and Persuasion, Safety Communication Conversational Activities -III customer Communication, Cross-Cultural communication, Marketing & Brand Communication Handling Q&A in Presentation	8	LO3
IV	Text Interpretation Expertise	Prepare Diagram Organizers on: Summarising text to Graphic Organisers (GO) Cause and effect diagram, sequence chart and flow charts, Hierarchy or Tree Diagrams Problem–Solution Charts , Mind Maps Summarising text in point form after,Tender documents, Infrastructure project reports Manufacturing process flow descriptions, Professional and Industry News	4	LO4
V	Technical Writing Skills	Technical content: Technical Blog Short And Long Reports (PPT using Canva) Installation GuidesWriting Cover Letter, Inquiry Letter Quotation/Order Letters Grievance Letter Short Technical Manuals & Tender notices, Safety Signage Text Studio Activities: Content Creation for Social Media CMS - Wordpress to create, manage and publish content. e-Commerce Platforms Blogs, Vlog Podcast titles, Landing pages Social media posts	6	LO5

VI	Community Communication and Management Skills	Local Area Visit, Field Visits. Local Manufacturing projects partnership with local groups , stem education Free workshop for residents of sustainable practices Surveys Feedback Analysis and Report Writing ,Providing solutions for Technical issues	4	LO6

Reference Books:

1. Communication Skills by Sanjay Kumar & Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick & Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online Resources:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/

List of Experiments.

Sr. No	Name of Experiment	Hours
1.	Prepare a case study on strategic Communication in Select Indian Companies: Siemens ,Caterpillar Inc. Bosch AECOM, Jacobs Engineering Group	02

2	Listening Skill Activity Sheet containing minimum three types of listening activities from Lab Syllabus.	02
3	A. Continuous Evaluation of at least three types of the activities from Lab Syllabus for proficiency in oral communication/presentation	02
4.	a. Summary report and Graphic Organizers for the relevant scenario or situation b. Powerpoint / Slide Preparation on Industry Cases studies available online.	02
5.	Three Types of Letter Writing in prescribed format (Full Block) along with impressive email messaging Technical Writing , Manuals , Safety Instructions Digital Content Creation from Lab syllabus (Minimum two activities for writing skills should be done with documentation).	02
6.	Conduct field visits and local area visits Government and non Government bodies, manufacturing plants, Green Building Projects ,Construction sites and ensure the implementation of your subject completely or partially for the smooth functioning. Conduct a Survey or get a feedback from outside agencies regarding the future inputs for synergistic solutions	02

R-2025- FE Civil Engineering with Computer Applications

F.E SEM-II Syllabus

SEM II

Theme: "**Engineering Foundations for Sustainable Futures**"

Aligned with **UNSDG 4 – Quality Education, UNSDG 7: Affordable and Clean Energy, UNSDG 9: Industry, Innovation, and Infrastructure**. **UNSDG 12 – Responsible Consumption and Production**

The theme "Engineering Foundations for Sustainable Futures" is a powerful and relevant framework for engineering education, deeply intertwined with the United Nations Sustainable Development Goals.

Problem Statement 1: Simple Greywater Recycling for Gardens

Redirect and treat wastewater from sinks or bathrooms for gardening. Reduce freshwater use in urban homes and colleges..

Problem Statement 2: Composting Machine for College Canteen

Challenges with waste collection and disposal. Build a Prototype mechanical composter that processes daily food waste into fertilizer.

Problem Statement 3: Low-Cost Modular Bridge for Rural Roads

Design a scalable bridge model using bamboo or recycled plastic.

Problem Statement 4: Mini Wind Turbine for Urban Homes

Design a compact wind turbine for use on balconies or rooftops.

Problem Statement 5: Urban Vertical Farming Unit

Create a compact hydroponic or vertical garden for city apartments.

Problem Statement 6: Renewable Energy Air Purifier for smoking zones.

Monitor key air pollutants in smoking zones, providing clean air with a purification system based on renewable energy sources.

R-2025- FE Civil Engineering with Computer Applications

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	
11111201	Differential Equations and Integral Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11111201	Differential Equations and Integral Calculus	20	20	40	60	2.5	-	--	100

Rationale:

In first-year Civil Engineering, mathematical concepts such as differential equations, integrals, and numerical methods form the backbone of engineering analysis and design. Higher-order linear differential equations are essential for modeling and analyzing structural elements such as beam deflection under various loading conditions and fluid flow in open channels. Double and triple integrals are widely used to compute areas, volumes, and mass—critical for determining the volume of earth to be excavated, the material required for construction, or the center of gravity of irregular cross-sections. Vector calculus, including operations like gradient, divergence, and curl, is crucial in fluid mechanics and environmental engineering to model flow fields, heat transfer, and pollutant dispersion. Complex integration helps solve certain boundary value problems and is applicable in potential flow analysis and structural stress analysis using conformal mapping. Numerical methods provide practical solutions where analytical techniques fail—such as estimating groundwater movement, solving differential

equations in soil mechanics, or modeling temperature variation in concrete curing. These mathematical tools equip civil engineering students with the analytical ability and computational skills needed for solving real-world engineering problems effectively and confidently.

Course Objectives:

1. To introduce the application of higher-order differential equations in modeling dynamic civil systems.
2. To explain double integration for calculating areas and mass in 2D civil structures.
3. To demonstrate the use of triple integrals for volume and mass computations in 3D structures.
4. To introduce vector operators for analyzing physical fields in civil engineering.
5. To teach complex integration techniques applicable in solving boundary value problems.
6. To present numerical techniques for solving PDEs and complex models in civil engineering.

Course Outcomes:

1. Students will be able to solve and interpret equations used in modeling beam deflection and groundwater flow.
2. Students will evaluate double integrals and use SCILAB to calculate cross-sectional areas and centroids of structural components.
3. Students will apply triple integrals and use SCILAB to determine the volume of reservoirs, concrete slabs, or foundations.
4. Students will analyze fluid flow and heat transfer in systems using gradient, divergence, and curl.
5. Students will solve civil engineering problems involving stress functions and flow nets using complex analysis.
6. Students will use numerical methods and use SCILAB to approximate solutions in slope stability analysis or temperature distribution in pavements.

Prerequisite:

1. Basics of integration and it's properties**.**

2**.** Linear differential equations

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Differential Equation	Exact differential Equations, Equations reducible to exact form by using integrating factors.	05	CO1
		Equation reducible to linear form, Bernoulli's equation.		
		Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax} , sin(ax + b), cos(ax +b), x^m.		
		Self-learning topics: 1. Method of variation of parameter 2. Particular integrals for $e^{ax}V$ and xV. 3. Cauchy's homogeneous linear differential equation. 4. Legendre's differential equation. 5. Applications of first order and first degree and also Higher order differential equation.	08	
II	Multiple Integral-I	Beta and Gamma functions and its properties.	05	CO2
		Double integration-definition, Evaluation of Double Integrals.(Cartesian & Polar)		
		Change the order of integration (No Evaluation)		

		Self-learning topics: 1. Rectification of curves. (Cartesian, Polar and Parametric) 2. Application of double integrals to compute Area and Mass of lamina.	07	
III	Multiple Integral-II	Evaluation of double integrals by changing to polar coordinates	O5	CO3
		Evaluation of integrals over the given region (Cartesian and polar).		
		Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates).		
		Self-learning topics: 1. Application of triple integrals to compute volume. 2. Triple integrals over a volume bounded by a plane. 3. Triple integrals over a volume bounded by a paraboloid. 4. Triple integrals over a volume bounded by a cone. 5. Triple integrals over a volume bounded by an ellipsoid.	07	
IV	Vector Calculus	Scalar and vector fields. Differentiation of vectors	05	CO4
		Directional derivative, Gradient, divergence and curl		
		Scalar potential function		
		Self-learning topics: 1. Line integrals – definition and problems. 2. Green's theorem in a plane, 3. Stokes' theorem (without Proof) 4. Gauss' Divergence theorem (without proof) and problems (only evaluation).	07	

		5. Angle between surfaces.		
V	Complex Integration	Cauchy's Integral theorem and formula,	05	CO5
		Taylor's series and Laurent's series - radius of convergence		
		Singularities and Poles, Cauchy Residue theorem.		
		Self-learning topics: 1. Line Integral in cartesian and parametric form. 2. Application of Residue Theorem to evaluate real integrations. 3. Conformal mapping	08	
VI	Numerical Methods	Numerical integration-by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all without proof)	05	CO6
		Interpolation by Newton's and Lagrange polynomials		
		Numerical solutions of transcendental equations by Newton Raphson method and Regula –Falsi method.		
		Self-learning topics: 1. Indeterminate forms, L- Hospital Rule, 2. Gauss Elimination Method, Gauss Jordan Method. 3. Maclaurin Series 4. Numerical solution of ordinary differential equation using (a) Euler's method (b) Modified Euler method, (c) Runge-Kutta fourth order method	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. Jain M.K., Iyengar SRK, Jain R K,: "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, 6th Ed., 2007.

3. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.

4. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.

5. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.

6. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education, 2015.

7. 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/111/105/111105122/
2.	https://www.youtube.com/watch?v=T6jHXD78dBI
3.	https://www.youtube.com/watch?v=KgItZSst2sU
4.	https://www.youtube.com/watch?v=w_KiHgultbM

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
11111202	Engineering Chemistry	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
11111202	Engineering Chemistry	20	20	40	60	2.5	--	--	100

Rationale:

1. Chemical science has contributed in many ways to most of the Engineering branches where "engineering materials" is the modern approach to learn impact of Technology on habitat and can be common to all Core Groups,
2. "Engineering Materials" can be prerequisites to impact of corrosion on metals as many civil engineering materials is the important area of concern.
3. "Conventional and Non-Conventional Energy Study" is the matter of general approach to all but especially to Mechanical group as energy issue is the most recent concern even for designing the energy efficient IC engine.
4. Chemical science has contributed in many ways to most of the Engineering branches where "Engineering Materials" such as water, polymers, fuel, lubricants and cement, can be prerequisites to many subjects of all core groups from the perspective of applications as a build material for structural as well as mountainous component

Course Objectives:

1. To study effect of hardness of water on various materials used in civil structures and

machine design.

2. To introduce important properties of polymers as Engineering material.
3. To study the effect of corrosion by different mechanisms on metals and methods of corrosion control
4. To study energy efficacies of various conventional and non-conventional source of energy.
5. To study mechanism and various lubricants used in engineering applications.
6. To recognize importance of alloys and can apply the phase rule on it to study the effect of temperature and composition
7. To recognize the composition, properties and functions of various cements used in civil engineering.

Course Outcomes:

Student will be able to –

1. determine the hardness of water and various method of water hardness removal.
2. use the polymers for specific engineering applications on the basis of the properties.
3. understand the causes of corrosion and apply different methods to minimize corrosion.
4. determine the quality of fuel and quantitative estimation of fuel.
5. understand the role of lubricants in corrosion prevention.
6. understand the various alloys and to Interpret various phase transformations of alloy using thermodynamics.
7. identify different types of cement and their specific role as structural materials for engineering applications

Prerequisite:

1. Knowledge about basic concept of hardness of water.
2. Knowledge of basic properties of polymers
3. Knowledge of concepts of Electrochemistry.
4. Knowledge of basic difference in Conventional and non-conventional energy sources.
5. Knowledge of basic mechanism and use of lubricant.
6. Knowledge of basic properties of metals and nonmetals and purpose of making alloys
7. Knowledge of Constituents of Cement and their functions.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge about basic concept of hardness of water, properties of polymers, concepts of Electrochemistry, basic difference in Conventional and non-conventional energy sources, mechanism and use of lubricant, properties of metals		

		and nonmetals and purpose of making alloys, Constituents of Cement and their functions.		
I	Water	1. Impurities in water, Hardness of water 2. Determination of hardness of water by EDTA method and numerical problems, 3. softening method of water and numerical based on it –i) Ion exchange process ii) electro dialysis iii) reverse osmosis iv) ultrafiltration. 4. Definition, significance and numerical problems based on BOD and COD.	05	CO1
		Self-learning Topics: **1.** Industrial applications of water treatment in power plants and manufacturing. **2.** Comparative study of water purification technologies (e.g., UV vs RO). **3.** Municipal water treatment plants. Environmental impact of untreated water discharge. **4.** Latest advancements in membrane filtration (e.g., nano filtration).	05	
II	Introduction to polymers.	**1.** Macro-molecular science, basic concept of polymers, Chemical bonding in polymers, Classification of Polymers. **2.** Properties of Polymers:- i) Molecular weight - Number average molecular weight, Weight average molecular	05	CO2

		weight, Numerical, ii) Crystallinity - Crystalline and amorphous polymers – Glass transition temperature, iii) Mechanical Properties: Hardness, tensile strength, creep, fatigue, impact resistance (introduction), iv) Electrical properties: dielectric strength, insulation resistance, surface resistivity (Introduction), v) Optical properties: refractive index, transmittance, photoelectric property, colour **3.** Advanced polymers: i) Intelligent (smart) polymers ii) Biopolymers		
		Self-learning Topics: **1.** Applications of smart polymers in medical and aerospace industries. **2.** Recycling of polymers: techniques and challenges. **3.** 3D printing and polymer materials. **4.** Use of biopolymers in packaging. **5.** Role of polymer composites in automotive design.	05	
III	Corrosion	**1.** Introduction: Definition, Types of Corrosion – i) Dry or Atmospheric Corrosion, ii) Wet or Electrochemical corrosion (In Acidic medium, In Neutral medium) **2.** Factors affecting rate of corrosion: i) Position of metal in galvanic series, ii) Purity of Metal, iii) Nature of Corrosion product, iv) Temperature, v) pH of medium, vi) concentration of medium, vii) moisture, viii)	05	CO3

		Relative Cathodic and Anodic area, ix) overvoltage **3.** Methods to control corrosion: i) Selection of metal, ii) Proper Designing, iii) Cathodic protection, iv) Use of Corrosion Inhibitors, v) Metallic Coating- metal cladding, galvanization, tinning, metal spraying.		
		Self-learning Topics: **1.** Corrosion failures in historical structures. **2.** Protective coatings used in marine and oil industries. **3.** Cathodic protection systems used in pipelines. **4.** Advanced corrosion monitoring techniques. **5.** Corrosion management in reinforced concrete structures.	05	
IV	Fuels	**1.** Introduction**:** i) Definition, Characteristics of good fuel. ii) Calorific value: Definition, Types, Determination, Dulong's formula, Numerical) iii) Solid fuel: Coal: - Analysis of coal – Proximate analysis, Ultimate analysis, Numerical, Combustion of coal – Numerical iv) liquid fuel: petroleum oil- composition, mining and refining of petroleum. **2.** Petroleum products: i) refining of petroleum, ii) advantages of unleaded petrol, iii) MTBE: its uses, advantages and disadvantages iv) power alcohol, v) knocking in petroleum products, antiknocking agents,	05	CO4

		octane number of petrol, Diesel: cetane number. **3.** Green fuel for sustainable development: Synthesis and Advantages of i) Biodiesel, ii) Ethanol		
		Self-learning Topics: **1.** Biofuel usage in Indian Railways or airlines. **2.** Life cycle assessment of fossil vs. alternative fuels. **3.** Energy policies promoting ethanol and biodiesel. **4.** Innovations in fuel cell technology. **5.** Environmental impacts of coal combustion.	05	
V	Lubricants and Alloys	Lubricants: **1.** Introduction- definition, mechanism and classification of lubricants, **2.** Types of lubricants: solid lubricants- graphite and molybdenum disulphide, semisolid lubricant, liquid lubricant, additives in blended oils, **3.** Important properties of lubricants- definition and significance of –viscosity, viscosity index, flash point and fire point, Claude point and pour point, oiliness, emulsification, acid value and numerical, saponification and numerical Alloys:	06	CO5, CO6

		1. Ferrous alloys – i) Plain-carbon steels ii) Heat and Shock resisting steels iii) Stainless steels iv) Effect of the alloying element- Ni, Cr, Co, Mn, Mo, W and V. **2.** Non Ferrous alloys: A) Aluminum alloys – Composition, properties and uses of i) Duralumin, ii) Magnalium B) Copper alloys – Composition, properties and uses of a) Brass – i) Dutch Metal ii) German Silver b) Bronze – i) Gun metal ii) Nickel bronze. C) Alloys of Pb – Composition, properties and Uses of i) Wood's metal ii) Tinman's solder. **3.** Numerical: i) based on Composition, ii) based on density iii) based on weight of an alloy.		
		Self-learning Topics: **1.** Lubricant selection for heavy machinery. **2.** Nano-lubricants and their industrial relevance. **3.** Smart lubricants and real-time condition monitoring. **4.** Applications of specific non-ferrous alloys in aerospace. **5.** Advances in high-performance alloys (e.g., Inconel, Titanium alloys).	06	
VI	Important Engineering materials	**1.** Introduction, **2.** Manufacturing of Portland cement, **3.** Chemical composition and constituent of Portland cement, **4.** Setting and hardening of Portland cement, concrete, RCC	04	CO7

		5. Decay process of cement.		
		Self-learning Topics: **1.** Use of green cement and eco-concrete in construction. **2.** Failure analysis of concrete structures. **3.** Cementitious materials in 3D printed buildings. **4.** Sustainable alternatives to Portland cement. **5.** Chemical admixtures in concrete and their mechanism.	04	

References:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science: F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry, Oxford University Press, 5 th edition

Online References:

Sr. No.	**Website Name**
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20ch41/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/topics/engineering/polymer-material
5..	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
11121203	Engineering Graphics	2	-	-	30	-	-	-	30	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
11121203	Engineering Graphics	20	20	40	60	2.5	--	--	100

Rationale:

Engineering Graphics develops spatial visualization and technical drawing skills essential for modern computing applications. It bridges the gap between digital systems and the physical world, supporting areas like embedded systems, IoT, and robotics. The course enhances understanding of 3D modeling, essential for AR/VR, digital twins, and simulation-based tools. It prepares students to work effectively in interdisciplinary teams involving hardware-software integration. Concepts like projections and solid modeling are foundational for CAD software, PCB design, and interface development. It supports UI/UX development for 3D applications, gaming, and visualization platforms. Engineering graphics aids in documenting and communicating design ideas clearly and accurately. Overall, it fosters analytical thinking and design communication, crucial for innovation in intelligent computing systems.

Course Objectives

1 To impart and inculcate proper understanding of the theory of projection.

2 To impart the knowledge to read and interpret a drawing.

3	To improve the visualization skill.
4	To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
5	To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.

Course Outcomes

1	Apply basic concepts of geometrical constructions to create engineering curves.
2	Apply the basic principles of projections in Projection of Lines and Planes
3	Apply the basic principles of projections in Projection of Solids.
4	Apply the basic principles of sectional views in Section of solids.
5	Apply the basic principles of projections in converting pictorial views into orthographic Views.
6	Apply the basic principles of projections in converting orthographic views into isometric drawing.

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
	Pre-requisite	To draw basic geometric shapes like circle, pentagon, hexagon, and square with different orientation. Divide a line, circle, etc. into equal number of parts.	01	
1	**Introduction to Engineering Drawing and Engineering curves**	**1.1** Introduction to Engineering Graphics and its significance in Engineering domain. **1.2** Types of Lines, Dimensioning Systems as per IS conventions. **1.3 Engineering Curves**: Basic construction of Conics, Cycloid, Involutes and Helix (cylinder only). **Self-learning topic:** - Explore the concepts of eccentricity, focus, vertex, axis, directrix - Explore other conics - ellipse, parabola and hyperbola using directrix-focus method	03 03	CO 1

2	**Projections of Points, Lines and Planes**	**2.1 Projections of points** in all four quadrants as well as lying on the planes. **2.2 Projections of lines** inclined to both the reference planes (Excluding Traces of lines). Simple application-based problems on projection of lines. **2.3 Projection of planes** (only standard geometrical shapes like square, triangle, pentagon, circle, etc.) inclined to one of the reference planes only. **Self-learning topic:** - Explore the projection of lines for mixed quadrants - Explore the projection of planes for planes inclined to both the reference planes	05 05	CO 2
3	**Projections of Solids**	**3.1** Projections of solids with the axis inclined to one reference plane include prism and cylinder **3.2** Projections of solids with the axis inclined to both reference planes include pyramid, and cone (Use change of position or Auxiliary plane method) **Self-learning topic:** - Explore the cuboid and tetrahedron solids inclined to one or both the reference planes. - Explore the applications of solid projection in machine components, structure, and packaging and manufacturing.	06 06	CO 3
4	**Sections of Solids and Development of Surfaces**	**Sections of Solids** Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to only one reference plane. Use change of position or Auxiliary plane method. **Self-learning topics:** - Explore the development of lateral surface for regular solids - Prism, Pyramid, Cylinder, & Cone	04 04	CO 4

		- Explore the real-life application of solids cut with section planes inclined to one plane.		
5	**Orthographic and Sectional Orthographic Projections**	Fundamental concepts of orthographic and sectional orthographic projections like Positioning of quadrants, observer, horizontal, vertical and profile plane, symbol etc., Different orthographic views, First and Third angle method of projection, different section (cutting) plane, its representation, importance of sectional views, rib and web in section. Views of simple machine parts as per the first angle projection method recommended by I.S. for Orthographic and Sectional Orthographic projection **Self-learning topics:** - Explore the third angle method of projection for orthographic views. - Explore half sectional and offset sectional views - Practice simple machine components with half section and offset section	06 06	CO 5
6	**Isometric Views**	Introduction to isometric projections and Fundamental concepts of Isometric projection - isometric and non-isometric lines, axes, and planes. Concept of isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views **Self-learning topics:** - Explore the concepts of isometric scale and isometric projection - Practice isometric projection of simple objects using isometric scale - Explore the isometric views and projections of holes and slots on an inclined plane	05 05	CO 6

Text Books:

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.

2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

References:

1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.

2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).

3. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.

4. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/105/112105294/
2	https://nptel.ac.in/courses/112103019
3	https://archive.nptel.ac.in/courses/112/102/112102304/

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	
11211204	Basic Fluid mechanics	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211204	Basic Fluid mechanics	20	20	40	60	2.5	--	--	100

Rationale:

Fluid Mechanics is a fundamental subject in the field of Civil and Mechanical Engineering as it forms the foundation for understanding the behavior and movement of fluids—liquids and gases—through various systems. This syllabus has been designed to help students grasp basic fluid properties, static and dynamic fluid behavior, and the principles governing real-life engineering applications such as water supply, hydraulic machines, and cooling systems. It incorporates sustainability and innovation to reflect modern engineering challenges like climate resilience, water conservation, and clean energy.

Course Objectives:

1. To introduce students to the fundamental properties.
2. To enable students to understand and apply fundamental principles of fluid behavior, pressure, and fluid motion to analyze basic flow systems and fluid-related engineering problems.
3. To introduce students to the applications of fluid mechanics in engineering systems, emphasizing how fluids function in infrastructure, machinery, and energy systems across civil and mechanical disciplines.
4. To introduce students to innovative and sustainable applications of fluid mechanics in civil and mechanical engineering through real-world systems, emerging technologies, and smart solutions.
5. To study the basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.
6. To introduce students to the sustainable use of fluid systems in engineering, highlighting their role in climate-resilient infrastructure, efficient water and energy systems, and modern smart technologies.

Course Outcomes:

After completing this course, students will be able to:

1. Identify and describe fundamental fluid properties.
2. Explain the behavior of fluids under static and dynamic conditions, and apply basic fluid mechanics principles to pressure measurement, flow visualization, and fluid force estimation.
3. Explain the role of fluids in engineering systems and differentiate between static and dynamic fluid behavior in civil and mechanical applications.
4. Illustrate how fluid mechanics principles are applied in innovative civil and mechanical engineering solutions related to water systems, automation, energy, and smart technologies.
5. Explain the compressible flow, propagation of pressure waves and stagnation properties.
6. Describe and apply fluid mechanics concepts to analyze sustainable engineering solutions like greywater recycling, buoyant foundations, and smart fluid-based energy systems.

Prerequisite: Mathematics and Physics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic algebra and physics, Units and dimensions, Algebraic manipulation of equations, Differentiation, Integration of simple functions		
I	Basics of Fluids	Difference between solids, liquids, and gases; Definition of fluid and fluid mechanics; Physical properties of fluids: density, specific weight, specific volume, relative density and viscosity. Newton's law of viscosity, classification of fluids, Real-life Applications ; Units and measurement	8	CO1
		Self-learning Topics: Temperature effect on fluid viscosity, Measurement of fluid properties, Fluids in daily life and machines, Units and conversion practice, fluid in cars and properties, 10 fluids used at home and their classification	8	
II	**Fluid Behavior and Flow Systems**	Basic concept of pressure, Pressure head, Types of pressure, Hydrostatic law, pressure measurement Total pressure and Centre of pressure on plane surfaces, Conditions of flotation, Applications Velocity and acceleration, Streamline, pathline, streakline – flow visualization, Flow classification Bernoulli's equation (concept only)	8	CO2
		Self-learning Topics: Pressure head use in dams/reservoirs, streamlines & vortex, Flow Nets & Seepage, TEL/HGL in Pipelines	8	
III	**Fluids in Engineering**	Role of fluids in engineering infrastructure and machinery, Difference between static and dynamic fluid systems,	8	CO3

		Fluids in Civil Engineering Applications: Water Supply Systems, Hydraulic Structures, Stormwater Management, Sewage and Wastewater Handling, Soil and Groundwater Flow Fluids in Mechanical Engineering Applications: Internal Combustion Engines, Pumps and Compressors, Heat Exchangers, Hydraulic and Pneumatic Systems, Refrigeration and Air Conditioning (HVAC)		
		Self-learning Topics: water supply systems work in buildings and cities, Hydraulic systems in construction and transport, Cooling systems using fluids	8	
IV	**Fluids and Innovation in Engineering**	Civil Engineering Innovations Using Fluids: Smart water systems, Urban flood mitigation, Sustainable water harvesting and reuse Mechanical Engineering Innovations Using Fluids: Hydraulic automation, Energy innovations, Fuel & coolant efficiency AI-enabled water meters, Zero-energy cooling using water/air flow	8	CO4
		Self-learning Topics: flowchart of a smart water pipeline, maps of flood-prone areas, hydraulic arms/lifts: identification of components and fluid role, smart fluids-based systems for improvement of urban and mechanical performance	8	
V	**Compressible Flow**	Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties.	6	CO5
		Self-learning Topics: Mach number for subsonic/supersonic flows, speed of sound in air and water, stagnation properties using online simulators	6	

VI	**Fluids and Sustainable Future**	Role of fluid systems in climate resilience, water conservation, and clean energy, Greywater recycling in buildings, Floodproof structures using buoyant foundations, Smart HVAC systems and district cooling, Fluid-based solar water heaters, Real-time monitoring of fluid systems, Smart irrigation using weather prediction	7	CO6
		Self-learning Topics: Extreme Rainfall: Case Studies in Indian Cities, Smart Drainage Systems, Green Infrastructure for Urban Flood Management	7	

Text Books:

1. Hydraulics & Fluid Mechanics by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House.
2. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
3. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.
4. A Textbook of Fluid Mechanics and Hydraulic Machines, Rajput, R. K, S. Chand Publishing

References:

1. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
2. Fluid Mechanics by YunusCengel, JhonCimbala, Tata MacgrawHill,New Delhi.
3. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.
4. Fluid Mechanics by Streeter & Wylie, Tata McGraw Hill.
5. Fluid Mechanics by K. Subramanya, McGraw Hill.
6. Fluid Mechanics by Frank White, McGraw Hill.

Online References:

Sr. No.	Website Name
1.	NPTEL – https://nptel.ac.in
2.	ASCE Sustainable Infrastructure Resources – https://www.asce.org

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	
11111205	Engineering Chemistry Lab	--	--	1	--	--	15	--	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11111205	Engineering Chemistry Lab	--	--	--	--	25	-	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.
2. To analyze experimental results and write laboratory report.

Lab Outcomes: After completion of experiment, the learners will be able to

1. Estimate the type of water hardness and calculate it.
2. Synthesize UF/PF resin at laboratory level.
3. Learn the effect of various factors on the rate of corrosion.
4. Understand the significance of proximate analysis of coal and determine quality of coal sample.
5. Understand causes of the detoriation of lubricant and its extent.
6. Learn volumetric quantitative analytical techniques to determine % of elements from alloy samples.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Determination of Total, Temporary and Permanent hardness of water by EDTA method	**01**
02	Synthesis of Urea formaldehyde Resin.	**01**
03	Synthesis of Phenol formaldehyde resin.	**01**
04	To compare rate of corrosion of various metals in acidic medium.	**01**
05	Determination of moisture content of coal.	**01**
06	Estimation of acid content in the given lubricant oil.	**01**
07	Estimation of saponification value the given lubricant oil.	**01**
08	Determination of % purity of iron.	**01**
09	Determination of Sn from solders volumetrically.	**01**
10	Determination of unknown concentration of Cu in the given sample by colorimetry	**01**

List of Assignments:

Sr No	List of Assignments	Hrs
01	Numerical on determination of hardness of water	**01**
02	Green Solvents: - characteristics and applications of Supercritical solvents and ionic liquids Green Fuels:- Synthesis and Advantages of i) Biodiesel, ii) Ethanol Calculation of % Atom economy of the given chemical reaction	**01**
03	Numerical based on calorific value determination, proximate and ultimate analysis of coal, Acid value and Saponification value in the given lubricants.	**01**
04	Concept, of Smart polymers: some examples of smart polymers with their properties and uses. Note on Liquid Crystal polymers	**01**
05	Composition, Properties of any 4 alloys	**01**

06	Note on Portland cement	**01**

References:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Estern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science : F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry ,Oxford University Press, 5 th edition.

Online Resources:

Sr. No.	**Website Name**
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20ch41/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/topics/engineering/polymer-material
5.	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
11122206	Engineering Graphics	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
11122206	Engineering Graphics	--	--	--	--	--	25	25	50

Lab Objectives:

1 To impart and inculcate proper understanding of the theory of projection.

2 To impart the knowledge to read and interpret a drawing.

3 To improve the visualization skill.

4 To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.

5 To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.

6 To impart basic AutoCAD skills.

Lab Outcomes:

1 Apply the concepts of Draw, Modify and basic concepts of ACAD to draw basic geometries and diagrams of simple engineering parts.

2 Apply the concepts of layers, and dimensions to create engineering drawing for a part drawing.

3	Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
4	Apply the basic principles of projections in 2D drawings using a CAD software.
5	Apply basic AutoCAD skills to draw different views of a 3D object.
6	Apply basic AutoCAD skills to draw the isometric view from the given two views.

List of Experiments:

Component: 01 – ACAD Print outs (activities to be completed in the CAD Laboratory - All printouts to be the part of Term Work.)

Sr. No.	List of Experiments	Hrs	CO mapping
1	Redrawing simple machine parts as given (05 problems)	04	CO1, CO2, and CO3
2	Orthographic projections (with and without section) (05 problems)	04	CO4 and CO5
3	Isometric Drawing – 3 problems.	04	CO6

Component: 02 – Drawing Sheets

01	Two problems on Engineering Curves	02	CO1
02	Two problems each on Projection of Lines and Planes	02	CO2
03	Two problems on Projection of Solids	02	CO3
04	Two problems on Section of Solids with DLS	02	CO4
05	Two problems each on Orthographic and Sectional Orthographic projection	02	CO5
06	Two problems on Isometric projection	02	CO6

Component: 03 – A3 size Sketch book

Sr No	List of Assignments	Hrs	CO mapping
01	Engineering Curves. (2 problems)	01	CO1
02	Projection of Lines and Planes (2 problems each)	02	CO2
03	Projection of solids. (2 problems)	02	CO3
04	Section of solids (2 problems)	02	CO4
05	Sectional Orthographic and Orthographic Projections (2 problems each)	04	CO5
06	Isometric Drawing. (3 problems)	03	CO6

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
11122207	Programming Lab (Python)	2	--	2	30	--	30	--	60	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term work	Practical/ Oral	Tut.	Total
		Internal assessment			End Sem. Exam				
		IAT I	IAT II	Total					
11122207	Programming Lab (Python)	--	--	--	--	25	25	--	50

Lab Objectives:

1. To familiarize learners with Python's basic syntax, variables, data types, operators, and input/output functions.
2. To reinforce the understanding and application of conditional statements, loops, and functions in Python programming.
3. To instill learners on file handling, exception management, and Python packaging.
4. To introduce object-oriented programming principles and their application in Python.
5. To explore advanced topics such as regular expressions, pattern matching, and GUI development.
6. To introduce and demonstrate the use of popular Python libraries for data handling.

Lab Outcomes: After completion of experiment, the learners will be able to

1. Demonstrate the proficiency in basic python programming or Create and perform various operations on data structures like list, tuple dictionaries and strings.
2. Apply Control Flow and Functions for efficient coding to solve problems.
3. Demonstrate proficiency in handling file operations, managing exceptions, and developing Python packages and executable files for modular programming.
4. Illustrate the concept of Object-Oriented Programming used in python.
5. Design Graphical User Interface (GUI) applications, utilizing appropriate Python libraries to create user-friendly interfaces.
6. Investigate and apply popular python libraries to conduct efficient data handling tasks.

Prerequisite:

1. Logical Thinking & Problem Solving: Ability to break down problems into smaller parts. Basic understanding of flowcharts or algorithmic thinking.
2. Mathematical Reasoning: Basic arithmetic operations (addition, subtraction, multiplication, division).
3. Understanding of variables, functions, and formulas (from school-level math).
4. Analytical Skills: Ability to spot patterns, debugs issues, and evaluates outputs.

Text Books:

1. Core Python Programming, Dr. R. Nageswara Rao, Second Edition, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
3. Python Programming, Anurag Gupta and G. P. Biswas, First Edition,McGraw-Hill Education.

References:

1. Learn Python the Hard Way, Zed Shaw, Third Edition, Addison-Wesley.
2. Python Projects, Laura Cassell,Alan Gauld, First Edition, Wrox Publication.
3. Introduction to computing and problem-solving using python, Balagurusamy, First Edition, McGraw Hill Education.

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106145
2.	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/science/article/pii/S2666920X24001127
5.	https://www.sciencedirect.com/search?qs=python%20programming

Suggested List of Experiments: (Expected Minimum 15 Experiments to be performed)

Sr No	List of Experiments	Hrs
01	To understand the structure and features of the Code::Blocks Integrated Development Environment (IDE) and to use it effectively for writing, compiling, debugging, and executing python programs, which will serve as the foundational tool for all further experiments in the lab.	**02**
02	Personalized Greeting Generator* - Write a python code to generate Personalized Greeting.	**02**
03	Calculating Areas of Geometric Figures* - Write a python program to calculate areas of any geometric figures like circle, rectangle and triangle.	**02**
04	Calculating Gross Salary of an Employee*: Write a Python program to calculate the gross salary of an employee. The program should prompt the user for the basic salary (BS) and then compute the dearness allowance (DA) as 70% of BS, the travel allowance (TA) as 30% of BS, and the house rent allowance (HRA) as 10% of BS. Finally, it should calculate the gross salary as the sum of BS, DA, TA, and HRA and display the result.	**02**
05	Task List Manager*: Develop a Python program to manage a task list using lists and tuples, including adding, removing, updating, and sorting tasks.	**02**
06	Student Record Keeper *: Write a Python program to create, update, and manipulate a dictionary of student records, including their grades and attendance.	**02**
07	Triangle Pattern Generator Using Loops: Write a Python program to print a triangle pattern (give any), emphasizing the transition from C to Python syntax.	**02**
08	Number Type Identifier*: Develop a Python program that takes a numerical input and identifies whether it is even or odd, utilizing conditional statements and loops.	**02**
09	**Grade Evaluator:** Develop a Python program that takes marks and evaluates grade using if-elif-else	**02**

10	**Fibonacci Sequence Generator:** Write a Python program to generate the first N terms of the Fibonacci series using loops.	**02**
11	Multiplication Table Generator: Write a Python program to take a numerical input from the user and generate its multiplication table using loops.	**02**
12	Extracting Words from Text File *: Develop a Python program that reads a text file and prints words of specified lengths (e.g., three, four, five, etc.) found within the file.	**02**
13	Basic Exception Handling*: Write a Python program that takes two numbers as input and performs division. Implement exception handling to manage division by zero and invalid input errors gracefully.	**02**
14	Online ATM System: Develop classes for ATM. Include methods for withdraw, deposit and check balance.	**02**
15	Password Strength Checker: Write a Python script that prompts the user to enter a password. Use regular expressions to validate the password based on these criteria: At least 8 characters long, Contains at least one uppercase letter, one lowercase letter, one digit, and one special character.	**02**

Sr No	List of Assignments / Tutorials	Hrs
01	Write a Python program to find the largest of three numbers using if-else.	**02**
02	Create a calculator using Python functions (Addition, Subtraction, Multiplication, Division).	**02**
03	Write a program to check whether a number is prime or not.	**02**
04	Develop a program to generate Fibonacci series using **for** and **while** loops.	**02**
05	Create a menu-driven program using functions for basic mathematical operations.	**02**
06	Write a program to sort a list using Bubble Sort and explain each step.	**02**
07	Create a Python program using lists to manage student records (Add, Delete, Search).	**02**

08	Write a Python program using dictionaries to store and display employee details.	**02**
09	Create a Python script to read and write data from/to a text file.	**02**
10	Write short notes on NumPy, Pandas, and Matplotlib with small sample codes.	**02**

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	
11212209	Basic Fluid Mechanics Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	IAT II	Total				
11212209	Basic Fluid Mechanics Lab	--	--	--	--	25	25	50

Lab Objectives:

1 Understand basic fluid properties and behaviors through experimental techniques.

2 Apply theoretical principles such as Bernoulli's and Pascal's laws in laboratory conditions.

3 Demonstrate fluid flow measurements using standard hydraulic devices and instruments.

4 Analyze energy losses in fluid systems under different flow and fitting conditions.

5 Visualize fluid flow patterns and behavior in open channels and pipes.

6 Introduce fundamental fluid machines (pumps, turbines) and flow-related structural behaviors.

Lab Outcomes:

1. After completion of the course, Students shall be able to
2. Measure and interpret viscosity, pressure, and flow using appropriate instruments.
3. Apply conservation laws to analyze pressure and velocity changes in fluid flow.
4. Quantify head loss and energy losses in pipelines and open-channel flows.

5. Visualize flow phenomena and interpret experimental results using theoretical principles.
6. Understand and analyze flow behavior through notches, orifices, and meters.
7. Describe and demonstrate performance characteristics of fluid machinery and floating structures.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Determination of Viscosity of a Fluid Using Stokes' Law	2
02	Verification of Bernoulli's Theorem	2
03	Use of Manometers for Pressure Measurement	2
04	Flow Visualization using Dye Injection	2
05	Friction Loss Measurement in Pipe Flow	2
06	Minor Losses in Bends and Fittings	2
07	Demonstration of Flow through Open Channels	2
08	Observation of Hydraulic Jump in a Rectangular Channel	2
09	Flow Through Notches	2
10	Flow through Orifice	2
11	Flow through Venturi meter	2
12	Flow through Orifice meter	2
13	Stability of Floating Body (Metacentric height of ship Body)	2
14	Study of Wind tunnel	2
15	Demonstration of Centrifugal Pump and Hydraulic Turbine – Working Principle and Performance Observation	2

Sr No	List of Assignments / Tutorials

01	Questions Based on Module I and Crate PPT based on self-learning topics of module I
02	Questions Based on Module II and Crate PPT based on self-learning topics of module II
03	Questions Based on Module III and Crate PPT based on self-learning topics of module III
04	Questions Based on Module IV and Crate PPT based on self-learning topics of module IV
05	Questions Based on Module V and Crate PPT based on self-learning topics of module V
06	Questions Based on Module VI and Crate PPT based on self-learning topics of module VI

Text Books:

1. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
2. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.
3. A Textbook of Fluid Mechanics and Hydraulic Machines, Rajput, R. K, S. Chand Publishing

References:

1. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
2. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.
3. Fluid Mechanics by K. Subramanya, McGraw Hill.
4. Fluid Mechanics by Frank White, McGraw Hill.

Online Resources:

Sr. No.	**Website Name**
1.	Virtual Lab

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	
11412210	Engineering Workshop II	--	--	2	--	--	30	15	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	IAT II	Total				
11412210	Engineering Workshop II	--	--	--	--	25	--	25

Lab Objectives:

1. To understand and implement the fundamental safety rules, personal protective measures, and standard operating procedures essential for preventing accidents and ensuring a safe working environment in the engineering workshop.
2. To develop skills in using hand tools for fitting operations by performing basic metal cutting, filing, marking, and fitting exercises while following proper safety and operational procedures.
3. The objective is to enable students to understand different types of welding joints, select appropriate electrodes and equipment, and fabricate simple welded components while following standard safety procedures and workshop practices.
4. To introduce students to basic IOT and embedded systems by programming a NODE MCU ESP8266 micro controller to blink an LED..
5. To introduce students to fundamental robotics concepts through the assembly and programming of a basic line following robot.
6. To understand flight dynamics, sensor integration, remote control systems, and applications of drones in real-world.
7. Identify different types of 3D printers (FDM, SLA, SLS) and their components

Lab Outcomes: At the end of the course, the student will be able to

1. Able to Understand and follow standard safety rules and operating procedures for tools

and machinery.

2. Able to identify and correctly use common fitting tools such as files, hacksaws, bench vices, punches, scribers, and hammers.
3. Able to Identify various types of welding processes such as gas welding, arc welding, and spot welding, along with their applications.
4. Able to collect data from sensors and control actuators using boards like Arduino, NodeMCU, or Raspberry Pi.
5. Able to Write and implement code to control robotic motion using microcontrollers like Arduino, Raspberry Pi, or other platforms.
6. Able to operate a drone using a remote controller and execute programmed missions using waypoint navigation
7. Able to Perform printer setup, filament loading, calibration, and execute the printing process successfully

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
	Safety and precautions	Lab rules and lab safety, knowledge of proper use of safety kit.	**1**	**LO 1**
1	**Fabrication**	Introduction to Fitting Section. ● Introduction to fitting tools, sheets ● Fitting job Introduction to welding section ● Introduction to types of welding machine , safety as well as types of welding etc. ● Lap Joint Job. Self learning https://youtu.be/deHaqv7WX5I?feature=shared(welding) https://youtu.be/NwWpuRfZDjI?feature=shared https://youtu.be/y-OKi8oSNQ4?feature=shared	**6** **6** **1**	**LO 2** **LO 3**
2	**Introduction to IOT and Embedded system**	Programming a NodeMCU ESP8266 microcontroller to blink an LED. ● Introduction to NODE MCU and IOT. ● Circuit setup and IDE configuration. ● Setting up Arduino IDE for ESP8266. Experimenting Variation and Discussion Self Learning Connect the DHT sensor to the NodeMCU. Write and upload a program using Arduino IDE to read temperature data.	**6** **2**	**LO 4**

		Write and upload a program using Arduino IDE to read temperature data. Send the data to Thing Speak (or any IoT dashboard). Visualize the readings on a real-time graph.		
3	**Introduction to Robotics**	Programming a basic line following robots ● Introduction to robotics and components ● Assembling a line following robots ● Programming the robot. Testing and evaluation Self learning Build and Control a Basic Line-Following Robot (Modify the code to adjust speed based on curves.)	**6** **1**	**LO 5**
4	**Introduction to drone technology**	Introduction to drone ● Components familiarizations ● Drone assembly ● Calibration and coding upload ● Flight testing and troubleshooting Self Learning Studying basic principle of drone Studying drone programming Basic drown fundamentals	**4** **2**	**LO 6**
5	**Introduction to 3D Printing**	To design and print your first object ● Introduction and basics. ● 3d modelling ● Slicing and preparing the print Printing and reviewing. Self Learning Explore process parameter of 3d printer Explore 2d and 3d drafting and modelling	**8** **2**	**LO 7**

Reference Books

1. Workshop Technology (Vol. 1)by S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy
2. Welding Technology by O.P. Khanna
3. IoT: Building Arduino-Based Projects by Peter Waher.
4. Robotics: Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo.
5. 3D Printing: A Practical Guide for Librarians by Sara Russell Gonzalez, Denise Beaubien

Bennett.
6. Make: DIY Drones for the Evil Genius by Ian Cinnamon.

Online Resources

Sr No	Reference
1	https://onlinecourses.nptel.ac.in/noc21_cs17 -Introduction to internet of things, by Prof. Sudip Misra , IIT Kharagpur
2	https://onlinecourses.nptel.ac.in/noc21_cs08 -Embedded Systems Design, By Prof. Anupam Basu, IIT Kharagpur
3	https://onlinecourses.nptel.ac.in/noc25_ae30/preview -Drone Systems and Control, By Prof. Suresh Sundaram, Dr. Rudrashis Majumder
4	https://onlinecourses.swayam2.ac.in/ntr25_ed66/preview - 3D Printing and Design for Educators, By Dr. Sharad K. Pradhan

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	Fitting Job	6
02	Lap joint Job.	6
03	Blinking LED with Node MCU.	6
04	Built and test basic Line following robot	6
05	Design and Print your first object.	8
06	To assemble and understand working of mini drone.	6

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	
11441211	**Indian Knowledge System**	**2**	**-**	**-**	**30**		**-**	**30**	**60**	**2**

		Theory	Term	Pract	Total

R-2025- FE Civil Engineering with Computer Applications

Course Code	Course Name	Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	work	/ Oral	
		IAT 1	IAT 2	Total					
11441211	Indian Knowledge System	20	20	40	60	2.5	--	--	100

Rationale::

The Indian Knowledge System (IKS) is vital for preserving India's rich cultural heritage, fostering holistic and sustainable practices, and integrating ancient wisdom with modern science to address contemporary challenges and enrich global knowledge.

Course Objectives:

1. To explore and understand the evolution of Indian scientific thought
2. To evaluate the historical and modern educational systems in our country.
3. To analyse sustainable practices in in ancient India.
4. To know the richness of Indian Arts and Culture
5. To understand the contributions of Indian Scientists and Nobel Laureates
6. To understand the principles of good governance.

Course Outcomes:

1. Recognize the sources and concepts of the Indian knowledge system
2. Learn about our history of Indian ancient knowledge and its significance in the current scenario.
3. Demonstrate sustainable development in various fields like Science, Technology, agriculture, industry, architecture performing arts, etc.
4. Understand and appreciate the rich heritage that resides in literature
5. Learn about the ancient Bhartiya education system in comparison with the modern era
6. Showcase the multi-dimensional nature of IKS and its importance in modern

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1.Students should have the foundational knowledge and skills necessary for a comprehensive understanding of IKS 2. Students should be familiar with the		

		Indian Culture, Language, and History of Science and Technology in India.		
I	**Introduction to The Indian Knowledge System (I.K.S.)**	Basic knowledge and scope of IKS, IKS in ancient India and modern india,, Preservation of culture, tradition and Dharma through education. Sources of Education, Aim of Education, Curriculum, methods of learning, Reviving, Knowledge (Ancient Scientific Discoveries) **Self-Learning Topics: Macaulay's Education Policy and Max Mullar Ideology in destroying Indian Tradition**	5 5	CO2
II	**Development of Scientific Thoughts in Ancient India**	Development in Science, Technology, Astronomy, Mathematics, and Life Sciences – Life Science, Physiology, Ayurveda, etc. Discoveries during Ancient times **Self-Learning Topics: Technological Innovations in Ancient India, Architecture and Engineering**	5 5	CO1
IV	**Good Governance in Ancient India**	Introduction to Indian religions,Moral and Ethical Governance,Vishva Kalyan through Vasudhaiva Kutumbkam,Principles of Good Governance about Ramayana, Mahabharat, Artha Sastra and Kauṭilyan State,Scientific Explanation of Vedic or traditional system of society for Good Governance **Self-Learning Topics:Governance Models and Kingdoms, Court System**	5 5	CO6

		and Judges, Crime, Punishment & Fairness		
V	**Contribution of Indian Scientist & Nobel Laureates**	Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna, Susruta, Kanada & Charak Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyan Chandrasekhar, Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi and Abhijit Banerjee **Self-Learning Topics: Indian Contributions to Global Science**	5 5	CO5
VI	**Sustainable Practices in Ancient India**	Agriculture, waste management, water conservation, forest conservation, architecture, urban planning, biodiversity preservation, etc Yoga, Pranayama, and meditation for health and well-being. **Self-Learning Topics: Vaastu Shastra Principles, Minimalism and Non-materialism**	5 5	CO3
		Total	60	

Text Books:

1. A.K Bag, History of technology in India (Set 3 vol), Indian Nation Science Academy, 1997.
2. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
3. Ancient Indian Knowledge: Implications To Education System, Boski Singh; 2019
4. India's Glorious Scientific Tradition by Suresh Soni; 2010 (Ocean Books Pvt. Ltd.)

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
11461212	NSS & Civil Defense	-	-	4*	-	-	60	-	60	2

5. Indian Art: Forms, Concerns, and Development in Historical Perspective (History of Science, Philosophy and Culture in Indian Civilization), General Editor: D.P. Chattopadhyaya, Ed. By. B.N. Goswamy; 1999 Munshiram Manoharlal Publishers Pvt. Ltd.
6. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
7. Pandey, K.K. Kriya Sarira Comprehensive Human Physiology, Chaukhambha Sanskrit series, Varanasi, 2018
8. Shukla Vidyadhar & Tripathi Ravidatt, Aayurved ka Itihas evam Parichay, Chaukhambha Sanskrit Sansthaan, New Delhi, 2017
9. Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan; 2023 (Garuda Prakashan) 6. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati; 2006
10. Traditional Knowledge System in India, Amit Jha
11. J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001.

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/explorer?searchText=iks
2.	https://iksindia.org/book-list.php
3.	https://iksindia.org/index.php

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11461212	**NSS & Civil Defense**	--	--	--	--	--	**25**	--	**25**

Rationale :

The National Service Scheme (NSS) is a central sector scheme of the Government of India aimed at developing the personality of students through community service. The NSS syllabus is designed with a strong rationale that aligns with the educational, social, and developmental goals of the nation.The NSS syllabus promotes the all-round development of students by instilling values such as discipline, leadership, empathy, and teamwork. It encourages experiential learning beyond the classroom, complementing academic education.

Course Objectives:

1. To Introduce National Service Scheme to learners and explain how it is used in current social studies.
2. To make the students aware of the need of having a foundation in social science and NSS.
3. To develop the personality of NSS volunteers through community service. It can enhance the personal growth and social skills of students.
4. To introduce students to social concepts and issues in society, as well as to get involved in resolving social issues.
5. To equip NSS volunteers with basic skills in civil defence, first aid, fire safety, and crowd management, enabling them to act as first responders during emergencies.
6. To build awareness, preparedness, and responsiveness among NSS volunteers to effectively assist in disaster situations.

Course Outcomes:

1. **Describe** the fundamentals and history of the National Service Scheme (NSS), with specific reference to its role in social work and nation-building.
2. **Demonstrate** understanding of NSS-related procedures, including organizational structure, volunteer enrollment, and activity planning.
3. **Participate** in community-based social service activities such as voter awareness drives, campus cleanup, tree plantation, and cyber safety campaigns.
4. **Develop** leadership, team-building, and project management skills through planning and executing NSS activities.
5. **Explain** the basic concepts of civil defence and disaster response mechanisms.
6. **Apply** practical skills in fire safety, first aid, and emergency management during simulated and real-life situations.

DETAILED SYLLABUS:

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
I	Leadership & Personality development	Meaning, definition, qualities, and characteristics of a Leader. Meaning of personality,Dimensions of personality. Personality and Leadership nexus. Universal Human Values and Ethics for youths, Sustainable Development Goals	6	Co1
II	Activity Based Programmes	(Colleges can plan various social activities for learners and make a detailed report) Activities can be conducted throughout the academic year .Evaluation will be based on record keeping of the attendance of the learner.	10	CO2
III	Awareness based Programmes	Awareness Programmes such as Rally,Seminar, Workshops, poster making, theme based rangoli making , essay writing, slogan writing, quizzes ,Celebration of National and International days, Personality Development Programmes, Group Activities, etc.,	10	CO3
IV	Area Based Projects	Visit to Adopted villages, Swatchatha \Programme, Visit and Conserving Ancient monuments and heritage site, Socio Economic Survey of village/slum, Nature Camp, Environmental Education, Women Empowerment Programme, Health and hygiene programmes and Blood donation, Legal awarenessProgramme, Literacy Programme, Cyber theft awareness Water Conservation Programme and RWH,One Day Special Camp	14	CO4

		in a village (preferably in adopted village/Adopted areas/Slums/MR Schools etc).		
V	Introduction to Civil Defence and Disaster Management	Definition and objectives of civil defence,Structure and functions of the Civil DefenceOrganization, Types of disasters: natural and man-made, Phases of disaster management: prevention, preparedness, response, recovery, NDMA (National Disaster Management Authority) and its role,Role of youth in disaster management	10	CO5
VI	Basics of Fire Safety and First Aid	Types of fires and fire extinguishers, Basic fire-fighting techniques, First aid for common injuries: bleeding, fractures, burns, CPR, Emergency numbers and response protocol, Evacuation techniques	10	CO6
		Total	60	

Text Books:

1.National Service Scheme Manual 2006, Government of India

2. Salunkhe P.B. Ed, Chhatrapati Shahu the Pillar of Social Democracy

3. National Service Scheme Manual, Govt. of India

4. Training Programme on National Programme Scheme TISS

5. Orientation Courses for N.S.S. Programme Officers, TISS

Online References:

Sr. No.	Website Name
1.	https://nssmu.in
2.	https://nss.gymkhana.iitb.ac.in/home

R-2025- S.E Civil Engineering with Computer Applications

S.E SEM-III

Syllabus

Sem III

Theme: Sustainable Infrastructure Development through Innovation, Technology, and Climate-Responsive Engineering (SUSTAIN ITC)

Aligned with UNSDG 6: Clean Water and Sanitation, UNSDG 8: Decent Work and Economic Growth, UNSDG 9: Industry, Innovation and Infrastructure and UNSDG 13: Climate Action

The theme "Sustainable Infrastructure Development through Innovation, Technology, and Climate-Responsive Engineering- SUSTAIN ITC" promotes the integration of innovative technologies and climate-responsive engineering practices to solve modern civil engineering challenges. It encourages the adoption of sustainable materials, digital tools like BIM and GIS, and disaster-resilient planning to create durable, low-carbon infrastructure. This theme aligns directly with global goals for sustainability: SDG 6 supports improved water infrastructure and flood management, SDG 8 fosters employment through eco-construction and green entrepreneurship, SDG 9 promotes infrastructure modernization using digital innovation and SDG 13 focuses on mitigating climate impacts through resilient design.

- **Problem Statement 1**
  With rising concerns over carbon emissions and environmental degradation, the conventional use of cement and other non-renewable materials in the construction industry is contributing significantly to climate change. **The challenge is to develop and implement sustainable construction materials that reduce the carbon footprint, enhance durability without compromising structural performance and compliance with existing building codes.**
- **Problem Statement 2**
  The increasing depletion of natural resources such as river sand and limestone used in concrete production poses a threat to the long-term sustainability of the construction industry. **The problem is to design and validate green concrete mixes using alternative materials**

ensuring workability, strength, and long- term durability under varying environmental conditions.

- **Problem Statement 3**
  Rapid urbanization, combined with climate change impacts like erratic rainfall, floods, and droughts, is overwhelming traditional water distribution systems. **There is an urgent need to develop an integrated, climate-resilient urban water management approach that ensures reliable water supply, effective stormwater control, and sustainable resource use, while also safeguarding infrastructure against extreme weather events.**
- **Problem Statement 4**
  In many rural areas affected by floods, roads get damaged or submerged during heavy rains due to poor elevation and weak construction materials. **As civil engineering students, you are challenged to explore and design modular, eco-friendly road systems that are easy to install, durable, and can withstand such extreme weather.**
- **Problem Statement 5**
  During metro rail construction in soft clay zones, **tunneling and excavation activities** encounter critical geotechnical challenges including **excessive ground settlement, soil heave, slope instability, and water ingress**.So what is the key challenge to encounter such situation.
- **Problem Statement 6**
  There is a growing need for **architectural solutions that address the dual challenges of affordability and environmental sustainability.**

  To develop a replicable architectural model for **sustainable, affordable urban housing** that can be implemented by city planners and housing authorities.

R-2025- S.E Civil Engineering with Computer Applications

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	
11111301	Integral Transform and Statistical Techniques	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11111301	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.

Prerequisite:

1. Basics of integration and it's properties.

2. Partial differentiation.

Detailed Syllabus

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
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.	08	

		Complex form of Fourier Series. Fourier Integral		
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

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	
11211302	Applied Fluid Mechanics	3	--	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211302	Applied Fluid Mechanics	20	20	40	60	2.5	--	--	100

Rationale:

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

Course Objectives:

1. To understand the properties of fluids, units and dimensions.

2. To understand the pressure measurement, manometer, Hydrostatic forces acting on different surfaces, principle of buoyancy and stability of floating body.

3. To understand kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.

4. To study the importance of fluid flow and various velocity measuring and discharge measuring devices used in pipes and channels.

5. To study the basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.

6. To Understand practical phenomenon and application of fluid static and dynamics.

Course Outcomes:

After completing this course, students will be able to:

1 Describe fluid properties, dimensional analysis & model Studies.

2 Analyze problems related to fluid at rest with practical application.

3 Understand the methods of measurement of fluid pressure.

4 Apply fundamental law of fluid mechanics for practical application.

5 Apply concept of conservation of mass, linear momentum and Bernoulli's theorem to flowing fluid.

6 Understand the kinematic, dynamic quantities using principles of Kinematics and Dynamics, and Analyze pipes network containing particular amount of discharge.

Prerequisite: Engineering Mechanics, Engineering Mathematics and Engineering Physics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic algebra and physics, Units and dimensions, Algebraic manipulation of equations, Differentiation, Integration of simple functions,		

		Introductory statistics (mean, fluctuations), Introduction to climate change and its effects		
01	**Properties of Fluid & Dimensional Analysis**	Definition of fluid and fluid mechanics: examples and practical applications involving fluids at rest and in motion, physical properties of fluids: density, specific weight, specific volume, relative density and viscosity. Newton's law of viscosity, classification of fluids, rheological diagram, Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, problems involving use of above fluid properties.	8	CO1
		Self-learning Topics: Fluid Behavior in Real Life, Application of Dimensionless Numbers, Role of Viscosity in Civil Engineering, Dynamic vs. Kinematic Viscosity - Concept Reinforcement	8	
II	**Fluid Statics**	The basic equation of hydrostatics, concept of pressure head, measurement of pressure (absolute, gauge), application of the basic	8	CO2

		equation of hydrostatics. Pressure measuring devices (simple manometers, differential manometers: U tube, inclined, Mechanical gauges and precision manometers, pressure transducers and their types). Centre of pressure, total pressure on plane and curved surfaces, practical applications. Introduction to IS code 3624-1987 (Pressure gauge and vacuum gauge) Introduction to Buoyancy and flotation		
		Self-learning Topics: Pressure head and its use in water tanks, reservoirs & dams, Mini Case Study: Centre of Pressure in Tanks & Gates, how buoyancy affects design of structures like floating bridges	8	

III	**Fluid Kinematics**	Methods of describing the motion of fluid, velocity and acceleration, and their components in Cartesian co-ordinates, stream line, stream tube, path line, and streak line, control volume. Classification of flow: steady and unsteady; uniform and non-uniform; laminar and turbulent; One, two, and three-dimensional flows; compressible and incompressible; rotational and irrotational; critical, sub critical and supercritical flows. Equation of continuity for three-dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, methods of drawing flow net (graphical and electrical analogy), uses and limitations of flow net.	8	CO3
		Self-learning Topics: Interactive Worksheet: Classifying Types of Flow, Flow Visualization in Rivers and Canals, Drawing Flow Nets –	8	

		Graphical Method, Use of Flow Nets in Seepage Analysis and Dam Design		
IV	**Fluid Dynamics, Bernoulli's Equation**	Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration, assumptions of Bernoulli's equation, Modified Bernoulli's equation, its applications and limitations, Hydraulic grade line and total energy line. Linear momentum equation and kinetic energy correction factor, momentum correction factor (Only information). Discharge measurement by Venturi meter, Orifice and orifice meter, Rotameter, Flow through sharp edged circular orifice discharging free, Hydraulic coefficients for orifice, Pitot tube.	8	CO4
		Self-learning Topics: Case studies of 5 civil/engineering applications, TEL and HGL on a pipeline system,	8	
V	**Laminar & Turbulent Flow**	A- Reynolds experiment, laminar flow through a circular pipe, flow between two fixed parallel plates: Couette flow (only introduction), methods of measurement of viscosity	7	CO5

		(Newton's Law of Viscosity: Rotating cylinder viscometer, Stokes' law: Falling sphere viscometer, Hagen Poiseuille Equation: Redwood Viscometer), Darcy's law.Characteristics of flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory. B- Flow through pipes: Darcy Weisbach Equation, losses in pipe flow		
		Self-learning Topics: Understanding Reynolds Number and Critical Values, Graphing: Velocity Profiles for Laminar and Turbulent Flow, Relate laminar and turbulent flow laws for pipe systems	7	
VI	**Climate-Responsive Hydraulics**	Impact of climate change on hydrological cycles, Extreme rainfall and flood modeling, Drought-resilient water distribution, Adaptive hydraulic infrastructure design (e.g., flexible weirs, smart drainage)	6	CO6

		Self-learning Topics: Extreme Rainfall: Case Studies in Indian Cities, Smart Drainage Systems, Green Infrastructure for Urban Flood Management	6	

Text Books:

1. Hydraulics & Fluid Mechanics by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House.
2. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
3. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.

References:

1. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
2. Fluid Mechanics by YunusCengel, JhonCimbala, Tata MacgrawHill,New Delhi.
3. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.
4. Fluid Mechanics by Streeter & Wylie, Tata McGraw Hill.
5. Fluid Mechanics by K. Subramanya, McGraw Hill.
6. Fluid Mechanics by Frank White, McGraw Hill.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in
2.	https://ocw.mit.edu
3.	https://www.cfd-online.com

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	
11211303	Sustainable Construction Materials and Concrete Technology	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211303	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 properties of concrete,	8	CO1

		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	8	
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	8	CO2

		Ready Mixed Concrete: Advantages of RMC, Components and Lay-out of RMC plant, Codes recommendations. Nondestructive testing on Concrete (NDT): Need, application and limitation		
		Self-learning Topics: Influence of curing conditions on concrete durability, Use of smart sensors for in-situ monitoring of concrete strength	8	
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	8	CO3
		Self-learning Topics: Use of mix design software, Sustainability considerations in mix design	8	
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,	8	CO4

		coconut shell, etc.), Bamboo, stabilized soil blocks, and bio-based composites Applications: Practical applications in roads, buildings, and rural housing		
		Self-learning Topics: Case studies of sustainable buildings and infrastructure in India, Carbon-neutral and carbon-negative material innovations	8	
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 with waste materials Case examples: Low-carbon M25/M30 mixes with 40–60% SCM replacement	7	CO5
		Self-learning Topics: Global innovations: CO_2-injected concrete, self-healing green concrete	7	

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.	6	CO6
		Self-learning Topics: Infrastructure Resilience Index (IRI), IS 16415, Success stories from India's Smart Cities Mission and AMRUT projects	6	

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

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	
11211304	Mechanics of Solids	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211304	Mechanics of Solids	20	20	40	60	2.5	--	--	100

Rationale :

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

Course Objectives:

1. To learn stress - strain relationship and resultant deformation of elastic members and thin cylinders subjected to forces.
2. To represent graphically the axial force, shear force and bending moment distribution in statically determinate beams and portal frames.
3. To compute area moment of inertia and to analyse flexural stress and shear stress in structural members.
4. To study circular shafts, direct and bending stresses in columns and centrally and Eccentrically loaded columns.
5. To determine principal planes and principal stresses and strain energy in elastic members.
6. To explore how innovation in structural systems promotes safe, efficient, and decent work environments.

Course Outcomes:

1. Evaluate stresses, strains, and deformations in homogeneous and composite structures under various loading and thermal conditions using generalized Hooke's law, stress-strain relationships, and elastic constants in both 2D and 3D stress systems.
2. Draw variation of axial force, shear force and bending moment diagram for statically determinate beams and frames.
3. Evaluate bending and shear stresses in solid and composite sections, and understand concepts such as flexure formula, section modulus, and shear stress distribution.
4. Predict the shear stress developed in torsion and direct and bending stresses developed in the cross section.
5. Analyze and evaluate the behavior of axially and eccentrically loaded columns using Euler's and Rankine's formulas, and apply the middle third rule to ensure structural safety under combined stresses
6. **Evaluate** how innovations in structural systems contribute to **safer, more efficient, and decent work environments**, integrating engineering principles with sustainable development goals.

Prerequisite: Applied Mathematics, Engineerng Mechanics and Basic Material Science.

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	**Simple Stresses and Strains**	Concept of stress and strains (Linear, lateral, shear and volumetric), Generalized Hook's law, Stress-Strain curves for brittle and ductile materials. Poisson's Ratio, Factor of Safety. Elastic Constants and their relationships, stresses, strains and	8	CO1

		deformations in determinate and indeterminate structures for homogeneous and composite structures under concentrated loads, self-weight and temperature changes.3D stress system, Plane stress system, Plane strain system.		
		Self-learning Topics: Understand the relationship between stress and strain in materials under axial loading using Hooke's Law, and apply it to real-life scenarios like **designing elevator cables**, where knowing the **elongation under load** ensures both safety and comfort during operation.	8	
II	**Shear Force and Bending Moment Diagram**	Concept of Axial force, Shear force and bending moment of different type of loading and beams. Loading diagram from SFD and BMD for statically determinate structure with or without internal hinges.	8	CO2
		Self-learning Topics: Draw shear force and bending moment diagrams for statically determinate beams to analyze internal forces: **as applied in**	8	

		real life to bridge spans, Floor Beams in Multistory Buildings etc.		
III	**Bending and Shear stresses**	Determination of Moment of Inertia for various cross sections. Stress due to bending: Theory of pure bending, flexure formula, Bending stress distribution diagram, Moment of resistance and section modulus. Sliced Beams and Composite Beams. Shear stress in beam: Concept of shear, Shear stress distribution diagram, concept of average shear stress; shear connectors.	8	CO3
		Self-learning Topics: Derive I for a built-up L-section manually. Compare bending stress in a steel I-beam vs. concrete beam under same moment. Plot bending and shear stress diagrams for a simply supported beam with UDL. Design example: Select cross-section to safely carry a given moment and shear force.	8	
IV	**Torsion and Principal stresses and Strains**	Concept of critical load and buckling, Euler's formula for column with hinged ends, equivalent length for various end conditions, Rankin's	7	CO4

		formula, Limitations of Euler's formula, Safe load on column. Direct and Bending stresses for different structural members (axially and eccentrically loaded). Concept of middle third rule of different sections.		
		Self-learning Topics: Apply to combined stress conditions (e.g., axial + bending + torsion) in structural elements for safe design and failure prediction. **Case Study: Transmission Shaft in Bridges / Flyovers (e.g., Bridge Bearings or Sign Gantries)**	7	
V	**Axially and eccentrically loaded columns**	Concept of critical load and buckling, Euler's formula for column with hinged ends, equivalent length for various end conditions, Rankin's formula, Limitations of Euler's formula, Safe load on column. Direct and Bending stresses for different structural members (axially and eccentrically loaded). Concept of middle third rule of different sections.	7	CO5

		Self-learning Topics: Evaluate on Precast RC Columns in Parking Garages and Steel Light Poles / Street Lamp Posts (use direct & bending stress calculations, Euler's and Rankine, middle third rule)	7	
VI	Innovation in Structural Systems for Safe, Efficient, and Decent Work Environments	Introduction to Sustainable Development Goal (SDG 8) in structural system. Link between decent work environments and structural integrity. Use of Smart Materials. Benefits in extreme environments: temperature, stress reversal	7	CO6
		Self-learning Topics: Case examples of structural failures due to poor design. Identify how materials and structural details can enhance worker safety and well-being. Study of IS 456:2000, RCC Code	7	

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

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. (Schaum's Outline Series)
9. 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/ Relevant Courses
2.	MIT Open Course Ware – Mechanics and Materials https://ocw.mit.edu
3.	Engineering Mechanics Portal – efunda.com https://www.efunda.com

R-2025- S.E Civil Engineering with Computer Applications

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	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
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:

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

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.

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 Entrepreneurship**	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits.	4	CO1

		Start-up Ecosystem in India. Challenges in Entrepreneurship		
		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 **Case Study**: Nirma – A middle-class entrepreneur revolutionizing detergents.	4	
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.	5	CO2
		Self-learning Topics: Lean Canvas, Persona Creation **Case Study:** Airbnb – Validating the concept with MVP	5	
III	**Business Planning & Strategy**	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management.	5	CO3

		Self-learning Topics: Financial forecasting using Excel/Google Sheets. **Case Study:** Zomato – Expansion through mergers & strategic pivots	5	
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	6	CO4
		Self-learning Topics: DPIIT recognition process and types of funding **Case Study:Paytm –** From Wallet to IPO: Funding journey	6	
V	**Marketing & Digital Presence**	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models.	5	CO5

		Self-learning Topics: Use of Canva, Google Analytics **Case Study:** Lenskart – Omnichannel e-commerce marketing	5	
VI	**Business Pitching & Prototype Development**	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch.	5	CO6
		Self-learning Topics: Canva for pitch deck or Successful Start-ups **Case Study:** Dunzo – MVP to final app evolution	5	
		Total	30	

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

R-2025- S.E Civil Engineering with Computer Applications

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	
98451309	Environmental Science	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	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:

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

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.

Prerequisite: Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.

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		Definition, scope and importance. Need for public awareness.	5	CO1

	The Multidisciplinary Nature of Environmental Studies	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.		
		Self-learning Topics: Environmental ethics **Case Study**: Chipko Movement (India) – Grassroot conservation.	5	
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:	5	CO2

		e. Energy resources: Role of an individual in conservation of natural resources: f. Equitable use of resources for sustainable lifestyles.		
		Self-learning Topics: Carbon footprint calculators **Case Study:** Rainwater Harvesting	5	
III	**Ecosystems**	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, Oceans, estuaries). Case study on various ecosystems in India.	5	CO3
		Self-learning Topics: Biodiversity in Indian context **Case Study:** various ecosystems in India.	5	
IV	**Biodiversity and its Conservation**	Introduction-Definition: genetic species and ecosystem diversity.	5	CO4

		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.		
		Self-learning Topics: Indoor pollution sources	5	
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. Role of an individual in prevention of pollution.	5	CO5
		Self-learning Topics: Greenhouse gases **Case study:** Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	5	

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.	5	CO6
		Self-learning Topics: Environmental audit methods. **Case Study:** Environmental Ethics.	5	
		Total	30	

Text Books:

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021

2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016

3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann 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), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)

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	
11212305	Applied fluid mechanics Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11212305	Applied fluid mechanics Lab	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1 To study the properties of fluids, units and dimensions.

2 To study Pressure measurement, manometry, Hydrostatic forces acting on different surfaces, Principle of buoyancy and stability of floating body.

3. To Understand Kinematic and Dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.

4. To Study Importance of fluid flow and various velocity measuring and discharge measuring devices Used in pipes and channels.

5. To Study the basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.

6. To Understand practical phenomenon and application of fluid static and dynamics.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

After completion of the course student shall be able to understand

1. Measurement of viscosity

2. Measurement of pressures
3. Verify the Bernoulli's theorem
4. Determine the discharge coefficients
5. Measure fluid flow using various devices
6. Determine the hydraulic coefficients of an orifice

List of Experiments.

Sr No	List of Experiments	Hrs
1.	Measurement of viscosity by Redwood viscometer or Stoke's Apparatus	2
2.	Measurement of pressures using different pressure measuring devices (including transducers /state of arts digital instruments also).	2
3.	Experimental verification of Bernoulli's theorem with reference to loss of energy	2
4.	Calibration of Venturi meter	2
5.	Calibration of Orifice meter.	2
6.	Determination of, minor loss in a pipe system	2
7.	Plotting the pattern of laminar flow using Reynolds apparatus.	2
8.	Determination friction factor for a given pipe.	2
9.	Developing a demo model related to any fluid flow phenomenon (physical model/ soft model).	3
10.	Determination of Coefficient of Discharge (Cd) for: Small circular orifice & External mouthpiece	3
11.	Flow over notches **(rectangular and triangular notches)**	2
12.	Determination of metacentric height **of a floating body**	2
13.	Verification of Pascal's Law	2
14.	Verification of Hydrostatic Law	2

Sr No	List of Assignments / Tutorials
01	Based on Properties of Fluid & Dimensional Analysis

02	Based on Fluid Statics
03	Based on Fluid Kinematics
04	Based on Fluid Dynamics, Bernoulli's Equation
05	Based on Laminar & Turbulent Flow
06	Based on Climate-Responsive Hydraulics

Text Books:

1. Hydraulics & Fluid Mechanics by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House.
2. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
3. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.

References:

1. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).
2. Fluid Mechanics by YunusCengel, JhonCimbala, Tata MacgrawHill,New Delhi.
3. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in
2.	https://www.youtube.com/user/LearnEngineering
3.	https://www.cfd-online.com

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	
11212306	Sustainable Construction Materials and Concrete Technology Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	IAT II	Total				
11212306	Sustainable Construction Materials and Concrete Technology	–	–	–	–	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. **Identify and test cement and aggregates** for properties like fineness, setting time, specific gravity, and gradation as per IS codes.
2. **Evaluate the effect of moisture content and admixtures** on the setting and workability of concrete.
3. **Conduct and interpret workability tests** to determine concrete's suitability for placement and compaction.
4. **Determine the compressive, tensile, and flexural strength** of concrete specimens and relate them to design requirements.
5. **Apply standard mix design methods** (IS 10262 and DOE) to prepare concrete mix proportions manually and via software tools.
6. **Demonstrate practical understanding of concrete production processes** and quality control through field exposure at an RMC plant.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Fineness and standard consistency of cement.	02
02	Initial and final setting time and soundness of cement.	02
03	Compressive strength of cement.	02
04	Moisture content, silt content, and Specific gravity of fine aggregate	02
05	Fineness modulus by sieve analysis of fine aggregate.	02
06	Moisture content, water absorption, and Specific gravity of coarse aggregate	02
07	Density of coarse aggregate and Fine Aggregate	02
08	Fineness modulus by sieve analysis and gradation of fine aggregates.	02
09	Workability of concrete by slump test, compaction factor, Vee Bee test, effect of admixture and retarders on setting time concrete.	02
10	Compressive strength test of concrete by crushing and Rebound hammer.	04
11	Indirect tensile strength and flexural strength of hardened concrete	04
12	Concrete mix design by IS code method and DOE method. Demonstration and application of concrete mix design software.	02
13	Site visit to RMC plant	02

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
3.	Updates on construction materials and innovations in India www.nbmcw.com
4.	Indian Green Building Council – resources and rating systems www.igbc.in
3.	Building Research Establishment Environmental Assessment Method www.breeam.com

R-2025- S.E Civil Engineering with Computer Applications

S.E SEM-IV

Syllabus

Sem IV

Theme : "Smart Infrastructure planning through Geospatial Structural Entrepreneurial thinking" (Smart InfraX)

Aligned with UNSDG 8: Decent Work and Economic Growth, UNSDG 9: Industry, Innovation and Infrastructure SDG 13: Climate Action and UNSDG 15: Life on Land

The theme " Smart Infrastructure planning through Geospatial Structural Entrepreneurial thinking - Smart InfraX" focuses on the development of intelligent, adaptive, and sustainable infrastructure through the integration of geospatial technologies, structural innovations, and entrepreneurial thinking. It directly supports the UNSDG: SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 13 (Climate Action) and SDG 15 (Life on Land).

- **Problem Statement 1**

Many rural roads suffer from poor alignment and seasonal damage due to lack of proper planning. **There is a need to develop a smart, geospatially optimized village road network plan that ensures connectivity and durability with computer application.**

- **Problem Statement 2**

Migrant workers in urban areas often reside in **unsafe, temporary shelters** that lack structural integrity, basic amenities, and long-term viability. These precarious living conditions expose them to health risks, extreme weather, and social vulnerabilities**.** So what is the **tailored based solution to counteract to the needs and economic capacities of migrant populations with computer application?**

- **Problem Statement 3**

In the face of growing urban populations and rising construction costs, there is an urgent need to **design safe, structurally efficient, and cost-effective residential buildings**. Traditional manual design methods can be time-consuming and may not accurately optimize structural member sizing or load distribution, leading to either overdesign or structural vulnerabilities. To ensure safety, material efficiency what detail analysis will be done with computer application.

- **Problem Statement 4**

Uncontrolled flooding in low-lying urban and rural areas **has become an increasingly frequent and destructive event due to poor drainage infrastructure, unplanned urban expansion, and changing climate patterns. These floods result in** extensive property damage, displacement of communities, loss of agricultural productivity, and threats to public health and safety**.**

- **Problem Statement 5**

The **lack of updated and accurate layout plans** of institutional or industrial campuses often leads to **mismanagement of utilities, inefficient space utilization, and difficulty in planning maintenance or future development**. Outdated or incomplete records hinder effective coordination between departments, delay infrastructure upgrades, and increase the risk of accidental damage to underground services during construction so what is the critical need.

- **Problem Statement 6**

Rapid unplanned urbanization in peri-urban areas leads to overlapping utilities, inefficient road networks, and poor drainage systems. **There is a need to develop an integrated smart infrastructure model by combining geospatial analysis, structural performance assessment, and entrepreneurial cost planning.**

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	
11111401	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
11111401	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

R-2025- S.E Civil Engineering with Computer Applications

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 Feasiblesolutions, slack variables, surplus variables.	05	CO4
		Simplex method.		
		Duality, Dual of LPP.		
		Dual Simplex Method.		
		Self-learning Topics: 1. Artificial variable method, Big M method. 2. 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:	08	

		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		
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 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.	08	

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.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117103017
2.	https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/
3.	https://archive.nptel.ac.in/courses/117/103/117103017/
4.	https://archive.nptel.ac.in/courses/111/102/111102111/
5.	https://www.youtube.com/playlist?list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
11211402	Surveying & Geomatics Engineering	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211402	Surveying & Geomatics Engineering	20	20	40	60	2.5	--	--	100

Rationale:

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

Course Objectives:

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 angular measurements and preparation of topographical maps.

3. To familiarize students with advanced surveying techniques including total station, GPS, remote sensing, and GIS technologies.

4. To equip students with skills for performing hydrographic surveys and layout works essential in water resource and marine projects.

5. To develop the understanding of the Earth's magnetic field and its use in finding directions for surveying and orientation purposes.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

CO1: Describe the use of magnetic property of earth to find the directions.

CO2: Determine the elevations of objects on earth surface.

CO3: Use theodolite observations for mapping.

CO4: Get acquainted to advance methods of surveying.

CO5: Set out of curves for highways and railways.

CO6: Carry out layout and perform hydrographic survey.

Prerequisite: Basic Geometry and Physics, Leveling procedure

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
01	**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.	08	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.	08	

02	**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, 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.	08	Co2
		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	
03		Study of vernier transit 20” theodolite, uses of theodolite for measurement of horizontal	08	Co3

	Theodolite Surveying.	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.		
		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 in complex construction projects, and comparisons between traditional and modern surveying equipment.	08	

04	**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 tacheometric 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	

05	**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 asked), Transition curves: necessity and types.	**08**	Co5
		Self learning topics: Students can explore the design and application of transition and reverse curves in highways and railways using modern CAD software.	05	
06	**Geomatics**	Introduction to Geographic Information Systems (GIS), Photogrammetry & GPS.	08	Co6

		Self learning topics: Students can explore the use of drone-based photogrammetry, satellite imagery, and LiDAR data in creating high-resolution maps and 3D terrain models.They can also study GIS applications in urban planning, disaster management, and environmental monitoring using platforms like QGIS and ArcGIS.	08	

Text Books:

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

References:

1. Surveying by C. Venkatramaiah , University Press.

2. Surveying, Vol. I & II by S. K. Duggal, Tata Mc-Graw Hill.

3. Surveying and Levelling by Subramanian, Oxford University Press.

Online References:

Sr. No.	Website Name
1.	Archive.org link
2.	NPTEL Civil Engineering – Surveying

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	
11211403	Structural Analysis	3	--	--	45	-	--	45	90	3
3.	Google Earth									

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
11211403	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: Six 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 behaviour, 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 indeterminancy 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 indeterminacy. Analysis of Indeterminate beams by Enegry methods & Castigliano's theorem (Propped Cantilever & Fixed beam)	8	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.	8	
II	**Deflection Analysis of Statically**	Concept of Strain Energy, Slope and deflection in beams, Principle of Superposition, Principle of Virtual work, Castigliano's theorems, Betti's	7	CO2

	Determinate Structures	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).		
		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.	7	
III	**Influence Line Diagram and Plastic Analysis**	Influence line diagrams for reactions, shear force and bending moment for cantilever, simply supported and overhang beams, Trusses. Maximum shear force and bending moment and absolute maximum shear force and bending moment under	6	CO3

		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	6	

		Simply supported and fixed beams, Propped cantilevers, Portal frames with 1–2 degrees of redundancy.		
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.	7	CO4
		Self-learning Topics: Bending Moment Diagram, Thrust Line, Axial force distribution in Arches Visualize and draw **real-world arch structures** (bridges, roofs).	7	
V	**Analysis of Indeterminate Structures**	Introduction to concept of Force Method (Flexibility Method) & Displacement methods Flexibility coefficients and their use in formulation of compatibility	10	CO5

		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)		
		Self-learning Topics: Understand and apply **Flexibility Method** and **Direct Stiffness Method** to analyze beams and simple frames (degree of indeterminacy ≤ 3). Flexibility Coefficients & Compatibility Equations. Stiffness Method Application & Settlements.	10	
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.	7	CO6

		Introduction to structural analysis software (e.g., STAAD.Pro, ETABS)		
		Self-learning Topics: Case Study: Basic structure of **Burj Khalifa** or **One World Trade Center (high-rise structures** and typical height thresholds,**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.	7	

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**
3.	NPTEL Structural Analysis by Prof. Devdas Menon: https://nptel.ac.in/courses/105105109
4.	YouTube Channels: *Gate Academy*, *Unacademy Civil*, *CivilGuruji*

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)						Total
		L	T	P	Theory			Term work	Prac / Oral	Credits (C)	
			Internal Assessment			End Sem Exam		Exam Duration (in Hrs)			(Notional Learning Hour/30
			IAT I	IAT II	Total				Notional Learning Hour		
9931147WW 9931147WW	Renewable and Non-Renewable Energy Sources Renewable and Non-Renewable Energy Sources	3	20 -	20 --	40 45	--	60 --	2.5 45	-- 90	--	3 100

Rationale:

The rationale behind both types of energy sources is essential for informed policy-making, sustainable development, and meeting global energy demands while addressing climate change.

Course Objectives:

1 To provide an understanding of the various forms of energy.

2 To distinguish between renewable and non-renewable sources.

3 To analyze environmental and economic aspects of energy generation.

4 To understand modern technologies for energy conversion and conservation.

5 To explore energy storage systems and smart energy utilization.

6 To promote awareness of sustainable and eco-friendly energy practices.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1.Classify different sources of energy

2. Explain principles of renewable energy technologies.

3. Evaluate the environmental impact of various energy sources.

4. Analyze performance of solar, wind, and other systems

5. Describe energy conservation techniques and policies.

6. Compare global and Indian energy scenarios

Prerequisite: Basic knowledge of Physics and Chemistry (10+2 level)

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Overview of energy units, basic physics of electricity, power		
I	**Introduction to Energy Sources**	Types of energy: Primary/Secondary, Commercial/Non-commercial Classification: Renewable vs Non-renewable. Global and Indian energy scenario. Energy demand and growth **Self-learning Topics:**	07	CO1
		National Energy Policies of India		
II	**Non-Renewable Energy Sources**	Fossil Fuels: Coal, Oil, Natural Gas - extraction, reserves, usage. Environmental impacts, pollution, global warming. Nuclear Energy: fission/fusion, reactors, safety, waste disposal **Self-learning Topics:**	08	CO2
		Kyoto Protocol, Carbon Credits		
III	**Solar Energy**	Solar radiation and measurement. Photovoltaic cells: working, types,	08	CO3

		efficiency. Solar collectors: flat plate, concentrating Solar thermal applications (water heater, cooker, dryer) Solar power plants and grid integration **Self-learning Topics:**		
		Solar Tracking Systems, MPPT Technology		
IV	**Wind and Hydro Energy**	Wind energy: principles, wind turbines, site selection. Wind farms: types, offshore/onshore. Hydro energy: working of hydro plants, turbines, pumped storage. **Self-learning Topics:**	08	CO4
		Offshore Wind Technology		
V	**Other Renewable Sources**	Biomass energy: sources, types, biogas plants. Geothermal energy: basics, resources, applications. Ocean energy: tidal, wave, OTEC. Comparison of various renewable sources **Self-learning Topics:**	07	CO5
		Biomass Gasifiers		
VI	**Energy Storage & Conservation**	Need for storage, types: batteries, hydrogen, flywheel. Smart grids and energy management. Demand-side	07	CO6

		management. Indian energy conservation policies and regulations **Self-learning Topics:**		
		Smart Metering Systems		

Text Books:

1. G.D. Rai, "Non-Conventional Energy Sources," Khanna Publishers

2. Tiwari and Ghosal, "Renewable Energy Resources," Narosa Publishing

3. S. Rao and B.B. Parulkar, "Energy Technology," Khanna Publishers

References:

1. S.P. Sukhatme, "Solar Energy," McGraw Hill

2. Manwell and McGowan, "Wind Energy Explained"

3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future"

Online References:

Sr. No.	Website Name
1	www.mnre.gov.in
2	www.iea.org
3	www.nrel.gov

R-2025- S.E Civil Engineering with Computer Applications

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	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	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)	4	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	4	
II	**Empathy**	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.	5	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	5	
III	**Define**	**S**ignificance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV	5	CO3
		Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples	5	

		Link: https://uxpressia.com/blog/how-to-create- persona-guide-examples		
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	6	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	6	
V	**Prototype**	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario Prototype.	4	CO5
		Self-learning Topics: IDEO Prototyping Toolkit	4	
VI	**Test**	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	6	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)	6	
Total			30	

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 Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

R-2025- S.E Civil Engineering with Computer Applications

R-2025- S.E Civil Engineering with Computer Applications

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	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	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,	5	CO1

		Corporate entrepreneurship, Entrepreneurial mindset.		
		Self-learning Topics: Case studies: Henry Ford https://www.thehenryford.org/docs/default-source/default-document-library/default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business	5	
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.	4	CO2
		Self-learning Topics:MSME Act and Udyam Registration portal **Case Study:** Amul – Co-operative innovation in dairy sector	4	
III	**Start-up financing**	**Start-up financing:** Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding,	5	CO3

		Government schemes funding(e.g., SIDBI, Startup India).		
		Self-learning Topics: Successful business pitching. **Case Study:** Shark Tank pitch breakdown.	5	
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.	5	CO4
		Self-learning Topics: Case Study: WIPO Patent Search Exercise	5	
V	**Business Model Development**	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.	6	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	6	
VI		Digital Business models (Subscription, Freemium *etc*),	5	CO6

	Digital Business Management	Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business.		
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	5	
Total			30	

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

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

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	
11212404	Surveying & Geomatics Engineering	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11212404	Surveying & Geomatics Engineering	--	--	--	--	25	25	50

Lab Objectives: Six 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 tacheometer.
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: Six Lab outcomes (Based on Blooms Taxonomy)

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 tacheometric 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.

Sr No	List of Experiments	Hrs
01	Measurement of magnetic bearings of sides of a triangle or polygon, correction for local attraction and calculations of true bearings using prismatic compass.	1
02	Finding horizontal and vertical distance using Tacheometer.	1
03	Simple and differential levelling with at least three change points using digital level.	1

04	Measurement of horizontal angles (by repetition method) using Vernier Transit Theodolite.	1
05	Setting out a circular curve by Rankine's method of deflection angles.	1
06	Setting out a building from a given foundation plan (minimum six co-ordinates).	1
07	Study and use of nautical sextant and measurement of horizontal angles	1
08	Solution to three point problem by analytical method	1
09	Distance and angle measurements using Total station.	1
	Project I: Road project using Auto level for a minimum length of 100 m including fixing ofalignment, 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).	
	Project II: Tachometric contouring project on hilly area with at least two instrument stationsabout 60 m to 100 m apart and generating contours using software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).	

Text Books:

1. T. P. Kanetkar and Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune VidyarthiGrihaPrakashan.

2. Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain , Surveying, Vol. I & II, Laxmi Publications.

References:

1. Surveying by C. Venkatramaiah , University Press.

2. Surveying, Vol. I & II by S. K. Duggal, Tata Mc-Graw Hill.

3. Surveying and Levelling by Subramanian, Oxford University Press.

Online Resources:

Sr. No.	Website Name
1.	vlab.co.in/civil-engineering
2.	geogebra.org
3.	NPTEL Surveying

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	
11312408	Renewable and Non-Renewable Energy Sources Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
11312408	Renewable and Non-Renewable Energy Sources Lab	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. Understand and analyze various renewable and non-renewable energy sources.

2. Perform practical measurements on solar, wind, and thermal systems.

3. Evaluate performance and efficiency of energy conversion devices.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Identify and explain the working principles of renewable and non-renewable energy systems.

2. Perform experiments to assess the performance of solar, wind, and fossil fuel-based energy systems.

3. Analyze experimental data to calculate efficiencies and losses.

4. Design and test basic setups for solar PV, wind turbine, and biodiesel generation.

5. Use simulation tools to model energy generation and storage systems.

6. Prepare technical reports and communicate findings effectively.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of solar PV system and measurement of V-I characteristics	2
02	Measurement of solar panel efficiency under various conditions	2
03	Determination of biogas production rate from organic waste	2
04	Efficiency test of a mini hydro turbine setup	2
05	Study of a wind energy conversion system using lab-scale wind turbine	2

Text Books:

1. S. P. Sukhatme – *Solar Energy: Principles of Thermal Collection and Storage*

2. G. D. Rai – *Non-Conventional Energy Sources*

3. Chetan Singh Solanki – *Renewable Energy Technologies: A Practical Guide for Beginners*

References:

1. D. Y. Goswami, F. Kreith – *Energy Conversion*

2. B.H. Khan – *Non-Conventional Energy Resources*

3. Tiwari & Ghosal – *Renewable Energy Resources: Basic Principles and Applications*

Online Resources:

Sr. No.	Website Name
1.	https://mnre.gov.in/
2.	https://nptel.ac.in/courses/103103206

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TE SEM V

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	
CEC501	Theory of Reinforced Concrete Structures	03	-	-	45	-	-	-	45	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC501	Theory of Reinforced Concrete Structures	20	20	40	60	2.5	--	--	100

Rationale:

Working Stress Method (WSM) makes use of the concept of modular ratio based on the higher factor of safety in evaluating the stresses in two different materials of the RCC i.e., steel and concrete. The Limit State Method (LSM) is based on the statistical probability which provides the rational solution to the design problems. The philosophy which lies behind, LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states. The subject involves the application of working stress method and limit state method in the analysis and design of various elements of the civil engineering structures.

Course Objectives: Six Course Objectives

1 To develop clear understanding of design philosophy amongst the students for the design of reinforced concrete structure using working stress method (WSM) and limit statemethod (LSM).

2 To study various clauses of IS: 456-2000 and their significance in the RCC design.

3 To apply various concepts of LSM in the analysis and design of beams, slabs and columns**.**

4 To study the concept of Serviceability and Durability for deflection and crack width calculation in RCC structures.

5 To develop the concept of design using design charts and curves for columns subjected to axial load and moment.

6 To study the concept of reinforced concrete footing design subjected to axial load and moment.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1) Understand the fundamentals of WSM and LSM.

2) Apply various clauses specified in IS: 456-2000 for designing structural members with safety and economy.

3) Understand the use of readymade design charts and curves from Special Publications of Bureau of Indian Standards.

4) Analyze and design various reinforced concrete elements such as beam, slab, column, footings using the concept of Limit State Method.

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping

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I	Working Stress Method:	Concept of reinforced concrete, Working Stress Method (WSM) of design for reinforced concrete, permissible stresses as per IS:456-2000; stress- strain curve of concrete and steel, characteristics of concrete and steel reinforcement. Concept of balanced, under reinforced and over reinforced sections. Analysis and design of singly reinforced and doubly reinforced rectangular beams for Flexure.	06	CO1
II	Limit State Method:	Introduction to limit state method of design as per IS:456-2000. Concepts of probability and reliability, characteristic load, characteristic strength, partial safety factors for loads and materials, introduction to various limit states of collapse and serviceability.	03	CO2
III	Limit State of Collapse: Flexure,	Design of Singly and doubly reinforced Rectangular and Flanged sections for flexure, shear and bond.	12	CO3

	Shear, Bond and Torsion:	Design of beams subjected to bending, shear and torsion.		
IV	Design of Slabs using Limit state method:	Design of simply supported one-way slabs as per IS:456-2000. Design of simply supported two-way slabs as per IS:456-2000.	04	CO4
V	Limit State of Collapse – Compression:	Limit state of collapse: compression for short and slender column. Introduction to Members subjected to combined axial and uniaxial as well as biaxial bending. Development of interactive curves and their use in column design.	08	CO5
VI	Design of Foundations:	Design of Isolated square and rectangular footings subjected to axial load and moment. Introduction to basic concepts of combined rectangular pad footing, slab beam type footing and Raft foundation.	06	CO6

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.

2. Limit State Design of Reinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee

3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.

4. Ultimate Strength Design for Structural Concrete: Arthur, P. D. and Ramakrishnan, V., Wheeler and Co. Pvt. Ltd.

5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.

6. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.

7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.

8. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.

9. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

.References:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.

2. Reinforced Concrete: Syal and Goel; Wheeler Publishers.

3. Reinforced Concrete Design: Pillai, S.U. and Menon, Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.

4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi

5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.

6. RCC Design (WSM and LSM): Punmia, B. C., Jain, A. K., and Jain, Arun, K., Laxmi Publications.

7. Limit State Design of Reinforced Concrete (as per IS: 456-2000): Punmia, B. C., Jain, A. K., and Jain, Arun, K., Laxmi Publications.

8. Relevant IS Codes: BIS Publications, New Delhi.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/105/105105105/
2.	https://archive.nptel.ac.in/courses/105/105/105105105/
3	https://archive.nptel.ac.in/courses/105/105/105105105/

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	
CEC502	Applied Hydraulics	3	-	-	45	-	-	-	45	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC502	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.

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Course Objectives: Five Course Objectives

1 To introduce the concept of impact of jets.

2. To study hydraulic machines like centrifugal pumps and turbines.

3. To study various Miscellaneous Hydraulic Machinery.

4. To study the uniform flow through open channels and design of most economical section.

5. To study the non-uniform flow through open channels.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Describe impact of jet on stationary, moving, hinged and series of plates also solve the numerical based on forces acting on it.

2. Distinguish various types of turbines, Characteristic curves and its components.

3. Analyze Centrifugal pumps by incorporating velocity triangle diagrams.

4. Know the working mechanism of various Hydraulic machines.

5. Identify the hydraulic behaviour of open channel flow and design the most economical section of channels.

6. Explain mathematical relationships for hydraulic jumps, surges, and critical, uniform, and gradually-varying flows.

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
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

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
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.	04	CO2
IV	Miscellaneous Hydraulic Machinery	Hydraulic Ram, Press, Accumulator, Intensifier, Crane and Lift.	03	CO3
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	07	

		formula, Manning's formula, hydraulically efficient channel cross-sections (most economical sections).		

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

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	
CEC503	Geotechnical Engineering-I	03	-	-	45	-	-	-	45	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC503	Geotechnical Engineering-I	20	20	40	60	2.5	--	--	100

Rationale :

Around all civil engineering structures are supported by soil and rock. Rock is rarely occurring and hence, mostly the supporting medium is soil. The stability of structure depends on the stability of supporting medium. Therefore, geotechnical analysis is required to be carried out. Geotechnical analysis depends on the basic understanding of physical properties of soil which are useful for determining the strength, compressibility, drainage characteristics etc. Soil mechanics is the basic tool for geotechnical engineering, which is the specialized section of civil engineering. Soil is also used as a construction material to build various civil structures, viz., dams, embankment etc. Thus, it is very essential to understand various concepts involved in this course of Geotechnical Engineering-I.

Course Objectives: Six Course Objectives

1 To study origin and mode of formation of soil as well as functional relationships among different unit weights, volumetric ratios, and water content.

2. To study clay mineralogy and plasticity characteristics of soils.

3. To comprehend particle size distribution and classification of soils as per IS code.

4. To study permeability and seepage flow of water through the soil.

5. To understand the concept of total stress, neutral stress and effective stress in soil.

6. To understand compaction characteristics of soils as well as the techniques of soil exploration, assessing the subsoil conditions and engineering properties of various soil strata.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Explain the basic concepts of the physical and engineering properties of soil and derive the relationships among various unit weights & other parameters.

2. Comprehend clay mineralogy and plasticity behavior of clay.

3. Analyze grain size distribution of soil and classify the soil as per IS code.

4. Evaluate the coefficient of permeability of different types of soils and draw the flow net diagram to estimate seepage discharge

5. Compute the effective stress and pore water pressure inside the soil mass under different geotechnical conditions.

6. Evaluate the compaction parameters in laboratory and field as well as understand the necessity and methods of soil exploration.

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DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Geotechnical Engineering, Basic Definitions & Relationships**	Definitions and scope of Geotechnical Engineering: rocks, soil, origin & mode of formation and types of soil obtained, soil mechanics, rock mechanics, geotechnical engineering. Soil phase systems, volumetric ratios: void ratio, porosity, degree of saturation, air voids, air content. Weight-volume relationship: different unit weights, water content, specific gravity of soil solids, mass and absolute specific gravity. Functional relationships among different unit weights, volumetric ratios, and water content. Relative density, relative compaction. Different methods to determine water content, specific gravity and unit weight of soil.	07	CO1
II	**Clay Mineralogy and Plasticity Characteristics of Soils**	Explanation about clay minerals, e.g., Montmorillonite, Illite and Kaolinite; formation of clay minerals and their role in plastic behavior of soil. Definition of plasticity of soil, consistency of soil, definition & determination of liquid limit,	06	CO2

		plastic limit, shrinkage limit. Definitions of shrinkage parameters, plasticity index, liquidity index, consistency index, flow index, toughness index, activity, sensitivity and thixotropy of soil. Importance of consistency limits.		
III	**Particle Size Distribution and Classification of Soils**	Wet & dry sieve analysis, Sedimentation analysis: Stoke's law, Hydrometer method of analysis, Limitation of sedimentation analysis. Particle size distribution curve/ gradation curve and its uses. Introduction to cohesive and cohesionless soil. Necessity of soil classification, Indian standard particle size classification, Indian standard soil classification system as per IS: 1498 - 1970, boundary classification.	06	CO3
IV	**Permeability of Soils & Seepage Analysis**	Types of soil water, definition of hydraulic head, hydraulic gradient, Darcy's law, validity of Darcy's law, permeability of soil. Determination of coefficient of permeability of soil in lab using constant head and variable head methods, factors affecting permeability of soil, effect of permeability on various properties of soil, determination of in-situ permeability with pumping out and pumping in tests.	08	CO4

		Permeability of stratified soil deposits. Definition of seepage and its importance for the analysis & design of hydraulic structures, graphical representation of seepage by flow net diagram, definition of flow line, equipotential line, flow channel, flow field, characteristics of flow net, use of flow net, phreatic line. Factor of safety against piping failure.		
V	**Effective Stress Principle**	Definition of geostatic stresses, total stress, neutral stress/ pore water pressure , effective stress. Effect of water table fluctuations, surcharge, capillary action, seepage pressure on effective stress; quick sand condition.	05	CO5
VI	**Compaction of Soil & Soil Exploration**	Theory of compaction, determination of optimum moisture content (OMC) & maximum dry density (MDD) in laboratory by conducting the light and heavy compaction tests. Factors affecting the compaction, effect of compaction on properties of soil, soil structure, placement water content, relative compaction, Proctor needle method for compaction. Necessity of soil exploration, methods of soil investigation, methods of boring, disturbed and undisturbed soil samples, soil sampling	07	CO6

		and samplers, number and spacing of bore holes, depth of bore holes. Penetrometer tests: SPT, SCPT and DCPT. Representation of data with borehole logs.		

Text Books:

1. Basic and Applied Soil Mechanics: Gopal Ranjan, A S R Rao; New Age International Publishers.

2. Soil Mechanics and Foundation Engineering: V. N. S. Murthy; CBS Publishers & Distributors

3. Soil Mechanics and Foundation Engineering: K. R. Arora; Standard Publishers and Distributors, New Delhi.

4. Soil Mechanics and Foundations: B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications (P) LTD., New Delhi

5. Geotechnical Engineering: C. Venkatramaiah; New Age International Private Limited

6. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley & Sons.

References:

1. An Introduction to Geotechnical Engineering: Robert D. Holtz, William D. Kovacs; Prentice-Hall, New Jersey

2. Soil Mechanics: R. F. Craig; Spon Press, Taylor and Fransis Group

3. Soil Mechanics: T. W. Lambe, R. V. Whitman; John Wiley & Sons

4. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi

5. Soil Mechanics in Engineering Practice: Karl Terzaghi, Ralph B Peck, Gholamreza Mesri; John Wiley & Sons

Online References:

Sr. No.	Website Name

R-2025- T.E Civil Engineering with Computer Applications

1	https://archive.nptel.ac.in/courses/105/101/105101201/
2	https://archive.nptel.ac.in/courses/105/105/105105168/

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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	
CEC504	Transportation Engineering	4	-	-		-	-	-	60	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC504	Transportation Engineering	20	20	40	60	2.5	--	--	100

Rationale:

An efficient transportation system is essential for sustainable economic development of the country and plays a significant role in promoting national and global integration. An efficient Transportation system helps in increasing productivity and enhances competitiveness of the economy. Hence, the transport sector is considered as an important component of the economy and a common tool used for development. Three basic modes of transportation include land, water and air. The course deals with understanding of basics of different modes of transportation (Highways, railways, airways and waterways). The highways owing to its flexibility in catering door-to- door service is one of the important modes. This course deals with the investigation, planning, design, construction and maintenance of highways in addition to traffic planning, operation and control.

Course Objectives: Six Course Objectives

1. To understand the technical aspects of Railways, Airways and Waterways.
2. To carry out Planning and design of geometric elements of Highways.
3. To study various traffic studies and to understand elements of Traffic Engineering for efficient planning and control.
4. To study Requirements of Highway materials and to design Rigid and flexible pavements using IRC codes.
5. To study methods of construction of Rigid and Flexible pavements, use of soil stabilization and drainage to highways.
6. To design the overlay on basis of pavement evaluation and failure identification on rigid and flexible pavements

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Compare various modes of transportation and understand basic technical aspects of railways, airways and waterways.
2. Understand different road plans, requirements of alignments and Design horizontal and vertical geometrical elements of highways.
3. Carry out different traffic studies and analyze basic parameters of traffic engineering for efficient planning and control of traffic.
4. Design the flexible and rigid pavement as per relevant IRC codes.
5. Construct different types of pavements, use of soil stabilization and planning of highway drainage
6. Carry out structural and functional evaluation of pavement, identify the failures and design the overlay.

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DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Transportation Systems**	Introduction to Transportation Engineering, Comparison of various modes of transportation (Roadways, Railways, Airways and Waterways). Introduction to Railway Engineering: Cross sectional elements of railway track (Foundation, Ballast, Sleepers and Rail), Introduction to turnout, Super elevation design, Negative Super elevation, Construction and Maintenance of Railway track. Introduction to Airport Engineering: Elements of Airport, Site selection of Airport, Design of Runway length, Taxiway and Exit Taxiway design. Introduction to Waterways: Definition of Docks, Harbor and Ports. Elements and types of Docks, Harbor and Port.	10	CO1
II	**Planning and Geometric Design of Highways**	Classification of roads based on various criteria, Road development plans, agencies related to highway development, Highway alignment (basic requirement and factors	10	CO2

		governing), hill roads, Surveys for highway location. Terrain Classification, Vehicular Characteristics, Cross section elements of highways (width of carriage way, shoulders, medians, width of road way, right of way, camber & its profile). Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance. Horizontal curves: design of super elevation, its provisions, minimum radius of horizontal curves, widening of pavement, transition curves. Gradients: different types, maximum, minimum, ruling exceptional, grade compensation on curves		
III	**Traffic Engineering**	Introduction to various traffic studies such as speed study, volume study, parking study, accident study, O&D study etc. Speed study: methods to determine speed, types of speed (Spot speed, Design speed, Upper & lower limit speeds, Mean Median and Modal speed); Traffic Volume study (flow):	10	CO3

		Definition, AADT, ADT, Design volume, methods of determining traffic volume. Traffic density: Definition, importance. Introduction to Relationship between Speed, density and volume. Capacity: Q-K-V curve, Different types and factors affecting capacity, Concept of PCU and LOS. Introduction to traffic control devices Traffic signs, signals (no design), road marking. Different types of Intersections-At-grade and Grade Separated; Grade separated interchanges; rotary intersection		
IV	Pavement Material and Design	Types of pavements, comparison of flexible and rigid pavements, Requirements of pavement materials, Soil: requirement of soils as subgrade material, CBR test. Aggregate: Requirements of aggregate as Pavement material, Tests on aggregate with specified values. Bitumen: Requirements of bitumen as pavement material test on bitumen with specified values, variants of bitumen (Modified bitumen) and its uses. Introduction to Bituminous mix design using Marshall	12	CO4

		Stability test. Flexible pavement design: Concepts related to flexible pavement design such as tyre pressure, contact pressure, ESWL, VDF and LDF. IRC approach for design (IRC: 37- 2001, IRC: 37- 2012), also IRC SP 72-2007/2015 and IRC 77 2008. Rigid pavement design: Modulus of subgrade reaction, equivalent radius of resisting section, radius of relative stiffness, stresses on rigid pavement, combine loading temperature stress.; Design of rigid pavements (IRC: 58-2002; IRC: 58- 2011, IRC: 58- 2015. IRC: SP- 62-2004, IRC: SP- 62-2014)		
V	**Pavement Construction, Soil Stabilization and Drainage**	Construction of different types of roads: water bound macadam (WBM) road, WMM, bituminous pavements, cement concrete pavement. And joint (As per IRC, MORTH specifications) jointed reinforced, continuously reinforced; fiber reinforced; roller compacted concrete pavements. Soil Stabilization: Significance, Principle of soil stabilization, different methods of soil Stabilization, use of Geo-synthetics in highways and allied	05	CO5

		structures. Highway drainage: Necessity/ Significance, mode of ingress of water in highway structure, Different methods of drainage- surface and subsurface drainage inkling for the roads in hilly areas.		
VI	**Pavement Evaluation, Failures and Maintenance**	Evaluation of pavement, Structural and functional evaluation, methods of structural evaluation (working of Benkelman beam, FWD, LWD), methods of functional evaluation (working of Bump indicator, profilometric systems) Distress / failure in Rigid and flexible pavement, reasons and measures. Strengthening of existing pavement, Overlay and its types, design of overlay (Benkelman beam method)	05	CO6

Text Books:

1. A Course of Railway Engineering: Saxena, S. C. and Arora, S. P.; Dhanpat Rai Sons, New Delhi.

2. Airport Planning Design: Khanna, S.K., Arora, M.G.and Jain, J.J.;Nemchand Bros., Roorkee.

3. Docks and Harbour Engineering: Bindra, S. P.; Dhanpat Rai and Sons,New Delhi.

4. Highway Engineering: Khanna, S.K. and Justo, C. E. G.; Nem Chand and Bros., Roorkee

5. Principles, Practice and Design of Highway Engineering (Including Airport Engineering)" Sharma, S.K.; S. Chand and Company Pvt. Ltd., New Delhi.

6. Highway Material and Pavement Testing: Dr. S. K. Khanna, Dr. C. E. G. Justo and Dr. A. Veeraragavan. Nem Chand and Bros., Roorkee, India.

References:

1. Indian Railway Track: Agarwal, M. M., Suchdeva Press New Delhi.

2. Planning Design of Airport: Horonjeff Mckelrey, Tata Mc-Graw Hill India Publishing House, New Delhi.

3. Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House.

4. Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi.

5. Principles of Transportation Engineering: Chakrabory, Partha and Das, Animesh; Prentice Hall India Learning Pvt. Ltd., New Delhi.

6. Transportation Engineering: Khisty, C.J. and Lall, Kent, B.; Prentice Hall India Learning Pvt. Ltd., New Delhi.

7. Traffic Engineering and Transport Planning: Kadiyali, L.R., Khanna Publishers, Delhi.

8. Principles and Practice of Highway Engineering: Kadiyali, L. R.; Khanna Publsihers, Delhi

9. Relevant specifications of MORTH and relevant IRC codes.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/105105107
2	https://archive.nptel.ac.in/courses/105/107/105107123/

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	
CEL506	Theory of Reinforced Concrete Structures (Lab)	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL506	Theory of Reinforced Concrete Structures (Lab)	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To develop a clear understanding of design philosophy amongst the students for the design of reinforced concrete structures using working stress method (WSM) and limit state method (LSM).
2. To study various clauses of IS: 456-2000 and their significance in the RCC design.
3. To apply various concepts of LSM in the analysis and design of beams, slabs and columns.
4. To study the concept of Serviceability and Durability for deflection and crack width calculation in RCC structures.
5. To develop the concept of design using design charts and curves for columns subjected to axial load and moment.

6. To study the concept of reinforced concrete footing design subjected to axial load and moment.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Understand the fundamentals of WSM and LSM.
2. Apply various clauses specified in IS: 456-2000 for designing structural members with safety and economy.
3. Understand the use of readymade design charts and curves from Special Publications of Bureau of Indian Standards.
4. Analyze and design various reinforced concrete elements such as beam, slab, column, footings using the concept of Limit State Method.

List of Assignments.

Sr No	List of Assignments / Tutorials	Hrs
01	Analysis and Design of Singly and Doubly Reinforced RCC beam using WSM (Numericals Based on this module will be solved in tutorial class)	02
02	Analysis and Design of Singly and Doubly reinforced RCC beam using WSM or any one activity from below: Solve set of Questions given by the course instructor. Write a report on provisions in IS 456 2000 related to the design of beams A comparative study consisting of advantages and disadvantages of WSM and LSM	02
03	Analysis and Design of Singly and Doubly Reinforced RCC beam using LSM. (Numericals Based on this module will be solved in tutorial class)	02
04	Analysis and Design of Singly and Doubly Reinforced RCC beam using LSM. Or any one activity from below: Solve set of Questions given by the course instructor. Study of IS 456 2000 provisions on Limit state of collapse: Flexure.	02
05	Analysis and Design of Flanged beams for Flexure using LSM. Design of RCC beams in shear, bond, and torsion. (Numericals Based on this module will be solved in tutorial class)	02

06	Analysis and Design of Flanged beams for Flexure using LSM. Or any one activity from below: Design of RCC beams in shear, bond, and torsion. Solve set of Questions given by the course instructor. Study of IS 456 2000 provisions on Limit state of collapse- Shear, Bond and Torsion.	02
07	Design of Simply supported One-way and Two-way slabs as per IS: 456-2000 (Numericals Based on this module will be solved in tutorial class)	02
08	Design of Simply supported One-way and Two-way slabs as per IS: 456-2000. Or any one activity from below: Solve set of Questions given by the course instructor. Study of IS: 456-2000 provisions on Design of RCC slabs.	02
09	Analysis and Design of Columns loaded Axially, Uni-axially, and Bi-axially, using LSM. (Numericals Based on this module will be solved in tutorial class)	02
10	Analysis and Design of Columns loaded Axially, Uni-axially, and Bi-axially, using LSM. or any one activity from below: Solve set of Questions given by the course instructor. Studying the development of interactive curves and their use in column design. Study of IS: 456-2000 Provisions for Limit State of Collapse – Compression	02
11	Design of Isolated square and rectangular footings subjected to axial load and moment. (Numericals Based on this module will be solved in tutorial class)	02
12	Design of Isolated Square and rectangular footings subjected to axial load and moment. or any one activity from below: Solve set of Questions given by the course instructor. Study of IS: 456-2000 provisions related to design of RCC foundations. Report or presentation on Significance and Design of different types of RCC Foundations by various groups of students.	02
13	Viva – Voce Examination	02

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Limit State Design ofReinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee
3. Limit State Design ofReinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Ultimate Strength Design for Structural Concrete: Arthur, P. D. and Ramakrishnan, V., Wheeler and Co. Pvt. Ltd.

References:

1. . Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
2. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.
3. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.
4. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.
5. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

Online Resources:

Sr. No.	Website Name
3.	https://archive.nptel.ac.in/courses/105/105/105105105/
4.	https://archive.nptel.ac.in/courses/105/105/105105105/

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	
CEL502	Applied Hydraulics	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL502	Applied Hydraulics	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To describe the concepts of fluid dynamics and its applications.
2. To exemplify the fundamentals of impulse momentum principle and explain the working of various hydraulic machines.
3. To classify the uniform and non-uniform flow in open channel.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Evaluate the efficiencies and discuss the working of various pumps and turbines.
2. Apply impulse momentum principle to hydraulic machines.
3. Determine the rate of flow through open channel.
4. Generate and evaluate Gradually varied flow (GVF) and Rapid varied Flow (RVF) in open channel flow.
5. Compute the Chezy's Constant through tilting flume.

List of Experiments.

Sr No	List of Experiments (Minimum Six)	Hrs
01	Impact of jet, flat plate, inclined plate, curved vanes.	02
02	Performance of Pelton turbine.	02
03	Performance of Francis Turbine.	02
04	Performance of Kaplan Turbine.	02
05	Performance of Centrifugal pumps.	02
06	Chezy's roughness factor.	02
07	Specific energy.	02
08	Hydraulic Jump.	02
09	Calibration of Broad crested weir/Venturi flume.	02

Text Books:

1. Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company

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

3. Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, Dhanpat Rai Publishing Company (P) Ltd-New Delhi.

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

References:

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

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

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

Online Resources:

Sr. No.	**Website Name**
5.	NPTEL
6.	SWAYAM
3**.**	WIKIPEDIA

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	
CEL503	Geotechnical Engineering-I	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL503	Geotechnical Engineering-I	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. Determination of moisture content, specific gravity of soil solids and in-situ field density of soils as well as field identification of fine-grained soils
2. To determine the grain size distribution of soils and consistency or Atterberg limits of fine-grained soils
3. To determine coefficient of permeability of soils in laboratory
4. To determine compaction characteristics of soils in laboratory
5. To determine the density index (relative density) of cohesionless soil
6. To determine field SPT 'N' value by Standard Penetration Test

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Determine the physical and engineering properties of soil

2. Determine the plasticity characteristics of soil

3. Carry out sieve analysis of soil, plot grain size distribution curve and determine the IS classification of soil

4. Determine coefficient of permeability of soils

5. Determine the compaction characteristics of soils

6. Compute the field SPT 'N' value and prepare the bore log

List of Experiments.

Sr No	List of Experiments	Hrs
01	Determination of natural moisture content of soil using oven drying method Following other methods to find moisture content shall be explained briefly: a) Pycnometer method b) Sand bath method c) Alcohol method d) Torsional balance method e) Moisture meter f) Radio activity method	2
02	Specific gravity of soil grains by density bottle method or Pycnometer method	2
03	Field density using core cutter method	2
04	Field density using sand replacement method	2
05	Field identification of fine-grained soils	2
06	Grain size distribution of coarse-grained portions (gravel and sand) of soil by sieve analysis	2
07	Grain size distribution of fine portions (silt and clay) of the soil by Hydrometer analysis	2
08	Determination of liquid (Casagrande method), plastic and shrinkage limits	2
09	Determination of liquid limit by cone penetrometer method	2
10	Determination of co-efficient of permeability using constant head method	2
11	Determination of co-efficient of permeability using falling head method	2

12	Compaction test, IS light compaction test/ Standard Proctor test	2
13	Compaction test, IS heavy compaction test/ Modified Proctor test	2
14	Relative density (or, density index) test	2
15	Standard penetration test	2

Text Books:

1. SCI/SCOPUS Indexed Refereed International Journals (For Case Studies)
2. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi.
3. Departmental Laboratory Manual

References:

1. Standard Geotechnical Engineering Handbook
2. NPTEL Video lectures on Practical.

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/105101160

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	
CEL504	Transportation Engineering	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL504	Transportation Engineering	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1.To determine Penetration grade and Viscosity grade of bitumen.

2.To find the Softening point and Ductility value of bitumen.

3.To determine Impact, Abrasion and Crushing value of aggregate.

4.To carry out shape test on aggregates.

5.To carry out Classified volume study and plot speed profile at mid-block section.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Classify Bitumen on basis of Penetration and Viscosity grade.

2. Select Bitumen as per suitability on basis of Softening point and Ductility value.

3. Determine suitability of aggregate on basis of Impact value, Abrasion value and Crushing value.

4. Differentiate Elongated and Flaky aggregates on basis of Shape test.

5. Carry out Classified volume study at mid-block section of road.

6. Plot speed profile curve (S-Curve) at mid-block section

List of Experiments.

Sr No	List of Experiments (Minimum Eight)	Hrs
01	Penetration Test on Bitumen.	2
02	Viscosity Test on Bitumen.	2
03	Softening Point Test on Bitumen	2
04	Ductility Test on Bitumen	2
05	Determination of Aggregate Impact Value	2
06	Determination of Aggregate Crushing Value	2
07	Determination of Abrasion Value of Road Aggregate	2
08	Shape Test of Aggregate	2
09	Classified Volume count at mid-block section	2
10	Speed profile study at mid-block section	2

Text Books:

1. Highway Engineering: Khanna, S.K. and Justo, C. E. G.;Nem Chand and Bros., Roorkee

2. Principles, Practice and Design of Highway Engineering (Including Airport Engineering)" Sharma, S.K.; S. Chand and Company Pvt. Ltd., New Delhi.

3. Highway Material and Pavement Testing: Dr. S. K. Khanna, Dr. C. E. G. Justo and Dr. A. Veeraragavan. Nem Chand and Bros., Roorkee, India

4. Traffic Engineering and Transport Planning: Kadiyali, L.R., Khanna Publishers, Delhi

References:

1. Principles and Practice of Highway Engineering: Kadiyali, L. R.; Khanna Publsihers, Delhi.

2. Relevant specifications of MORTH and relevant IRC codes

Online Resources:

Sr. No.	Website Name
1	https://ts-nitk.vlabs.ac.in/
2	https://nptel.ac.in/courses/105105107

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	
CEL505	Professional Communication and Ethics	--	--	2*+2	--	--	60	--	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL505	Professional Communication and Ethics	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. Discern and develop an effective style of writing important technical/business documents.
2. Investigate possible resources and plan a successful job campaign.
3. Understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. Develop creative and impactful presentation skills.
5. Analyze personal traits, interests, values, aptitudes and skills.
6. Understand the importance of integrity and develop a personal code of ethics.

Lab Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.

2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry.

3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.

4. Deliver persuasive and professional presentations.

5. Develop creative thinking and interpersonal skills required for effective professional communication.

6. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

Detailed Syllabus.

Sr.No	**Name of Module**	**Detailed Content**	**Hrs**
1	Advanced Technical Writing: Project/ Problem Based Learning	Subject Matter (Technology, Accounting, Finance, Marketing, etc.); Time Interval (Periodic, One-time, Special); Function (Informational, Analytical, etc.); Physical Factors (Memorandum, Letter, Short & Long). Parts of a Long Formal Report Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter). Language and Style of Reports: Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables and Equations, Referencing Styles in APA & MLA Format, Proofreading through Plagiarism Checkers. Definition, Purpose & Types of Proposals: Solicited (in conformance with RFP) & Unsolicited Proposals, Types (Short and Long proposals). Parts of a Proposal Elements: Scope and Limitations, Conclusion. Technical Paper Writing: Parts of a Technical Paper (Abstract, Introduction, Research	06

		Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References), Language and Formatting, Referencing in IEEE Format	
2	Employment Skills	Cover Letter & Resume: Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resume (Chronological, Functional & Combination). Statement of Purpose: Importance of SOP, Tips for Writing an Effective SOP. Verbal Aptitude Test: Modelled on CAT, GRE, GMAT exams. Group Discussions: Purpose of a GD, Parameters of Evaluating a GD, Types of GDs (Normal, Case-based & Role Plays), GD Etiquettes. Personal Interviews: Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioral, Problem Solving & Case-based), Modes of Interviews: Face-to face (One-to one and Panel) Telephonic, Virtual	06
3	Business Meetings	Conducting Business Meetings: Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members, Meeting Etiquette. Documentation: Notice, Agenda, Minutes	02
4	Technical/ Business Presentations	Effective Presentation Strategies: Defining Purpose, Analysing Audience, Location and Event, Gathering, Selecting & Arranging Material, structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a	02

		Presentation, Platform Skills. Group Presentations: Sharing Responsibility in a Team, Building the contents and visuals together, Transition Phases	
5	Interpersonal Skills	Interpersonal Skills: Emotional Intelligence, Leadership & Motivation, Conflict Management & Negotiation, Time Management, Assertiveness, Decision Making	08
6	Corporate Ethics	Intellectual Property Rights: Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications, Integrated Circuits, Trade Secrets (Undisclosed Information). Case Studies: Cases related to Business/ Corporate Ethics	02

Sr No	List of Assignments / Tutorials	Hrs
1	Cover Letter and Resume	2
2	Short Proposal	2
3	Meeting Documentation	2
4	Writing a Technical Paper/ Analysing a Published Technical Paper	2
5	Writing a SOP	2
6	IPR	2
7	Interpersonal Skills	2
8	Aptitude test (Verbal Ability)	2

Text Books:

1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/ Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.

2. Bovée, C. L., &Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ: Pearson.

3. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.

4. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). Personal development for life and work. Mason: South-Western Cengage Learning.

References:

1. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson.

2. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press

3. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness. Oxford University Press

4. Sanjay Kumar & Pushp Lata (2018). Communication Skills a workbook, New Delhi: Oxford University Press

Online Resources:

Sr. No.	Website Name
1	https://www.youtube.com/watch?reload=9&v=CHzL4PJIKLw
2	https://www.youtube.com/watch?v=w1wiIkVbfGY

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	
CEL511	Mini Project – 2A	--	--	4	--	--	60	--	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL511	Mini Project – 2A	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

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

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Identify problems based on societal /research needs and formulate a solution strategy
2. Apply fundamentals to develop solutions to solve societal problems in a group

3. Analyze the specific need, formulate the problem and deduce the interdisciplinary approaches, software-based solutions and computer applications.

4. Develop systematic flow chart, evaluate inter disciplinary practices, devices, available software, estimate and recommend possible solutions.

5. Draw the proper inferences from available results through theoretical/ experimental/ simulations and assemble physical systems.

6. Create devises or design a computer program or develop computer application.

- **Guidelines for Mini Project -2A**

  Expected outcome is hardware based, "A Working Model."

  Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.Students should find 'List of Mini project – 2A problems' in University web portal www.mu.ac.in, and in consultation with faculty supervisor/ head of department/ internal committee of faculties select the title.Students shall submit implementation plan in the form of Gant/ PERT/ CPM chart, which will cover weekly activity of mini project.A log book to be prepared by each group, wherein group can record weekly work progress, guide/ supervisor can verify and record notes/ comments.Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor. Students shall convert the best solution into working model using various components of their domain areas and demonstrate. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that Students come out with original solution. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/ modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

List of approved problems for Mini Project -2A:
H501: Construction of Model showing New application of alternative materials and byproducts of different industries for Durability and sustainability.
H502: Construction of Model/ device for Smart Traffic Management System Using Internet of Things
H503: IOT based smart device for traffic signal monitoring system using vehicle Count.
H504: Mini Project on Construction of Model showing New application of use of Fly Ash in Civil Engineering works
H505: Mini Project on specimen of Modified Concrete Pavements (using unconventional, recycled or waste product)
H506: Novel device for Base isolation system for multistoried building
H507: Mini project on specimen of light transmitting concrete.
H508: Model of Novel Seismic isolation devices for bridge structures.
H509: Novel Applications of Bamboo as a building material specimen.
H510: Development of device using sensors for deflection of girders. Beams, slabs or bridges.
H511: Development of device using sensors for detection of fracture in Railway tracks.
H512: Mini project on specimen of Bubble deck slab.
H513: Construction of specimen of GFRG panels as walls in buildings instead of conventional walls.
H514: Construction of specimen of Agro waste reinforced panels as walls in buildings instead of conventional walls.
H515: Construction of specimen of unconventional panels as walls in buildings instead of conventional walls.
H516: Construction of specimen of Ferro cement Slab as a replacement to RCC slab.

H517: Construction of specimen of No Fines Concrete or porous Concrete and its applications.
H518: Construction of Model of Novel Soil Stability technique to prevent landslides.
H519: Construction of Model of a dwelling unit (house) in rural area.
H520: Typical design of Model for construction of toilets in rural India.
H521: Construction of Model for Typical applications of Ferro concrete.
H522: Construction of Model of road paths with locally sourced materials in villages.
H523: Construction of Model showing Typical application of Prestressed concrete.
H524: Construction of Model showing Typical application of fiber reinforced concrete.

(This is tentative list, this list will be continuously updated by contributions from faculty, industry and alumni.)

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Modern Surveying Instruments and Techniques	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Revolutionary changes have taken place in the last few years in surveying instruments and techniques that are used for measuring level differences, distances, angles, areas, volumes, etc. This has become possible due to the advent of electronics in the surveying instruments. With rapid advancements in the technology and availability of cheaper and innovative electronic

components, these instruments have become affordable and user friendly.

This course outlines the advancements in instruments and techniques such as digital levels, electronic distance measuring instruments, electronic theodolites, total stations, GPS, GIS, Remote Sensing, drone survey, aerial photogrammetry and hydrographic survey. It also makes the learner industry-ready with respect to the applications of the modern tools in data capturing and further in mapping using appropriate software.

Objectives

a. Understand the working principles and methodologies of modern surveying instruments and compare with conventional instruments.
b. Exhibit the concepts of Global Positioning System, Geographical Information system and remote sensing techniques.
c. Demonstrate the importance of Aerial photogrammetry in surveying works, 4 Develop recent methods of maintaining land records,
d. Study the art of delineating the levels underwater bodies.
e. Highlight the modern techniques in the field of surveying and mapping using various softwares.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Modern Surveying Instruments:**		06
	1.1	Principles governing modern instruments and comparison with the conventional instruments.	
	1.2	E.D.M. Electromagnetic spectrum, Electromagnetic distance measurement, Instruments – Digital planimeter, Auto Level, Laser Level, Electronic Digital Theodolite,	

		Total Station, Scan station, Smart Station (Total station with GPS).	
2	**Geoinformatics**		**12**
	2.1	Global Positioning System- Global Positioning System – working principle and methods, Different Approaches to use GPS and their accuracies, Advantages of GPS in Navigation, Survey, Planning and Mapping.	
	2.2	Geographical Information System -Introduction, Definition, Objectives, Components (people, procedure, hardware, software & data) & functions (input, manipulation, management, query & analysis and visualization) of GIS. Coordinate systems and projections, Geo-referencing, GIS data – spatial (Raster & vector) & spatial data. Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of a spatial data.	
	2.3	Remote Sensing introduction, Definition, Necessity, Importance and use; Basic concepts in Remote Sensing, Basic Laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter, Resolution in remote sensing, Satellite remote sensing, Problems confronting remote sensing system. Ideal and Real remote sensing systems.	
3	**Aerial Photogrammetry**		**06**
	3.1	Introduction, principle and uses of Aerial photographs, Definitions, of different terms, Scale of vertical and tilted	

		photograph (simple problems), Ground Coordinates.	
	3.2	Relief Displacements, Ground control, Procedure of aerial survey, overlaps and mosaics, Stereoscopes	
4	**Cadastral Surveying**		**04**
	4.1	Cadastral Surveying: Contemporary Techniques of maintaining survey records, 7-12 Extracts, Form-8 (Namuna-8).	
	4.2	Role of Survey Department, Role of revenue department. Soft/digitized formats of land records, Comparison with conventional record keeping	
5	**Hydrographic Surveying**		**04**
	5.1	Hydrographic Surveying: Objects, Applications, establishing controls, Shore line survey, Sounding, sounding equipment, Methods of locating soundings – conventional and using GPS.	
	5.2	Reduction of soundings, Plotting of soundings, Nautical sextant and its use, Tides and tide gauges, determination of MSL.	
6	**Applications of Modern Survey Techniques and Map Preparation Using Software**		**07**
	6.1	Applications of Total Station, GIS, GPS, Remote sensing, LIDAR, Drones in Civil Engineering.	
	6.2	Introduction of GRAM++, Q-GIS, Map Info etc.	

Total	**39**

Recommended Books:

1 Agor R, Advanced Surveying, Khanna Publishers, New Delhi (ISBN9788174909053). 2Kanetkar, T.P. and Kulkarni, S.V., Surveying and Levelling Vol. II, Pune Vidhyarthi Gruh Publication (ISBN9782508807185).

2 Arora, K.R., Surveying Vol. III, Standard Book House. New Delhi (ISBN9788189401276).

3 Basudeb Bhatta, Remote Sensing and GIS, Third Edition, Oxford University Press, New Delhi. ISBN: 9780199496648

4 B. C. Punmia, Ashok K Jain, Arun K Jain, Advance Surveying, Laxmi Publications (ISBN 9788170088530)

5 R. Subramanian, Surveying and levelling, Oxford University Press, New Delhi (ISBN9780198085423)

6 P.Dong , Q.Chen, Lidar Remote Sensing and applications ,CRC Press (ISBN 9781138747241)

Reference Books:

1 Basudeb Bhatta, Remote Sensing and GIS, Third Edition, Oxford University Press, New Delhi. ISBN: 9780199496648

2 T.M Lillesand, R.W Kiefer, and J.W Chipman, Remote sensing and Image interpretation, 5th edition, John Wiley and Sons, India; ISBN: 978-1-118-34328-9 3Kaplan E.D and Hegarty C.J., Understanding GPS: principles and applications, Artech House (ISBN978-1-63081-058-0)

3 Wolf P.R. and Dewitt B.A., Elements of Photogrammetry, McGraw Hill,(ISBN 978- 0072924541)

4 DeMers M.N., Fundamentals of GIS, John Wiley (ISBN978-0470129067) Gibson P.J., Introductory Remote Sensing: Principles and Concepts, Routledge (ISBN0 415 18962 4).

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Building Services and Repairs	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

The building services are based on engineering operations of buildings & the built environment. Building services are responsible for the environment in which we live & work. Building service systems are complex. They are typically a major source of cost & potential problems in building service conditions. Fundamental knowledge of how

mechanical, electrical, plumbing & other systems work & interact is important to the construction professionals. This course provides an introduction to building service systems which include the study of design, interfaces & specifications of various building services in buildings. For an existing building, it is necessary to be in a good condition to perform the intended functions. Adequate maintenance extends the building life & ensures the safety of occupants. Most of the structures are getting old & are in the dire need of the repair and maintenance. Hence, there is a huge employment potential in conformity with the field of repair and maintenance. This course, therefore, finds its place in the curriculum such that the pupils can acquire the competency in this area. The course deals with the different building services, health monitoring of buildings, their maintenance, repair materials and repair methodologies.

Objectives

1 To understand the concepts of mechanical systems in buildings such as lifts, escalators, HVAC systems, pumps & their applications.

2 To understand design concepts of electrical system, safety and illumination fundamentals.

3 To get familiar with the plumbing system and services in buildings related to water supply, drainage, gas supply and firefighting installations.

4 To learn about causes of distress of concrete structures and learn various instrumental testing methods for Condition assessment & evaluation of structure and assess the extent of repairs.

5 To acquire the knowledge of repair materials and repair methodologies for rehabilitation of RCC structures.

6 To learn implementing repair process and to follow safety during construction work.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Building services: Mechanical systems.**		**06**
	1.1	Lifts/elevators, escalators, conveyors: their components, capacity and principles of working, common problems.(3L)	
	1.2	Motors, Generators, Pumps, HVAC Systems - Heating systems, Cooling Systems, Packaged HVAC, types, capacity, components and their principles of working, common problems.(3L)	
2	**Building services: Electrical systems & Illumination in Buildings**		**07**
	2.1	Electrical grids and supply system: Layout of substations Transformers & switch gears, Main & distribution boards, electrical systems in buildings, Single / Three phase supply, ISI specifications, electrical load, electrical layout plan in a building, Types of wires, wiring system & their choice, Solar energy, CCTV, LAN. Protective devices in electrical installation: Earthing for safety, Types of Earthing, fuses, circuit breakers, lightening arrester.(4L)	

	2.2	Principles of Illumination Design: Visual task, Factors affecting visual task, Luminous flux, candela, solid angle illumination, utilization factor. Modern theory of light &color: Synthesis of Light, Additive & Subtractive synthesis of colour, classification of lighting, artificial lights sources, spectral energy distribution, luminous efficiency, color temperature, colour rendering. Level of illumination: Lighting for stores, offices, school, hospitals and house lighting, elementary idea of special features required and minimum level of illumination required in buildings.(3L)	
3	**Building services: Plumbing Systems in Building**		**06**
	3.1	Water Distribution system: Material for service pipes, service connection, size of service pipe, Water meter, valves and storage tanks, water requirement for domestic use and firefighting.(2L)	
	3.2	Drainage system: Pipe and traps, system of plumbing, house drainage plans, Chambers- gradient and spacing, manholes, septic tanks and soak pit, Introduction to rain water harvesting system.(2L)	
	3.3	Other plumbing systems: Fire safety, fire-fighting installations, types and purpose, piped gas supply systems, AC ducting.(2L)	
4	**Deterioration of Concrete Structures & Condition assessment**		**06**

	4.1	Durability & Causes of deterioration of concrete structures: effects of climate, moisture, temperature, chemical, wear, erosion & loading on serviceability & durability. Design errors & construction errors, causes of seepage & leakage in concrete structures, formation of cracks including those due to corrosion.(2L)	
	4.2	Condition Survey, Evaluation & Damage Assessment: Structural audit and bye laws. Diagnostic methods & analysis. Destructive, semi-destructive and non-destructive methods: core test, carbonation test, chloride test, petrography, corrosion analysis, cover meter test, rebound hammer test, ultrasonic pulse velocity test, and crack measurement techniques, Concrete endoscopy & thermal imaging, pull- off test & pull out test.(4L)	
5	**Repair Materials & Methodologies For Repairs**		**08**
	5.1	Repair analysis, Repair materials: and their desired properties, Polymer modified mortar/ concrete, micro concrete, bonding chemicals, protective materials and their properties for moisture barrier systems, water-proofing of concrete structures, Systems like integral, crystalline, coatings, membranes, joints sealants, crack repair fillers, corrosion resistant steels, Pre-packed zinc sacrificial anode, Snap-On zinc mesh anode CP system, corrosion inhibitors, rust solvents.(4L)	
	5.2	Repair methodologies: Crack and patch repair, Injection grouting, surface coatings, column jacketing, guniting, shotcrete, Ferroconcrete, FRP, Carbon fiber wrapping, methods of rebar corrosion protection, cathodic	

		protection.(4L)	
6	**Repair Process Implementation and Safety During Repairs**		**06**
	6.1	Legal Documentation and Records: Estimates of repair work, procedure and flow chart for repairs, Bill of quantities, Tendering, Work order, Agreement and Contract, Measurement book, bills, security deposits, role of PMC.(3L)	
	6.2	Safety during Repairs: Causes of accidents, safety signs, barricading, insurance, Temporary Support structures such as, formwork, shuttering, centering, staging and scaffolding.(3L)	
Total			**39**

Recommended Books:

1 Heat Pumps and Electric Heating: *E. R. Ambrose*, John and Wiley and Sons, Inc., New York, 1968

2 Handbook for Building Engineers in Metric Systems, NBC, New Delhi, 1968. 3 Philips Lighting in Architectural Design, McGraw-Hill, New York, 1964.

4 The Lighting of Buildings: *R. G. Hopkinson and J. D. Kay*, Faber and Faber, London, 1969.

5 National Building Code.

6 Building Construction: *Dr. B. C. Punmia, Ashok K Jain*, A.K Jain

7 Construction Engineering and Management: *S. Seetharaman*, Umesh Publications, Delhi.

8 Water supply and Sanitory Installations: *A. C. Panchdhari*, New Age International

Publication, Delhi

9 Concrete Repair and Maintenance: *Peter H. Emmons and Gajanan M. Sabnis,* Galgotia Publication

10 Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.

Building Services and Repairs: Dr. A. S. Radke, Tech Knowledge Publications

Reference Books:

1 Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia

2 CPWD hand book on Repairs and Rehabilitation of RCC buildings published by DG (Works), CPWD, Government of India (Nirman Bhawan), http://www.cpwd.gov.in/handbook.pdf.

3 Guide to Concrete Repair, *Glenn Smoak*, US Department of the Interior Bureau of Reclamation, Technical Service Center, http://books.google.co.in.

4 Management of Deteriorating Concrete Structures: *George Somerville*, Taylor and Francis publication

5 Concrete Building Pathology: *Susan Macdonald*, Blackwell Publishing.

6 Testing of Concrete in Structures: *John H. Bungey*, *Stephen G. Millard and Michael G. Grantham*, Taylor and Francis Publication.

7 Durability of concrete and Cement Composites: *Page, C.L.*and Page, *M.M.*, Woodhead Publishers

8 Fire Safety in Building: V. K. Jain, New Age International Publication, Delhi

9 MEP systems & Repairs of Buildings: A.S. Radke, Published by Synergy Knowledgeware.

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Sustainable Building Materials	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Meeting the needs of the present without compromising the ability of future generations to meet their needs is considered to be the simplest and effective sustainable development. The greatest threats to the sustainable development on earth are: population growth and urbanization, energy use and global warming, excessive waste generation and the subsequent pollution and limited supply of resources. Concrete is the primary construction material in the world. Construction industry consumes 40 percent of the total energy and about one half of world's major resources. Hence, it is imperative

to regulate the use of materials and energy in this industry. The largest environmental impact of the concrete industry comes from the cement manufacturing process that leads to relatively high greenhouse gas emissions. Minimizing the quantity of cement in a concrete mix has many potential benefits. Thus, the use of industrial byproducts such as fly ash, silica fume as cementitious materials in concrete structures can lead to significant reduction CO2 emissions and consumption of energy and raw materials. Green and intelligent buildings also have been evolved for sustainability of the construction industry. This course provides knowledge of different sustainable building materials and technologies in construction industry.

Objectives

1 To have more awareness among students about sustainability.

2 To understand environmental issues due to building materials and the energy consumption in manufacturing building materials.

3 To study the alternative masonry unit and mortar for sustainable practices.

4 To know the importance of cement reduction and replacements for a sustainable development.

5 To understand the alternative building technologies which are followed in construction.

6 To have cognizance of alternative roofing systems in practice.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Sustainability**		**07**
	1.1	Introduction: Need and concept of sustainability, Social Environmental and economic sustainability concepts,	

	1.2	Sustainable development, Nexus between technology and Development, Challenges for sustainable development Fundamentals of sustainability.	
	1.3	Global Environmental issue: Resource degradation, ozone layer Depletion Climate change, Carbon cycle, Factors affecting Carbon credits and carbon trading, carbon foot Print, Carbon sequestration-carbon capture and storage (CCS).	
	1.4	Environment legislation in India-water act and air act	
2	**Energy In Building Materials**		**06**
	2.1	Embodied energy and life cycle energy, Calculation of embodied energy in wall, Environmental issues concerned to building materials, Global warming and construction industry.	
	2.2	Environment friendly and cost-effective building technologies. Requirements for building of different climatic regions.	
	2.3	Traditional building methods and vernacular architecture Green buildings, Intelligent buildings, green materials, green building ratings-IGBC & LEED.	
	2.4	Renewable and nonrenewable energy sources.	
3	**Elements of Structural Masonry**		**06**
	3.1	Characteristics of building blocks for walls, Stones and Laterite blocks, Bricks, Fly ash bricks and hollow clay blocks, Concrete Blocks, Stabilized blocks: mud blocks,	

		steam cured blocks, Fal G Blocks stone masonry block.	
	3.2	Masonry Mortars: Mortars, Cementitious materials: Lime, OPC, PPC, Masonry cement, Lime pozzolana (LP)cement. Sand: natural and manufactured, Classification of mortar as per BIS, Types of mortar, Properties and requirements of mortar, Selection of mortar.	
4	**Cementitious and Supplementary Cementitious Materials and their Characterization:**		**06**
	4.1	Lime, Lime pozzolana cements, Pozzolana: Surkhi, Fly ash, IS (3812) (Type C and F), GGBFS, Silica Fumes, Metakaolin,	
		RHA, Composite cements and its types, IS (16415:2015), Magnesia based cements, Calcium sulfo- cement, Alkali activated, cement (Type 1 and Type II), Geopolymers. Composition, Properties and uses.	
	4.2	Membrane curing: wax and resin based, self-curing compound: Polymer and polyethylene glycol, Water reducing admixtures, use of treated domestic effluent (TDE) for mixing and curing	
5	**Alternate Building Technologies**		**07**
	5.1	Fiber reinforced cement composites: Matrix materials, reinforcing Materials, Applications	

	5.2	Fiber reinforced polymer composites: Matrix materials, types of polymers used and applications	
	5.3	Ferrocement and ferroconcrete building components: Materials, Construction methods, Mechanical properties, Applications.	
	5.4	Nanotechnology for sustainable construction.	
6	**Alternate Building Materials and Roofing Systems**		**07**
	6.1	Building materials from agro and industrial waste: Typical agro- waste and biomass resources, Use of industrial waste: Fly ash, Blast furnace slag, Iron ore tailings, Gold mine tailings Granite and marble polishing fines, demolished building waste	
	6.2	Concepts in roofing alternatives, Types of roof, Roof as a structural system, Cost reduction through construction process efficiency	
	6.3	Filler slab roofs, Composite beam and panel roofs, construction Details and roof assembly.	
	6.4	Masonry domes and vaults: Relevance, analysis and design, Barrel vault.	
Total			**39**

Recommended Books:

1 Alternative Building Materials and Technologies by KS Jagadish, BV Venkatraman Reddy and KS Nanjunda Rao, New Age International publications.

2 Sustainability Engineering: Concepts, Design and Case studies by Allen D.T, and Shonnard D.R , Prentice Hall.

3 Sustainability Engineering: Concepts, Design and Case studies by Bradley A.S; Adebayo A.O, and Mario P., Cengage learning

4 Sustainability of construction materials by Jamal M Khatib, Woodhead publishing limited.

5 Renewable energy sources by Twidell J.W and Weir A.D, English Language Book Society (ELBS)

Reference Books:

1 ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy efficiency Publications—Rating system, TERI Publications – GRIHA Rating system.

2 Structural Masonry by Arnold W Hendry, Macmillan Publishers

3 Systems Analysis for Sustainable Engineering: Theory and Application by Ni bin Chang, Mc Graw Hill Professional

4 NPTEL course on sustainable materials and green building https://nptel.ac.in/courses/105/102/105102195

5 Relevant codes

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Advanced Structural Mechanics	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

The structures are subjected to various types of loading/ forces. These are axial force, shear force, bending moment, torsion etc. This course enables the students with the knowledge in conformity with analysis of behaviour of structural members under different types of loading. The course facilitates in imparting theoretical concepts and physical understanding, which in turn will help in solving structural mechanics problems, mostly involving beams & thin-walled structures under different loading conditions.

Objectives

1 To understand the concept of unsymmetrical bending, shear centre and spring & evaluate the stress due to unsymmetrical bending, shear centre for symmetrical & un- symmetrical thin-walled sections.

2 To study the concepts and behavior of beams curved in elevation & to evaluate the stress.

3 To study the concepts and behavior of beams curved in plan subjected to different types of loadings.

4 To understand the concept &behavior of beams resting on elastic foundation.

5 To understand the concept of different theories of failure in regards of materials.

6 To study the behavior of deep beams using different theories available for the analysis of different sections.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Unsymmetrical Bending, Shear Centre and Springs**		**07**
	1.1	Product of inertia, principal moment of inertia, flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.	
	1.2	Shear Centre for symmetrical & unsymmetrical (about both axes) thin-walled open sections.	
	1.3	Helical springs, flat spiral springs, laminated springs.	
2	**Beams Curved in Elevation**		**07**
	2.1	Bending of beams with large initial curvature, loaded in	

		their plane of curvature.	
	2.2	Application to analysis of hooks, circular closed rings, chain links with straight length & semi-circular ends.	
3	**Beams Curved In Plan**		**05**
	3.1	Analysis of Beams Curved in Plan such as cantilever circular arc, semicircular beams fixed at two ends and subjected to central concentrated load.	
	3.2	Simply supported semicircular beam subjected to UDL supported on three equally spaced columns, Analysis of circular ring beam.	
4	**Beams on Elastic Foundation**		**07**
	4.1	Analysis of beams of infinite length subjected to concentrated force/moment & semi-infinite length subjected to concentrated load/moment at one end.	
	4.2	Semi-infinite beam hinged at one end (origin) & subjected to UDL throughout.	
5	**Theories of Failure**		**07**
	5.1	Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory.	
	5.2	Maximum total strain energy theory.	
6	**Analysis of Deep Beams**		**06**
	6.1	Determination of deflection.	

	6.2	Determination of shear correction factor for various sections: rectangular solid & hollow section, circular solid & hollow section & I-section	
Total			**39**

Recommended Books:

1 Mechanics of Materials: Popov, E.P. Prentice Hall of India Pvt. Ltd. 2 Advanced Mechanics of Materials: Arthur P. Boresi and Omar M. Sidebottom, Wiley and Sons.
3 Strength of Material Part I and Part II: Timoshenko, McGraw Hill, New York.
4 Mechanics of Solids: Shames, I and Pitarresi, J. M., Preentice Hall, New Delhi.
5 Strength of Materials: Subramanian, Oxford University Press.
6 Advanced Mechanics of Solids, L.S. Srinath, Tata McGraw Hill,20 7 Strength of Materials: R. K. Rajput, S. Chand and Co. Ltd.

Reference Books:

1 Mechanics of Materials: Beer, F.P., E. Russell Jhonston and John T. DeWolf, TMH, New Delhi.
2 Beams on Elastic Foundation: Heteny M.
3 Mechanics of Materials: James Gere, M., Thomson Brooks.
4 Reinforced Concrete Deep Beams: F.K. KONG, Taylor & Francis Books, Inc.

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Air and Noise Pollution and Control	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires, possibly causing diseases, death to humans, damage to living organisms. Noise pollution impacts millions of people on a daily basis. The most common health problem it causes is Noise Induced Hearing Loss (NIHL). Exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress. This subject is intended to make students aware about the noise

and air pollution, various sources which contribute in degradation of air quality, assessing the air quality through air quality index, and various air and noise pollution control methods and equipment used by industries.

Objectives

The students will be able to learn:

1 Understanding of basic concepts of air and noise pollution.

2Study of air pollution episodes. Reasoning of the entire episode, identification of the parameters, conditions, mechanisms.

3 Study of sampling types and methods for ambient air and stack.

4 Study of macro and micro meteorology for understanding the dispersion of pollutants.

5 Simple and complex modeling for point source, line source and area source. 6 Study of pollution control methods, mechanism and devices, laws.

Detailed Syllabus

Module	Course Module / Contents	Periods
1	Introduction to Air Pollution: Definition, Air pollutants and its classification and sources of generation. Emission Inventory. Indoor air pollution. Measurement of air pollution. Air pollution in India and other countries. Air Quality Index. Numerical on conversion of units of pollutants.	**05**
2	Environmental Effects of Air Pollution: Effects of air pollutants on human beings, plants, animals, properties and visibility. Exposure to air pollution. Numerical problems based on COH, CoHb	**06**

3	Measurement and Control technology of Air Pollutants: methods to measure ambient air pollution and stack emissions, high volume sampler, wind rose diagram. Control Technology: Control Devices Principles, operations and types, simple hoods and ducts. Settling chambers, cyclones, electrostatic precipitators (ESP), Filters, scrubbers, absorption towers and incinerators. Collection efficiencies for laminar and turbulent flows for settling chambers, particle cut size for cyclone, ESP Concept of frictional and overall efficiencies. Design criteria for filters, scrubbers, absorption towers and incinerators.	**10**
4	Meteorological process and air quality monitoring: Large scale wind circulation geotropic wind, gradient wind, cyclone, anticyclone, planetary boundary layer. Lapse rate, stability conditions, wind velocity profile, maximum mixing depth, topographic effects. Plum patterns, plum dispersion, Gaussian model for predicting concentration, downwind from a single source, diffusion coefficients, Turner's stability categories and graphs for dispersion estimates. Maximum ground level concentration, inversion effects, distance touching ground modification of Gaussian model to predict particulate dispersion, plume rise, modified Holland equation for small source.	**10**
5	Current Issues on Air Pollution and Global -Legal Aspects, air pollution laws, Indian standards- emission and air quality standards Greenhouse effect/ Global warming, Ozone Pollution, Acid Rain.	**04**
6	Noise Pollution: definition and introduction, the effects of noise, characteristics of sound and its measurement, levels of noise and	**04**

	problems, noise rating system, noise level standards, sources of noise and their noise levels, noise abatement and control.	
Total		**39**

Recommended Books:

1 Air Pollution: Rao. M. N. and Rao, H. V. N., Tata McGraw Hill Publication, New Delhi.

2 Environmental Pollution Control Engineering: Rao C.S., New Age International Publishers.

3 Noise Pollution: Agarwal S.K., APH Publishing Corporation.

4 Noise Pollution and Control Strategy: Singal S.P., Alpha Science International LTD. 5 Sewage disposal and Air pollution engineering: Garg, S.K., Khanna pbl.

Reference Books:

1 Air Pollution: Part A- Analysis and Part B-Prevention and Control: Ledbetter, J. O., Make Dekker Inc., New York.

2 Air Pollution: Wark and Warner, Harper and Row, New York.

3 Air Pollution Vol.1: Tripathi, A. K., Ashish Publication House, New Delhi. 4 Air Pollution Handbook: Magill, P. L.et al., McGraw Hill publication. 5 Air and Noise Pollution Control: Volume 1: Wang,L.K. and Pereira, N.C., Humana

6 Textbook of Noise Pollution and its Control: Bhatia S. C., Atlantic Publishers and Distributors, New Delhi.

7 Industrial Air Pollution Handbook: Parker, A., Tata McGraw Hills Publication. 8 Air Pollution: Henry Capeskins, McGraw Hill publication.

9 Environmental Noise Pollution: Noise Mapping, Public Health, and Policy,Enda Murphy and Eoin King.

10 Air Pollution: Wark and Warner, Harper and Row, New York.

11 Government of India's Publication of laws related to air pollution, Maharashtra

Pollution Control Board's (MPCB) Publication of standards. IndianStandards relevant to Air Pollution Monitoring, Definitions, Standards.

12 Air Pollution Control Theory: Martin Crawford, McGraw Hill publication.

R-2025- T.E Civil Engineering with Computer Applications

Course Code	Course Name	Credits
CEC55X	Department Level Optional Course - 1 Transportation Planning and Economics	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

The ultimate aim of Transport planning is to generate alternatives for improving Transportation system to meet future demand and selecting the best alternative after proper evaluation. The Course concentrates on Transportation system planning, Public Transportation Planning, Parking planning, and economic analysis of Transportation projects. Basic purpose of transportation planning is focusing on what's the most efficient movement for people and goods around the world. Improving access to an area not only reduces congestion, but the accessibility attracts new residents and businesses ultimately

helping economic development.

Objectives

1 To understand various urban development policies in India and to learn different planning surveys.

2 To analyze and plan future traffic flow using four stage modelling.

3 To understand the implementation of land use transport model in Urban area. 4 To carry out economic analyses for different transportation infrastructure projects.

5 To understand and plan Urban public Transportation system.

6 To plan and design Parking system for residential, commercial and other projects.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Urban Transportation Planning**		**04**
	1.1	Problems & factors in Transportation Planning, Development of Transportation Systems in India, Growth of Transport - Trends in Traffic - Imbalances in Transport System.	
	1.2	Urban growth mechanism – Urban morphology - Urbanization & travel demand - Urban development planning policy – NUTP - Urban transport projects - Urban transport problems in India	
	1.3	Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system, Trip based and activity-based approach - Four stage travel demand modelling.	

2	**Four Stage Modelling**		**10**
	2.1	Trip generation analysis: trip classification, multiple regression analysis, category analysis	
	2.2	Trip distribution analysis: introduction, methods of trip distribution, uniform and average factor method, Fratar method, Furness method, the gravity model, opportunities model.	
	2.3	Modal split analysis: introduction, Modal split analysis modal split models.	
	2.4	Traffic Assignment: purpose of traffic assignment, Assignment techniques: All or nothing assignment, Multiple route assignment, Capacity restraint assignment, Diversion Curves.	
3	**Land Use Transport Modelling**		**05**
	3.1	Urban system components - Urban spatial structure – Accessibility - Location theory.	
	3.2	Land use models - Land use transport models, Lowry & Garin – Lowry models.	
4	**Transportation Economics**		**10**
	4.1	Economic evaluation of highway schemes, need for economic evaluation, cost and benefits of transportation projects	
	4.2	Basic principles of economic evaluation, Net present value method, benefit/cost ratio method, internal rate of return method. Vehicle operating costs.	

5	**Urban Public Transport Planning**		**05**
	5.1	Growth history – Urban growth & public transport needs - Modes of public transport and comparison - Public transport travel characteristics	
	5.2	Technology of bus, rail, rapid transit systems, and basic operating elements. Transit characteristics - Fleet size and capacity estimation.	
6	**Parking Planning and Design**		**05**
	6.1	Types of Parking's, Methods of surveys, Parking inventories, Parking Design	
	6.2	Planning of parking for residential and commercial buildings including shopping complex, malls and multiplex.	
Total			**39**

Recommended Books:

1 Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2002.

2 IRC: SP: 30-1993., Manual on Economic Evaluation of Highway Projects in India.

3 Sarkar P K., Maitri V.,Economics in Highway and Transportation Planning, Standard Publisher, New Delhi, 2010.

4 K.S. Ramegauda, Urban and Regional Planning, Mysore University Publication.

5 Ceder, A.,Public Transit Planning and Operation: Theory, Modeling and Practice, B-H Elsevier Ltd., MA, 2007.

6 IRC:SP:12-2015, Guidelines for Parking Facilities in Urban Roads

Reference Books:

1Khisty C J., Lall B.Kent, Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2005

2 Ortuzar, J. D., Willumsen, L.G., Modeling Transport, John Wiley & Sons, 1994

3Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI, New Delhi,2002

4Hutchinson B.G., Principles of Urban Transportation System Planning, Mc-Graw Hill, 1974.

Course Code	**Course Name**	**Credits**
CEC55X	Department Level Optional Course – 1 Advanced Concrete Technology	03

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

Theory					**Term Work/Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**Term Work**	**Pract.**	**Oral**	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Basic concept of concrete technology is essential for civil engineering students to execute the civil engineering projects as per the standard laid down time to time. Advancements in concrete technology is the backbone of infrastructure of civil engineering field. This course provides necessary knowledge about various concreting operations and testing operations during and after construction. This course is intended for gaining knowledge about the properties of materials, especially concrete and to maintain quality in construction projects. This course will also provide knowledge to the students about the

criteria to be remembered during the selection of materials, its mix proportioning, mixing, placing, compacting, curing and finishing.

Objectives

1 To understand the various properties and tests of materials used in concrete along with the rheology of fresh concrete.

2 To study the different procedures for testing hardened concrete, its compositions and quality of in place concrete.

3 To understand the concept of durability and cracking in concrete. To also understand the significance and parameters of concreting under extreme environment and conditions.

4 To understand the concept and optimization of the mix design of concrete by various codes.

5 To study the various constituents, properties, significance and applications of special concrete.

6 To study the quality of concrete and check the acceptance criteria.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Constituents and Properties Of Concrete**		**08**
	1.1	Introduction of cement and water: Chemical composition of OPC, hydration, chemistry of cement, cement testing, water requirement for hydration, water quality for concrete and water quality test.	
	1.2	Aggregates: Types of aggregate (natural, synthetic, recycled), required characteristics of aggregates for	

		concrete, introduction to gradation of aggregates, standard grading curve and gap grading.	
	1.3	Chemical admixture: Introduction to accelerators, retarders, plasticizers, super plasticizers, viscosity modifying admixtures, water proofers, miscellaneous admixtures.	
	1.4	Mineral admixture: Introduction, composition of mineral admixture, fly ash and its type, silica fume, ground granulated blast furnace slag and others. Effects of mineral admixture on fresh and hardened concrete properties.	
	1.5	Properties of fresh concrete: Introduction to properties of fresh concrete, w/c ratio, w/b ratio, gel space ratio, maturity concept, aggregate cement bond strength, pumping of concrete.	
	1.6	Rheological models of fresh concrete: Introduction, simple flow test, rheological models and test methods, factors affecting rheological properties of concrete and effect of rheological properties on different types of concrete.	
2	**Testing of Concrete**		**05**
	2.1	Introduction to testing of hardened concrete - compression, tension, and flexure. Methods of testing (destructive, semi destructive, non-destructive).	
	2.2	Properties of hardened concrete: Factors influencing strength, importance of end effects in compression testing, tensile strength of concrete (split and flexural),	

		relationship between compressive and tensile strength.	
	2.3	Advanced non-destructive evaluation: Ground penetration radar, probe test penetration, pull out/off, break off method, stress wave propagation method, electrical / magnetic methods, infrared thermography, and core test.	
3	**Durability of Concrete**		**10**
	3.1	Introduction to durability and permeability: Transport mechanism of fluids and gases in concrete, role of w/c and admixture on durability. Design of durability using performance specification.	
	3.2	Corrosion and carbonation: Introduction to corrosion of reinforcement in concrete, factors influencing corrosion, damages preventive measures of corrosion, tests for existing structures and remedial measures of corrosion, introduction and measurement of depth of carbonation.	
	3.3	Concrete structures in special environment: Frost action, fire or	

		high temperature, chemical attack and aggressive environment (sulphate attack, chloride attack, acid attack in sewers, sea water attack), alkali aggregate reaction (alkali silica and carbonate reaction).	
	3.4	Concreting under extreme weather: Hot and cold weather concreting, underwater concreting.	

4	**Concrete Mixture Design**		**07**
	4.1	Design of concrete mixes by IS 10262 (latest edition) Method – with and without fly ash, super plasticizer, effect of pumping of concrete on mixture design.	
	4.2	Design of concrete mixes by American Concrete Institute (ACI) Method – Air and non-air entrained concrete.	
	4.3	Design of concrete mixes by Department of Environment (DoE) Method.	
	4.4	Design of concrete mixes by Road note 4 Method.	
	4.5	Design of high strength concrete mixes using ACI 211.4R - 93 Method.	
5	**Special Concretes**		**06**
	5.1	Light weight concrete and ultra-light weight concrete: Types and properties of light weight aggregates, factors influencing the strength and density of light weight aggregate concrete, properties of light weight aggregate concrete. Introduction to other light weight concrete – Cellular and foamed concrete. (01).	
	5.2	High performance concrete: Methods for achieving high performance concrete, requirements for high performance characteristics, material selection, advantages and applications.	

	5.3	Self-compacting concrete (SCC): Materials for SCC, comparison of traditional and SCC constituents, requirements for SCC, initial mix compositions, production and placing of SCC, fresh concrete tests for SCC.	
	5.4	Fiber Reinforced Concrete (FRC): Study of different fibers (metallic fiber, polymeric fibers, carbon fibers, glass fibers, naturally occurring fibers) in concrete with respect to volume fraction, orientation and aspect ratio, physical and mechanical properties - steel and polypropylene fiber reinforced concrete. Applications of steel and polypropylene fibers reinforced concrete.	
	5.5	Introduction to other special concrete – Vacuum concrete, waste material-based concrete, shotcrete, roller compacted, mass concrete.	
6	**Quality Control (QC)**		**03**
	6.1	Introduction: Statistical QC, quality factors, control charts.	
	6.2	Acceptance criteria according to Indian standards: Strength of concrete (site and laboratory)	
Total			**39**

Recommended Books:

1 Concrete Technology: A. R. Shanthakumar, Oxford University Press, New Delhi, 2007.

2 Concrete Technology Theory and Practice: Shetty M.S., S. Chand. 3 Properties of concrete: Neville, Isaac Pitman, London.

4 Concrete Technology: Gambhir M.L., Tata McGraw Hill, New Delhi.

5 Concrete Technology: Neville A.M. & Brooks. J. J., ELBS-Longman, Pearson Education Ltd.

6 Relevant I.S. codes: Bureau of Indian standard and ACI code.

7 Design of concrete mixes by N Krishna Raju (Latest Edition), CBS Publishers and Distributers Pvt. Ltd.

Reference Books:

1 Fibre Reinforced Cementitious Composites: Arnon Bentur and Sidney Mindess, Modern Concrete Technology Series, Tylor and Francis.

2 Concrete- Microstructures, Properties and Materials: P. Kumar Mehta and Paulo J. M. Monteiro, Indian Edition, Indian Concrete Institute, Chennai, 1999

3 Special Publication of ACI on Polymer concrete and FRC.

4 Concrete Technology: D.F. Orchardi, Wiley, 1962.

5 www.theconcreteportal.com

R-2025- T.E Civil Engineering with Computer Applications

T.E SEM-VI

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	
CEC601	Design and Drawing of Steel Structures	03	-	-	39	-	-	-	39	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
CEC601	Design and Drawing of Steel Structures	20	20	40	60	4	--	--	100

Rationale:

Steel structures are preferred due to their higher strength, speed of construction and aesthetic view. Civil Engineers must have knowledge of designing and detailing of steel structures to make structures safe and serviceable during its life span. I.S. code specifying the use of Limit State design philosophy for design of steel structures and its various components. This course is designed to provide basic knowledge of design and detailing of steel structures.

Course Objectives: Six Course Objectives

1. To make students familiar with behavior of steel structure and their components under the action of various loads.
2. To train the students for effective use of IS codes, design tables and aids in analyzing and designing the steel structures by limit state method.
3. To help students design connections of steel members.
4. To equip students with aspects required for designing tension member, compression members and column bases.
5. To equip students with aspects required for designing of flexural members.
6. To aid students in designing steel trusses.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Use the knowledge of Limit State Design philosophy as applied to steel structures. IS 800 code clauses
2. Design bolted and welded connections.
3. Design members subjected to axial tension.
4. Design compression members, Built-up columns and column bases.
5. Design members subjected to bending moment, shear force etc.
6. Estimate design loads as per IS 875 for roof truss and design the Steel roof truss

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Types of steel structures, Properties of Structural Steel, Indian Standard Specifications and Sections, Advantages and limitations of WSM, permissible stresses in WSM. Introduction to Limit State Design, partial safety factors for load and	03	CO1

		resistance, design load combinations, section classification such as plastic, compact, semi-compact and slender.		
II	Design of Bolted And Welded Connections	Design of bolted and welded connections for axial force, beam to beam and beam to column connections. Framed, stiffened and unstiffened seat connections, bracket connections	06	CO2
III	Design of Tension Members	Introduction, types of tension members, net area calculation. Design strength due to yielding, rupture and block shear. Design of tension members with welded and bolted end connection using single angle section & double angle section.	04	CO3
IV	Design of Compression Members and Column Bases	Introduction, types of compression members, classification of cross sections, types of buckling, effective length of column and slenderness ratio, buckling curves, design of compression members as struts using single angle sections & double angle section. Design of axially loaded column using rolled steel sections, design of built-up column, laced and	11	CO4

		battened Columns Design of slab bases & gusseted base.		
V	Design of Flexural Members	Design strength in bending, effective length, Lateral torsion buckling behavior of unrestrained beams, design of single rolled section with or without flange plates, design strength of laterally supported beams, low and high shear, design strength of laterally unsupported beams, web buckling, web crippling, shear lag effect and deflection. Design of welded plate girder: proportioning of web and flanges, flange plate curtailment	11	CO5
VI	Design of Truss	Design of determinate truss. Calculation of dead load, live load and wind load acting on truss. Load combinations and calculation of internal forces. Design and detailing of members. Support detailing. Design of angle section purlin.	04	CO6

Text Books:

1. Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi.
2. Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.
3. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. S., I.K. International Publishing House, New Delhi.
4. Design of Steel Structures by K. S. Sai Ram, Pearson Education, New Delhi.

5. Limit state design of steel structures as per IS 800/2007. by S. Kanthimathinathan. I.K. International Publishing House, New Delhi
6. Relevant Indian Specifications, Bureau of Indian Standards, New Delhi
7. Limit state design of steel structure by Dr. V.L. Shah and Gore, Structure publication Pvt. Pune.

References:

1. Design of Steel Structure by Allen Williams
2. Practical Design of Steel Structure by Karuna Moy Ghosh, Whittles Publishing
3. Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi.
4. Teaching Resources Material for steel structures by INSDAG Kolkata

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/105/105/105105162/

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					

CEC602	Water Resources Engineering	20	20	40	60	2.5	--	--	100
		Teaching Scheme			Teaching Scheme				Total

Course Code	Course Name	(Contact Hours Per Week			(Contact Hours Per Semester)					Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
CEC602	Water Resources Engineering	03	-	-	39	-	-	-	39	03

Rationale:

India is an agricultural country where majority of population lives in villages so agricultural industry is the backbone of Indian economy. Being a tropical country with large temporal and spatial variation of rainfall and availability of rainfall only for three to four months, irrigation is strongly needed in India. To satisfy this need, enhancing the irrigation facilities in the country is required. This course provides necessary knowledge and information about various irrigation methods as well as water requirements of crops, hydrologic processes, control level fixation of dams and reservoirs and hydraulics of wells. In addition to this, it provides necessary knowledge about analysis and design of gravity dams and earthen dams, different silt theories related to irrigation channels, detailed classification of canal head-works and its distribution system and finally discusses about different canal structures and cross drainage works.

Course Objectives: Five Course Objectives

1 To study different irrigation engineering methods and water requirement of crops.

2 To study hydrological cycle, its elements and plotting of hydrographs.

3 To study and calculate discharge from aquifers.

4 To study control level fixation for reservoir, Dams i.e., gravity dam, its various components and analysis and suitable conditions of earthen dam and its seepage analysis.

5 To study importance of silt theories and its design considerations.

6 To study Canal headwork, its distribution system and design of canal structures.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Describe National water Policy, Calculate Crop water requirement and Classify various types and methods of irrigation.

2. Estimate flood discharge and Runoff by traditional and modern usage tools for planning and management of water resources projects.

3. Apply knowledge on ground water, well hydraulics to estimate the safe yield and ground water potential

4. Analyze and design gravity dams and earthen dams with spillways for sustainable development

5. Compare different silt theories related to irrigation channel and design the same.

6. Classify and Explain various canal structures and suggest remedial measures for water logging to save fertile irrigation

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Irrigation Methods and Water Requirement of Crops	National water policy. Introduction to irrigation and need of irrigation, Benefits of irrigation and ill effects of irrigation, types of Irrigation Projects: minor, medium and major irrigation projects and National water	07	CO1

		policy. Methods of Irrigation Systems: Surface irrigation and different techniques of water distribution for surface irrigation, Subsurface irrigation, sprinkler irrigation and drip irrigation. Water Requirement of Crops: Crops and crop seasons in India, delta and duty of crops, relationship between delta and duty of crops. Soil water relationship and its significance from irrigation considerations, root zone soil water, infiltration, consumptive use, frequency of irrigation.		
II	Hydrology	Hydrologic cycle, Precipitation: Forms and Types of precipitations. Measurement of rainfall by rain gauges and stream flow measurement. calculation of missing rainfall data and adequacy of rain gauge stations. Runoff: Runoff- factors affecting runoff, computation of runoff, yield of the catchment runoff hydrograph, flood discharge and its calculations. Hydrograph: Flood hydrograph- Its components and base-flow separation, Unit hydrograph, application of unit hydrograph, methods of deriving unit hydrograph, S-hydrograph and its application.	07	CO2

III	Ground Water and Well Hydraulics	Ground water resources and occurrence of ground water. Well hydraulics: steady state flow conditions in wells. Equilibrium equations for confined and unconfined aquifer. Aquifer tests. Difference between open well and tube well, Well Losses	05	CO3
IV	Dams and Spillways	Reservoir, various zones of storage reservoir, control level fixation for a reservoir. Introduction to reservoir sedimentation and control measures. Gravity Dams: Definition, typical cross section and components of gravity dam, forces acting on gravity dam, modes of failure of gravity dam, structural stability analysis of gravity dam, elementary and practical profile of gravity dam, low and high gravity dam, galleries in gravity dam – Function of gallery and different cross-sections of gallery adopted in practice, joints in gravity dam. control of cracking in concrete dams. Earthen Dam: Types of earthen dams and methods of construction of earthen dam, causes and failures of earthen dams, seepage line/phreatic line for different conditions and its location using graphical method, seepage control through embankment and through	09	CO3

		foundations. Spillways: Introduction, types of spillways – its working and functionality.		
V	Irrigation Channels (Silt Theories)	Kennedy's theory and method of channel designs silt supporting capacity according to Kennedy's theory. Lacey's regime theory and application of Lacey's theory for designing channel cross-section. Comparison between Kennedy's theory and Lacey's theory. Drawbacks of Kennedy's theory and Lacey's theory. Introduction to sediment transport in channels.	06	CO5
VI	Canal Headwork-Distribution System and Canal Structures	Canal Headwork and Distribution System: Classification of canals, canal alignment, canal losses, canal lining, water logging and remedial measures for water logging. Canal Structures Canal Falls and types of canal falls, canal escapes and types of canal escapes, canal regulators and types of canal regulators, canal outlets and types of canal outlets, cross drainage works and types of cross drainage work.	05	CO6

Text Books:

1. Irrigation and Water Power Engineering: B.C. Punmia, PandeB.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi
2. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-9789383656899.

3. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
4. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: S. K. Sharma, S. Chand and Co

References:

1. Theory and Design of Irrigation Structures: R. S. Varshney and R, C. Gupta, Nem Chand
2. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
3. Design of Small Dams: USBR.
4. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
5. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/105/105/105105110/
2	https://archive.nptel.ac.in/courses/105/104/105104103/

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	
CEC603	Geotechnical Engineering-II	03	-	-	39	-	-	-	39	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC603	Geotechnical Engineering-II	20	20	40	60	2.5	--	--	100

Rationale :

Basic knowledge of analysis and design of foundations is very important for all civil engineers, more so for geotechnical and structural engineers. Soil testing (both field and lab tests) and its analysis are not only compulsory prerequisites for the analysis, design and construction of any major structure but also holds lucrative consultancy work and job opportunities in the field of civil engineering. Immense research opportunities are also available in this field.

Course Objectives: Six Course Objectives

1. Students will gain knowledge of consolidation theory.
2. Students will evaluate the shear strength characteristics of the soil. Moreover, they would apply the knowledge for solving the related problems.
3. Students will analyze stability of slopes.
4. Students will analyze and evaluate lateral earth pressure.
5. Students will analyze and design shallow foundation.
6. Students will analyze and design deep foundation.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Evaluate the consolidation parameters for the soil.
2. Calculate the shear strength parameters for the soil.
3. Calculate the factors of safety of different types of slopes under various soil condition, analyze the stability of slopes.
4. Calculate lateral earth pressure under various soil condition.
5. Calculate bearing capacity of shallow foundations using theoretical and field methods.
6. Calculate load carrying capacity of individual as well as group of pile foundation using theoretical and field methods and pile settlement.

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Consolidation of soils	Compressibility & settlement, comparison between compaction & consolidation, concept of excess pore water pressure, initial, primary secondary consolidation, spring analogy for primary consolidation, consolidation test results, coefficient of compressibility, coefficient of volume change, compression, expansion, recompression indices, normally and over consolidated soils. Terzhaghi's theory of consolidation (no proof)- assumptions, coefficient of vertical consolidation, distribution of hydrostatic excess pore water pressure with depth & time, time factor, relationship between time factor and	06	CO1

		degree of consolidation, determination of coefficient of vertical consolidation, pre consolidation pressure. Final settlements of a soil deposit in the field, time settlement curve, field consolidation curve.		
II	Shear strength	Introduction, frictional cohesive strength, state of stresses in soil mass, principal stresses, determination of stresses on an inclined plane by using analytical and Mohr's circle method, important characteristics of Mohr's circle. Coulomb theory, Mohr-Coulomb theory- shear strength parameters; Mohr-Coulomb failure envelope- relation between major and minor principal stresses, total & effective stress analysis. Different types of drainage conditions UU, CU and CD: Direct shear test, Triaxial compression test, Unconfined compression test, Vane shear test; comparison between direct & triaxial tests, interpretation of test results of direct shear & triaxial shear tests stress-strain curves. Determination of	05	CO2

		shear strength of soil- pull out test and Introduction to liquefaction of Soils.		
III	Stability of Slopes	Introduction: Types of slopes, types of slope failures, factors of safety. Stability analysis of infinite slopes in i) cohesionless soil and ii) cohesive soil under a) dry condition, b) submerged condition and c) steady seepage condition along the slope. Stability analysis of finite slopes: i) Taylor's stability number ii) friction circle method iii) Swedish circle.	06	CO3
IV	Lateral Earth Pressure Theories	Introduction to Lateral Earth Pressure Theories: Concept of lateral earth pressure based on vertical and horizontal stresses, different types of lateral earth pressure. Rankine's earth pressure theory: i) assumptions, ii) active and passive states in cohesionless soil: effect of submergence, effect of uniform surcharge, effect of inclined surcharge iii) active and passive states in cohesive soil. Coulomb's wedge theory: i) assumptions, ii) active and passive states in cohesionless soil, iii) active and passive states in cohesive	08	CO4

		soil. Rehbann's Graphical Method (no proof). Culmann's Graphical Method (no proof)		
V	Shallow Foundations	Introduction: types of shallow foundations, definitions of different bearing Capacities. Theoretical methods of determining bearing capacity of shallow foundations: i) Terzaghi's theory: assumptions, zones of failure, modes of failure, ultimate bearing capacity equations for general and local shear failure, factors influencing bearing capacity: shape of footing and water table, limitations of Terzaghi's theory ii) Vesic's theory: bearing capacity equation I.S. Code Meth006Fd: bearing capacity equation. Field methods of determining bearing capacity of shallow foundations: i) standard penetration test and ii) plate load test	08	CO5
VI	Pile Foundations	Introduction to pile foundations: necessity of pile foundations, types of pile foundation. Theoretical methods of determining load carrying capacity of pile foundations: i) static formulae and ii) dynamic formulae. Field	06	CO6

		method of determining load carrying capacity of pile foundations: pile load test. Group action of piles, settlement of pile groups, negative skin friction		

Text Books:

1. Soil Mechanics and Foundation: Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications
2. Soil Mechanics and Foundation Engineering: K.R. Arora; Standard publishers and Distributors
3. Soil Mechanics and Foundation Engineering: V.N.S Murthy; Saitech Publications
4. Geotechnical Engineering: C. Venkatramaiah; New age International
5. Theoretical Soil Mechanic: K. Terzaghi; John Wiley and Sons

References:

1. Fundamentals of Soil Engineering: D. W. Taylor; John Wiley and sons
2. Relevant Indian Standard Specification Code: BIS Publications, New Delhi
3. Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House
4. Geotechnical Engineering: Purushothama Raj; Tata McGraw Hill Publications
5. Basic and Applied Soil Mechanic: Gopal Ranjan and A.S. Rao; New Age International

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_ce96/preview

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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	
CEC604	Environmental Engineering	04	-	-		-	-	-	52	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
CEC604	Environmental Engineering	20	20	40	60	2.5	--	--	100

Rationale:

Every civil engineer must be acquainted with the principles of public health engineering, purification of water, sewage collection, design of water and sewage treatment and develop rational approaches towards sustainable waste management via appropriate treatment and reuse. The course deals with the overall features and study of treatment of water, building drainage, rain water harvesting, sewage treatment processes and solid waste management. The course also lays emphasis on the knowledge of Air and Noise pollution.

Course Objectives: Six Course Objectives

1. To demonstrate the necessary knowledge and concepts in the fields of water supply and quality of water.
2. To impart necessary skill for the design and operation of various units of water treatment facilities.

3. To recognize the necessary knowledge of good plumbing system, building drainage and rainwater harvesting.

4. To demonstrate the necessary knowledge on domestic sewage and Sewerage system.

5. To develop a flow Content for sewage treatment and design its units.

6. To impart the basic understanding of Air pollution, noise pollution and solid waste so as to control its adversity on ambient environment.

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Analyse the quality of water and make outline of water Supply scheme.
2. Design the various units of water treatment plant and apply the advanced, miscellaneous treatments whenever necessary
3. Build service connection of water supply from main and building drainage system at construction site along with rain water harvesting layout.
4. Analyse and plan sewerage system along with test for sewer line.
5. Design the units of sewage treatment plant. Also, able to apply the knowledge of low cost treatment and stream sanitation
6. Understand air pollution, noise pollution and functional elements of solid waste management.

DETAILED SYLLABUS: total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Water Supply and Quality Of Water	Water supply: Water supply systems, water resources, types of intake structures, distribution systems of water and distribution layouts. Quality of water: Introduction to pure water: potable, wholesome, palatable, distilled, polluted and contaminated	04	CO1

		water, drinking water standards and characteristics of water, water borne diseases.		
II	Water Treatment	WTP: Typical layout of WTP, Aeration, Types of Aeration systems, sedimentation, types of settling, tube settlers, design of sedimentation tank. Coagulation and flocculation: Principle of coagulation, flocculation, Clari flocculator, coagulants aids. Filtration: rapid sand filters, operation, cleaning and back washing, Entire design of rapid gravity filter with under drainage system. Pressure filter: Construction and operation. Disinfection: Different methods of disinfection, chlorination and chemistry of chlorination, chlorine demand, free and combined chlorine, various forms of chlorine, types of chlorination. Numerical to calculate quantity of required chlorine doses. Advanced and Miscellaneous Treatments: Water softening by lime soda process and by base exchange method, Reverse Osmosis, Activated	15	CO2

		carbon, Membrane filtration, Removal of Iron and Manganese.		
III	Building Water Supply, Drainage and Rainwater Harvesting	Building water supply: Water demands, Per capita Supply, Service connection from main, Water meter. Building drainage: basic principles, traps-types, location and function, Systems of Plumbing, anti siphonic and vent pipes. Rainwater harvesting: Need for rainwater harvesting, Annual potential, Roof-top rain water harvesting. Numerical on annual rainwater harvesting potential.	04	CO3
IV	Domestic Sewage and Sewerage System	Sewage: Introduction to domestic sewage, and storm water, System of sanitation, Physical and chemical characteristics, decomposition of sewage, BOD, COD, numerical on BOD. MPCB norms for disposal of sewage effluent. Sewerage system: Systems of sewerage and their layouts: Separate, Combined and partially combined system, merits and demerits, self-cleaning velocity and non-scouring velocity, Sewer- Shape, hydraulic design of sewers, Laying and testing of sewers, manhole-	08	CO4

		location, necessity, types and drop manhole, ventilation		
V	Sewage Treatment	Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Primary treatment: Screening, Grit removal, Oil and Grease removal, settling tank. Secondary Treatment Methods: Trickling filter- Principle, Process description and Design of trickling filter. Activated sludge process (ASP) - Principle, Process description, Recirculation of sludge, (numerical), Sludge volume index. Introduction to Biological Treatment: Aerated lagoons, Oxidation ponds, oxidation ditches. Self-purification of natural waterbodiess: Oxygen economy, Disposal of treated effluent. Disposal of Raw and treated sewage on land and water, DO sag curve. Rural and Low-cost sanitation: Septic Tank and Soak Pit Operation, suitability and Design	15	CO5
VI	Air Pollution, Noise Pollution and	Air pollution: Composition of air, Quantification of air pollutants, Air		

	Municipal Solid Waste Management	quality standards, Effect of air pollution on Environment, Introduction to Air pollution control devices. Noise pollution: Basic concept and measurement, Effects of noise, and control methods, and numerical on sound level. Municipal Solid Waste Management: Sources, storage, treatment, disposal,5R Principles.	06	CO6

Text Books:

1. Water Supply Engineering: S. K. Garg, Khanna Publication.
2. Water Supply Engineering: P.N. Modi, Rajsons Publication
3. Water Supply and Sanitary Engineering: S.K. Hussain, Oxford & IBH Publication, New Delhi.
4. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
5. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan
6. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi
7. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian
8. Integrated solid waste management, Tchobanoglous. Theissen and Vigil, McGraw Hill Publication.

References:

1. Manual on Wastewater Treatment 3rd Ed. Pub: CPH and Env. Engg. Organization, Ministry of Urban Development, Govt. of India, New Delhi, 1991.
2. Plumbing Engineering, Theory and Practice: Patil S. M., Seema Publication, Mumbai.
3. Manual on Municipal Solid Waste Management: Ministry of urban development, New Delhi
4. Water Supply and Sewerage:E.W. Steel.
5. Manual on Water Supply and Treatment, (latest Ed.): Ministry of Urban Development, New Delhi.

6. Water supply and pollution control: J.W. Clark, W. Veisman, M.J. Hammer, International textbook company.
7. CPHEEO Manual on Water Supply and Treatment.
8. CPHEEO Manual on Sewage and Treatment.
9. Environmental Engineering: Peavy,H.S., RoweD.R., TchobanoglousG.; 1991, Tata Mcgraw Hill.

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/127/105/127105018/
2	https://archive.nptel.ac.in/courses/105/103/105103205/

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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	
CEL601	Design & Drawing of Steel Structures	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL601	Design & Drawing of Steel Structures	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To estimate the design loads on steel structures as per IS 875
2. To analyze the member forces by any suitable method.
3. To design the members for axial, flexure and shear forces.
4. To prepare the detailed design report and fabrication drawings by manual or CAD software.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Calculate dead, live and wind loads on the structure.
2. Analyze the structure by analytical/graphical method.
3. Use steel table for selecting appropriate section.
4. Design the members for various load combinations.
5. Design the bolted and welded connection
6. Read and Prepare the detailed fabrication drawing and design report.

The Project shall be given to a group of students consisting of not more than10 students.

Schedule	List of Projects	Hrs
Project I	Design and drawing of steel roof truss for industrial shed should consist of the following items.	
1	Introduction, problem statement, Calculation of panel point DL, LL, and WL on truss.	02
2	Analysis of truss by graphical method/ any software and calculation of design loads in members	02
3	Design of purlins, Principal rafter, Main Tie, Design of remaining members of truss. etc.	02
4	Design of bolted /welded connections and design of sliding and hinged supports including anchor bolts	02
5	To generate/draw fabrication drawings on full imperial size drawing sheet and design report on A4 size pages.	02
6	To generate fabrication drawings and design report including estimation of steel required.	02
Project 2	Design and drawing of floor beam system for steel building G+1 should consist of the following items	
7	Introduction, problem statement and to draw grid floor plan.	02
8	Calculation of DL, LL on slab, beams etc. and to analyze frame for BM and SF.	02
9	Calculation of design loads on columns and footing.	02
10	Design of beams, columns and footings	02
11	Design of beam end and beam-column connections.	02

12	To generate/draw fabrication drawings on Full imperial size drawing sheet and design report on A4 size pages.	02
13	To generate fabrication drawings and design report including estimation of steel required.	02

Text Books:

1. Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi

2. Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.

3. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. S., I.K. International Publishing House, New Delhi

4. Design of Steel Structures by K. S. Sai Ram, Pearson Education, New Delhi.

5. Limit state design of steel structures as per IS 800/2007. by S. Kanthimathinathan. I.K. International Publishing House, New Delhi.

6. Relevant Indian Specifications, Bureau of Indian Standards, New Delhi.

References:

1. Design of Steel Structure by Allen Williams
2. Practical Design of Steel Structure by Karuna Moy Ghosh, Whittles Publishing
3. Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi.
4. Teaching Resources Material for steel structures by INSDAG Kolkata.

Online Resources:

Sr. No.	**Website Name**
7.	https://archive.nptel.ac.in/courses/105/105/105105162/

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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	
CEL602	Water Resource Engineering	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL602	Water Resource Engineering	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1 To study different irrigation engineering methods and water requirement of crops.

2 To study hydrological cycle, its elements and plotting of hydrographs.

3 To study and calculate discharge from aquifers.

4 To study control level fixation for reservoir, Dams i.e gravity dam, its various components and analysis and suitable conditions of earthen dam and its seepage analysis.

5 To study importance of silt theories and its design considerations.

6 To study Canal headwork, its distribution system and design of canal structures.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1 Classify various techniques of water distribution and compute water requirement of crops.

2 Discuss in detail about hydrological process and interpret plotting of hydrographs.

3 Apply their knowledge on well hydraulics and compute discharge from an aquifer.

4 Classify and describe various hydraulic structures such as dams and carry out its analysis for structural stability.

5 Compare different silt theories related to irrigation channel and design the same.

6 Identify and classify different canal head works - its distribution system and canal structures.

List of Experiments.

Sr No	List of Assignments / Tutorials	Hrs
1	Assignment no 1: Irrigation projects in India and Numerical based Water requirement of crops.	02
2	Assignment no 2: Numerical based on missing data, hydrographs.	02
3	Assignment no 3: Numerical based on yield of aquifer.	02
4	Assignment no 4: Numerical based on stability of gravity dam, seepage line (earthen dam)	02
5	Assignment no 5: Numerical based on Silt Theories	02
6	Assignment no 6: Case study on different canals in India and abroad.	02
Model Preparation		
1	Prepare a model for any one water distribution technique referring to introductory chapter.	06
2	Prepare model for Dam (Gravity or Earthen Dam).	

Text Books:

1. Irrigation and Water Power Engineering: B.C. Punmia, PandeB.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi.

2. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-9789383656899.

3. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.

4. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.

5**.** Design of Irrigation Structures: S. K. Sharma, S. Chand and Co.

References:

1. Theory and Design of Irrigation Structures: R. S. Varshney and R, C. Gupta, Nem Chand

2. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley

3. Design of Small Dams: USBR.

4. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.

5. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.

Online Resources:

Sr. No.	**Website Name**
1	https://archive.nptel.ac.in/courses/105/105/105105110/
2	https://www.youtube.com/watch?v=fx1uUek3Iqg&t=3s

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	
CEL603	Geotechnical Engineering-II	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL602	Geotechnical Engineering-II	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To study consolidation characteristics of soil.
2. To study and examine shear strength parameters of soil.
3. To Study and determine the strength of sub-grade soil. To Study and determine swelling pressure of soil. To gain the knowledge of stress distribution in soil.
4. To gain the knowledge of various geotechnical software.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Determine consolidation parameters such as coefficient of compressibility, coefficient of volume change, coefficient of consolidation.
2. Determine cohesion and angle of shearing resistance for various soil types.
3. Determine the CBR value of soil for pavement design.
4. Determine swelling pressure of soil.
5. Understand the concept of stress distribution in soils due to vertically applied load.
6. Solve design problems using geotechnical software

List of Experiments.

Sr No	List of Experiments (Minimum Five)	Hrs
1	Determination of pre-consolidation pressure and coefficient of consolidation from one dimensional consolidation test	2
2	Determination of shear strength parameters using direct shear test	2
3	Determination of shear strength parameters using unconsolidated undrained tri-axial compression test	2
4	Determination of undrained cohesion using unconfined compression test	2
5	Determination of shear strength of soft clays by vane shear test	2
6	Determination of CBR value using CBR test	2
7	Determination of swelling pressure of clays	2

Text Books:

1. Engineering Soil Testing: Shamsher Prakash, P.K. Jain; Nem Chand & Bros

2.Soil Testing for Engineers: William T. Lambe; John Wiley and Sons, Inc.

3.Soil Mechanics Laboratory Manual: Brij Mohan DAS; Oxford University Press Inc.

4. Soil Mechanics in Engineering Practice: Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri; John Wiley and Sons, Inc.

References:

1. Soil Mechanics and Foundations: Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar; Laxmi Publications

2.Soil Mechanics in Theory and Practice: Alam Singh; Asia Publishing House

3. Soil Mechanics and Foundation Engineering: V. N.S. Murthy; Saitech Publications

4. Relevant Indian Standard Specifications Code: BIS Publications; New Delhi

Online Resources:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_ce96/preview

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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	
CEL604	Environmental Engineering	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL604	Environmental Engineering	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To analyse engineering skill related to water and wastewater sample.
2. To apply decision related to treatment of water and wastewater based on standards.
3. To understand the fundamental characteristics of municipal solid waste.
4. To acquire knowledge on the severity of air pollution and suggest remedies and preventive measures.
5. To understand the basic concepts of noise and its measurement.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Impart the knowledge on quality or characteristic of water and wastewater sample.

2. Interpret the required treatment for water and wastewater based on standards and norms.
3. Impart the knowledge on quality of solid waste.
4. Measure the concentration of particulate matters, dust and dispersed pollutants in air.
5. Inspect the levels of noise and interpret the results.

List of Experiments.

Sr No	List of Experiments (Minimum Eight)	Hrs
01	Determination of pH of water/ sewage sample /solid waste.	2
02	Determination of Turbidity in water sample.	2
03	Determination of Total Solids, suspended solids, dissolved solids, volatile solids.	2
04	Determination of chlorides.	2
05	Determination of Optimum dose of coagulant by using Jar Test.	2
06	Determination of Dissolved Oxygen	2
07	Determination of Residual chlorine	2
08	Determination of air quality using High Volume air Sampler.	2
09	Determination of Level equivalent of Noise	2
10	Determination of Bio Chemical Oxygen Demand of sewage sample	2
11	Determination of Chemical Oxygen Demand of sewage sample	2
12	Determination of moisture content of solid waste.	2

Text Books:

1. Water Supply Engineering: S. K. Garg, Khanna Publication.
2. Environmental Engineering Vol II: Garg, S. K., Khanna Publishers New Delhi.
3. Water Supply Engineering: P.N. Modi, Rajsons Publication.
4. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.

References:

1. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan.
2. CPHEEO Manual on Water Supply and Treatment.
3. CPHEEO Manual on Sewage and Treatment.

Online Resources:

Sr. No.	Website Name
1	https://ee1-nitk.vlabs.ac.in/
2	https://ee2-nitk.vlabs.ac.in/

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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	
CEL605	Skill Based Lab Course-III	--	--	3	--	--	45	--	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL605	Skill Based Lab Course-III	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To Provide hands on training on analysis, modelling and design of R. C. C. Framed structure and Steel structure.
2. To prepare the database and perform its statistical analysis using relevant software.
3. To understand and apply the basic functions of excel for data analysis, preparation of programs and generation of reports having mathematical and pictorial representation.
4. To design reliable and sustainable transportation systems.
5. To evaluate the demand of water for given population and create the proper distribution system.
6. To Apply the basic knowledge of various computer languages to create the programme pertaining to civil engineering domain.

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Lab Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. To understand the functions involved various softwares related to civil engineering field.

2. To perform different functions of the software related to analysing modelling and designing the structure, creation of database and its analysis.
3. To describe and represent the data obtained from site, experimental work in various formats as per industrial requirements
4. To import road geometric design into the software as well as relate with the design standards applied into the software.
5. To design the effective distribution network system for the distribution of water resources.
6. To apply the knowledge to create the programme in excel and various computer languages for solving problems pertaining to civil engineering field.

Detailed Syllabus.

Sr No	List of Experiments (Minimum Eight)	Hrs
Analysis, Modelling and Design of structure using professional software		15
1	Introduction to structural engineering software. Study of basic commands and tools	3
2	Analysis of determinate and in-determinate structure. Extraction of shear force and bending moment diagram for given structure manually as well using software	3
3	Developing a model of simple plan of a building (square or rectangular)	3
4	Analysis of frames – R. C. C. framed structure	3
5	Analysis of frames – Steel structure	3
Preparation and analysis of database using open-source software		3
6	Introduction to statistical software – Basic function required for preparing database, statistical analysis of the data and its representation	2
Excel		2
7	Introduction to Excel – Basic function required for preparing database, statistical analysis of the data and its graphical representation a. Creation of database of result obtained from Traffic volume survey and its analysis b. Creating database of results obtained from laboratory experiments and its analysis	03

8	Preparation of programme using various functions in excel or any other relevant exercise in civil engineering field 1. Mix design of concrete 2. Design of pavement 3. Design of structural members	03
9	Preparation of checklist for various items of work in building construction for quality control, Preparation of various reports like Daily progress report, Daily Labour report, Weekly progress report, Weekly Labour report, Geotechnical reports, Audit reports	03
10	Use of transportation engineering related software for creation of contour, creation of cross section, setting horizontal and vertical alignment and calculation of cut and fill	03
11	Use of open-source software for designing and simulation of water distribution network	03
Programming using open-source software C or C++ or java or python		06
12	Introduction to programming software, Basics commands and tools for development of programme related to civil engineering field	03
13	Programming for Civil Engineers with content related to any domains of Civil Engineering problem solving using programming software.	

Text Books:

1. Excel with Microsoft Excel: Comprehensive & Easy Guide to Learn Advanced MS Excel Paperback – 1 January 2019 by Naveen Mishra (Author); Publisher: Penman Books; Publication date: 1 January 2019; ISBN-10: 9389024153; ISBN-13: 978-9389024159.

2. Publication date: 1 January 2019; ISBN-10: 9389024153; ISBN-13: 978-9389024159 Structural Modeling, Analysis & Design Using Staad Pro Software Paperback – 15 October 2015 by Vignesh Kumar M (Author); Publisher: LAP Lambert Academic Publishing; Genre: Business & Economics; ISBN: 9783848447671, 9783848447671

3. Discovering Statistics Using SPSS for Windows: Advanced Techniques for the Beginner; By Andy P. Field; Publisher:Sage Publications; ISBN:9780761957553, 0761957553.

References:

1. Quality Management in Construction Projects; By Abdul Razzak Rumane; Copyright Year 2018; ISBN 9780367890032; Published December 10, 2019 by CRC Press

2.Introduction to Machine Learning with Python: A Guide for Data Scientists Paperback – 7 October 2016; by Andreas C. Mueller (Author), Sarah Guido (Author); ISBN-10: 1449369413; ISBN-13: 978-1449369415, 1st Edition; Publisher O ′Reilly

Online Resources:

Sr. No.	Website Name
1	https://www.youtube.com/watch?v=WITGMxs2x68&pp=0gcJCf0Ao7VqN5tD

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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	
CEL606	Mini Project -2B	--	--	3	--	--	45	--	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL606	Mini Project -2B	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

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

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1. Identify problems based on societal /research needs and formulate a solution strategy

2. Apply fundamentals to develop solutions to solve societal problems in a group.

3. Analyze the specific need, formulate the problem and deduce the interdisciplinary approaches, software-based solutions and computer applications.

4. Develop systematic flow chart, evaluate inter disciplinary practices, devices, available software, estimate and recommend possible solutions.

5. Draw the proper inferences from available results through theoretical/experimental/simulations and assemble physical systems.

6. Create devises or design a computer program or develop computer application.

- **Guidelines for Idea Lab**

  Expected outcome is Software based, "A Computerized Model/ A software/ A computer program, an IOT application or A Computer or Mobile based application ".

  Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity. Students should find 'List of Idea Lab problems' in University web portal www.mu.ac.in, and in consultation with faculty supervisor/head of department/internal committee of faculties select the title. Students shall submit implementation plan in the form of Gant/PERT/CPM chart, which will cover weekly activity of mini project. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor. Students shall convert the best solution into A Computerized Model/ a software/ A computer program, an IOT application or A Computer or Mobile based application using various components of their domain areas and demonstrate. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that Students come out with original solution. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

List of approved problems for Idea Lab
S501: Development for Mobile App for Smart Traffic Management System Using Internet of Things
S502: Development for Mobile App for IoT based smart traffic signal monitoring system using vehicle Count.
S503: Development of (AI Based) software or mobile App. To identify quantity of (bricks, pipes, bars etc.) from photograph.
S504: Development of (AI Based) software or mobile App. To identify size of cracks in distressed structure from coin aimed photograph.
S505: Development of (AI Based) software or mobile App. To identify size of cracks in distressed structure.
S506: Development of (AI Based) software or mobile App. For Assessment of Irrigation Water Quality Index.
S507: Development of (AI Based) software or mobile App. For Ground Water Quality monitoring in industrial zone.
S508: Development of (AI Based) software or mobile App Advanced Earthquake Resistant Techniques
S509: Development of Remote Monitoring System For Civil Engineering projects.
S510: Application of Geographic Information system using Quantum GIS software.
S511: Development of (AI Based) software or mobile App for Building Information Modelling using ArchiCAD/ Revit architecture software.
S512: Development of (AI Based) software or mobile App Digitization of Slump cone Test.
S513: Development of (AI Based) software or mobile App Digitization of other mechanical Tests.

S514: Development of (AI Based) software or mobile App Civil Engineering quantity calculator.
S515: Development of (AI Based) software or mobile App Digitization of Non-destructive testing of concrete-various methods.
S516: Development of (AI Based) software or mobile App Mapping of area using Total Station and plotting the same on 3-d drafting.
S517: Preparation of Excel VBA sheet for solving Survey, Soil Mechanics, Structural Analysis problems
S518: Development of (AI Based) software or mobile App Smart street lights and fault location monitoring in the cloud over IoT
S519: Development of (AI Based) software or mobile App IOT based smart irrigation system
S520: Development of (AI Based) software or mobile App Smart cities: Traffic data monitoring over IoT for easy transportation/alternative route selection
S521: Development of (AI Based) software or mobile App Dam gate level monitoring for water resource analysis and dam gate control over IoT
S522: Development of (AI Based) software or mobile App Smart colony: RFID based gate security system, street lights, and water pump automation.
S523: Development of (AI Based) software or mobile App Agriculture automation using GSM (soil moisture level control and motor control)

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course -2 Rock Mechanics	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

The Civil Engineering structures are built on or through rocks. The design of structures depends on the rock mass properties and the interaction between the rock and the structure. This demands the study of deformation resulting from the strain of rocks in response to various stresses working on them. The mechanisms and character of the deformation of rocks can be investigated through laboratory experiments. The course will give an idea of in- situ testing of the rock and observation of geological conditions that can affect the way a rock behaves when subjected to loads and stresses.

Objectives

1 To provide basic knowledge of Rock -Mechanics to understand design aspects of various structures on or through rocks.

2 To study the various classification schemes of rock masses and their application.

3 To study the physical properties of rocks and various lab test conducted on them to determine the strength.

4 To determine properties and behavior of various types of rock under different loading conditions.

5 To study bearing capacity, stress distribution and factor of safety within the rock.

6 To study the stability of rock slopes and design aspects of openings in/on the rocks.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Structural Geology and Data Interpretation**		05
	1.1	Introduction to Rock Mechanics and Importance	
	1.2	Geological classification of rocks	
	1.3	Description of discontinuities and their effect on rocks	
	1.4	Stereographic Analysis of structural Geology	
2	**Engineering Classification of Rocks and Rock Masses:**		06
	2.1	Classification of intact rocks. Rock mass classifications: Rock Quality Designation (RQD), Rock Structural Rating (RSR), Rock Mass Quality (Q system).	
	2.2	Strength and Modulus from classifications, classification based on Strength and Modulus.	
	2.3	Geo-mechanics (RMR)} and Geo-engineering classification	
	2.4	Deere and Miller's Engineering Classification	
3	**Laboratory Testing of Rocks: Field and Laboratory Tests on Rocks**		07
	3.1	Determination of physical properties of rocks	
	3.2	Uniaxial Compressive Strength Test	
	3.3	Tensile Strength Test	
	3.4	Direct Shear Test and Triaxial Test	
	3.5	Slake Durability Test	
	3.6	Schmidt Rebound Hardness, Swelling Pressure and Free-Swell, Void Index, Hydraulic fracture, Flat Jack Test	
	Strength, Modulus and Stress-Strain Responses of Rocks:		
	4.1	Factors influencing rock responses, Strength criteria for isotropic intact rocks, Modulus of isotropic intact rocks.	

4	4.2	Uni-axial Compressive Strength of intact anisotropic rocks, Strength due to induced anisotropy in rocks, Compressive Strength and Modulus from SPT.	**07**
	4.3	Stress- strain models (constitutive models, elastic stress-strain model, elastic-plastic stress-strain model, Visco-elastic Model.	
5	**Bearing Capacity of Rocks:**		**06**
	5.1	Estimation of bearing capacity (foundation on intact rock, heavily fractured rock), UBC with Hoek-Brown criterion, foundation on slope	
	5.2	Stress distribution in rocks, Factor of safety, strengthening measures (concrete shear keys, bored concrete piles, tensioned	
		cable anchors, concrete block at toe),	
	5.3	Settlement in rocks (from joint factor, for horizontal joints, from field tests).	
6	**Stability of Rock Slopes & Opening in Rocks**		**08**
	6.1	Modes of failure, rotational failure, plane failure, wedge method of analysis, buckling failure, toppling failure, application of stereographic projection, Remedial measures.	
	6.2	Rock Bolting and Grouting: Methods to improve rock mass responses, grouting in rocks, objectives, contact grouting, consolidation grouting, process of grouting, grout requirement, types of grout, stage grouting, grout curtain. Rock Bolting Rock anchors.	
	6.3	Tunneling: Ground conditions in tunneling, Computing structural discontinuities in rock masses, requirement of lining in tunnels, pressure tunnels and tunnels for other purposes, application of stereographic projection.	
		Total	**39**

Recommended Books:

1 Introduction to Rock Mechanics: Goodman, RE (1989), Canada, Jhon Wiley & Sons.
2 Rock Slope Engineering, Hoek, E and Bray, JW (1977), The Institution of Mining and Metallurgy, London.
3 Rock Mechanics and Design of Structures on Rock: *Obert, Leon and W. I. Duvall*.
4 Engineering Rock Mass Classification, Singh, B and Goel RK (20011), Oxford, UK, Elsevier Inc.

Reference Books:

1 Rock Mechanics in Engineering Practice: *K. G. Stagg and O. C. Zienkiewicz*, John Willey and Sons, New York.

2 Rock Mechanics – Vol. I and II: *Jumukis*, Trans Tech Publication, USA.

3 Fundamentals of Rock Mechanics: Jaeger, JG, Cook, NGW and Zimmerman, RW (2007) 4 th Ed., Singapore, Blackwell Publishing

4 Rock Mechanics and Design of Structures on Rock: Obert, Leon and W. I. Duvall.

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course - 1 Biological Process and Contamination Removal	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Biological treatment processes are widely used in both developed and developing countries to control and accelerate the natural process of organic matter decomposition. The process is often used to treat biodegradable waste materials released from domestic, commercial and industrial sources before they are disposed of. However, it is also observed to further treat the wastewater for contamination removal in order to remove and treat toxic materials. The course deals with the overall features and study of biological treatments of wastewater and contamination removal. The course lays emphasis on complete updates of these processes and knowledge related to design of treatment units.

Objectives

1 To understand quality, quantity, characteristics and treatment process of wastewater generated from various sources
2 To understand the biological process and treatment of wastewater.
3 To provide students the necessary knowledge and concepts of advancements/ emerging techniques of Microbial Growth Kinetics, Utilization of soluble substrate and biotechnological remedies
4 To study and design the aerobic decomposition and its application in Aerobic Suspended

Growth Biological Treatment Systems.

5 To study and design the anerobic decomposition and its application in wastewater treatment.

6 To develop rational approaches towards natural and biotechnological methods for contamination removal.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Waste Water Generation, Collection and Conveyance**		08
	1.1	Introduction: Domestic waste water, Industrial Wastewater and Stormwater, Conservancy and Water carriage system, Systems of sewerage, Quantity and Quality of Wastewater.	
	1.2	Need for Analysis, Characteristics of wastewater: Analysis of wastewater, Characteristics of wastewater and sampling, Composition, Biochemical characteristics, aerobic decomposition, anaerobic decomposition,	
	1.3	Waste Water Treatment and Flow diagram: Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Waste Water Treatment Plant and Effluent Treatment Plants. Various combinations and options. Low-cost treatment plant.	
2	**Introduction to Biological Treatment:**		03
	2.1	Overview of biological wastewater treatment, objectives of the treatment, role of microorganisms, types of biological processes for wastewater treatment, suspended and attached growth systems.	
3	**Microbial Growth Kinetics**		06
	3.1	Microbial Growth Kinetics terminology, rate of utilization of soluble substrates, rate of biomass growth with soluble substrate, rate of oxygen uptake, effects of temperature, total volatile suspended solids and active biomass, net biomass yield and observed yield.	

	3.2	Biotechnological remedies - Bio-fertilizers, Physical, chemical and Microbiological factors of composting, Health risk – Pathogens, Odor management, Microbial cell/enzyme technology, Adapted microorganisms, Biological removal of Nutrients.	
4	**Aerobic Decomposition:**		**08**
	4.1	Aerobic Suspended Growth Biological Treatment Systems: Aerobic biological oxidation, process description, environmental factors, Modifications of ASP: Complete Mix activated sludge, Extended Aeration system, Oxidation Ditch systems, Oxygen activated sludge, Oxidation ponds, Stabilization ponds, Aerobic attached Growth Biological Treatment-Trickling Filter.	
	4.2	Design of ASP, Trickling Filter, Oxidation Pond, Oxidation Ditch and Aerated lagoons.	

5	**Anaerobic Decomposition:**		**08**
	5.1	Anaerobic Decomposition: Mechanism of anaerobic fermentation – a multistep process, Microbiology and Biochemistry of Anaerobic processes, Substrate inhibition, Stuck reactors, Standard rate, High rate and Multistage anoxic digesters. Introduction to UASB.	
	5.2	Design of anaerobic treatment units: Anaerobic Lagoons	
6	**Natural and Biotechnological Methods of Contamination Removal:**		**06**
	6.1	Natural Treatment Systems: Development of natural treatment systems, Rapid infiltration systems, Overland Flow systems, constructed wetlands, Floating aquatic plant treatment systems. Introduction to engineering Fundamentals of Biotechnology. Heavy Metal Removal using advance treatment methods – Membrane filtration, Reverse Osmosis and Ion exchange.	
		Total	**39**

Recommended Books:

1 Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, T.M.H. Edition, New Delhi, 1995.
2 Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi.
3 Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
4 Wastewater Treatment for Pollution Control and Reuse by Soli. J Arceivala (Author), Shyam. R Asolekar.
5 Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
6 Water Supply and Sewerage: E.W. Steel.
7 Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
8 Introduction to Environmental Engineering: P. Aarne Vesilind, Susan M. Morgan, Thompson.
9 Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
10 Basic Principles of Wastewater Treatment Book by Marcos Von Sperling.

Reference Books:

1 Manual on Wastewater Treatment 3rd Ed. Pub: CPH and Env. Engg. Organization, Ministry of Urban Development, Govt. of India, New Delhi, 1991.
2 CPHEEO Manual on Sewage and Treatment.
3 Relevant Indian standard specifications and BIS publications.
4 Handbook of Water and Wastewater Treatment Plant Operations Book by Frank R. Spellman

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course-2 Construction Equipment & Techniques	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Machines have revolutionized every sphere of human being's life. Engineering constructions also have seen a drastic reformation due to introduction of various construction equipment and techniques. This course provides an extensive overview of advanced equipment used in construction industry and also discusses certain methods/techniques used to construct facilities using these equipments. It makes the student aware of the equipment/techniques required while constructing different kinds of civil engineering structures. Student will be introduced to some emerging technologies in the field of Civil engineering which will make them more industry ready.

Objectives

1 To understand the characteristics and complexities involved in large civil engineering projects so that the equipment/technique requirements of a project can be listed out.

2 To know the various conventional techniques/equipments used in civil engineering projects.

3 To get acquainted with the modern equipments/techniques which have replaced the conventional ones.

4 To select the appropriate equipment/techniques in construction for large and heavy engineering projects on the basis of suitability, availability, productivity, output, initial and operation

cost, savings in time and other resources, etc.

5 To understand the characteristics and complexities involved in large civil engineering projects so that the equipment/technique requirements of a project can be listed out.

6 To know the various conventional techniques/equipments used in civil engineering projects.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		06
	1.1	Equipment v/s Labour, Standard and Special equipments, Types of costs related to equipments including related numerical, Equipment life and Replacement decisions including related numerical, Cycle time, Balancing of equipments and related numerical.	
	1.2	Different categories of construction equipments used conventionally with reference to available types and their output, working mechanism, factors affecting their performance and criteria for selecting a particular equipment: Earthmoving and other hauling equipment, Pavers for road construction. Numbering and Record maintaining of Earthmoving and other hauling equipment's; Pile driving equipment; Applications of Air compressor. Dewatering techniques for trenches; Stone crushing equipment.	
	Underground & Underwater Tunnelling		
	2.1	Various purposes for which tunnelling may be carried out, Basic terms related to tunnelling. Conventional methods of carrying out tunnelling in different types of soils/rocks. Methods for dewatering tunnels.	

2	2.2	Detailed Procedure for underwater tunneling. Modern methods of tunnelling and detailed study of following equipments/ techniques in this regard. Use of drones, construction robots for aerial surveys. Use of GPS and remote sensing for setting out tunnel alignment. Jumbo – used for drilling and blasting, Blasting Techniques for quarrying stones for construction purpose. Diaphragm wall construction and other ground stabilization methods. Vertical shaft sinking machine (VSM). Tunnel Boring machine (TBM), Micro tunneling. New Austrian tunnelling method (NATM). Cut & cover method, Top to bottom construction. Tunnel lining trolley. Tunnelling for Metro projects. Difference in Tunnelling for Roads and Metros.	**09**
3	**Modern Formwork Systems and Working Techniques in Limited Space**		**06**
	3.1	Difference in conventional and modern systems of formwork Mivan, Doka shuttering along with their advantages and disadvantages. Modular shuttering, Slip and jump form.	
	3.2	High rise construction: Concrete making on mass scale, pumping and placing booms. Tower cranes and the benefits they offer for high rise construction. Range diagram.	
	3.3	Prefabricated housing systems, Difficulties faced in the installation and operation of all these systems. Emergency housing for disaster management.	
	3.4	Working skills/tricks required for managing a site in urban/restricted space environment. Techniques for controlled demolition of buildings.	
4	**Equipments For Laying of Utility Lines, Bridge Construction & Installation of Structural Steel Members.**		**06**
	4.1	Use of ground penetrating radar (GPR) for locating underground utilities. Laying of pipes using pipeline insertion system. Installation and operation of underground power transmission lines as well as overhead transmission towers.	
	4.2	Incremental launching method and balanced cantilever method of bridge/flyover construction with reference to the recent infrastructure developed in the local and global context.	

	4.3	Equipments/techniques used for connecting structural steel components of bridge decks, terminals, malls, stadiums, car sheds, etc.	
5	**Equipments/ Techniques for Setting Up of Power Generation/Supply Structures.**		**06**
	5.1	Hydropower station. Tidal power plants. Desalinization plants. Thermal power station. Solar power station. Atomic power generation. Installation and operation of wind mills. Construction of a fuel station.	
6	**Equipments/ Techniques for Construction of Transporting Facilities**		**06**
	6.1	Construction of railway lines using track laying machine. Methods, techniques and equipments involved in the construction of Metro, mono and maglev trains. Connecting link between underground and overhead metro systems. 5D BIM integration in Metro projects.	
	6.2	Equipments required for construction and operation of an airport and sea port. Application of Drones, GIS, GPS and BIM for monitoring project progress/working of Airports and Seaports. Piling Equipment's for Jetty Construction.	
	6.3	Light Detection and Ranging (Lidar) Technique for Railways/ Highways/ Bullet train alignments.	
		Total	**39**

Reference Books:

1 Design and Construction of Nuclear Power Plants Rüdiger Meiswinkel, Julian Meyer, Jürgen Schnell Wiley Publishers
2 Energy and Power generation handbook K.R Rao ASME Press
3 Magnetic Levitation Hyung-Suk Han Dong-Sung Kim Springer
4 Metro Rail Projects in India M Ramachandran Oxford
5 BIM Handbook Eastman,Teicholz,Sacks,Liston John Wiley and Sons
6 IRC:43-2015 Recommended Practice for Plants, Tools and Equipment Required for Construction and Maintenance of Concrete Roads (First Revision).
7 IRC-2018 Pocket book for Road Construction Equipment.
8 IRC: SP-97- 2013 Guidelines on Compaction Equipment for Roads Works

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course -2 Urban Infrastructure Planning	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Indian cities are currently expanding at a rapid rate, and are therefore facing immense pressure for the improvement of their services and infrastructure. Without coordination and planning for the anticipated spatial growth and densification, the infrastructure services are neglected. Such growth areas can become under-serviced places of the cities, one from which many problems of the city stem: water, sanitation and waste problems, uncontrolled pests, and crime due to poor access to water and sanitation services. To address the emerging issues of urban centre, there is a pressing need to train urban infrastructure specialists who can comprehensively plan for city's growing infrastructure needs and formulate projects for efficient infrastructure service delivery for existing areas. There are ample urban infrastructure challenges and opportunities in terms of planning; effective policy, program and project formulation for well-trained young urban infrastructure professionals with specific domain knowledge

Objectives

1 Describe an infrastructure system using accurate terminology;

2 Demonstrate an understanding of the main concepts and principles of infrastructure planning;

3 Identify the key features of a sustainable infrastructure system and explain how they

promote sustainable development;

4 Apply analytical tools for infrastructure planning;

5 Critically evaluate infrastructure cases/projects/proposals through the lens of sustainability;

6 Identify the gaps between theoretical principles of sustainable infrastructure and their application in practices.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Planning**		04
	1.1	Origins and growth of cities, effects of cultural influence on physical form; Human settlements as an expression of civilizations; Basic elements of the city; Concepts of space, time, scale of cities.	
	1.2	Contribution of housing to micro and macro economy, contribution to national wealth and GDP, housing taxation, national budgets, fiscal concessions; need of affordable housing for urban poor, concept of RERA	
2	**Urban Economics**		06
	2.1	General introduction to principles of economics and public finance. Importance of economics in Urban Development and Planning	
	2.2	Industrial location policies, any other economic activity base policies and their impact on urban development, Role of land economics in preparation of Urban Development plans. Relevant case studies of Urban Land Economics.	
	2.3	Economic growth and development, quality of life; Human development index, poverty and income distribution, employment and livelihood; Economic principles in land use planning; Policies and strategies in economic planning, balanced versus unbalanced growth, public sector dominance; changing economic policies, implications on land.	
	Infrastructure Planning		

3	3.1	Role of Infrastructure in Development, Elements of Infrastructure (physical, social, utilities and services); Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, provision of infrastructure, and land requirements; Principles of resource distribution in space; Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc.	**12**
	3.2	Zoning, Various growth patterns of town, Housing layouts and road networks in town, Urban aesthetics and landscaping, MRTP and Land Acquisition Acts	
		Planning and Management of Water, Sanitation and Storm Water; Water – sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning	
		provisions and management issues; Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, institutional arrangements, planning provisions and management issues. Storm water – rainfall data interpretation, points of water stagnation, system of natural drains, surface topography and soil characteristics, ground water replenishment, storm water collection and disposal, norms and standards, institutional arrangements, planning provisions and management issues;	
	3.3	Solid Waste Disposal and Management Basic principles, generation, characteristics, collection, disposal, management	
	3.4	Fire and Electrification, and Social Infrastructure Planning for fire protection, services and space standards, location criteria; Planning for Education, health, civic, cultural infrastructure and facilities for transport and other miscellaneous infrastructure services	
	3.5	Planning for Education, health, civic, cultural infrastructure and facilities for transport and other miscellaneous infrastructure services	
	Traffic and Transportation Planning		

4	4.1	Evaluation of urban structure: Transport system, infrastructure and management, transport systems and their types, design and operating characteristics, urban road hierarchy, planning, and management criteria for road and junction improvements, arterial improvement techniques.	**07**
	4.2	Traffic management, mass transit system: Problems and prospects. Review of existing traffic management schemes in Indian cities. Case study of various metro rail project envisaged for Mumbai, Navi Mumbai & Pune.	
	4.3	Economic evaluation: pricing and funding of transport services and systems, economic appraisal of highway and transport projects. Techniques for estimating direct and indirect road user costs and benefit value of time	
	4.4	Intelligent transport system (ITS) its types and applications	
5	**Urban Management and Governance**		**06**
	5.1	Introduction to Development Management and Urban Governance- Concept, approaches, components, interface with national goals and political economic system. Urban Development Management Strategies, Tools and Techniques; organizations involved Land and Real Estate Development Economic concepts of land, Land Pricing / valuation; Urban reforms and acts and policies. Overview of Urban Governance Definition, concepts, components, government and governance, hierarchy and structure, forms of governance, process of inclusion and exclusion.	

	5.2	Information System and Urban Reforms Spatial and Non - spatial information systems; Use of GIS in overlaying infrastructure facilities, use of remote sensing in identifying and mapping urban structures.	
	5.3	Present organizations and involved in urban governance with focus on MCGM, TMC and CIDCO. Urban Local Governance and Participatory Processes System, structure, functions, powers, process and resource, performance, interface with NGO's, other agencies.	
6	**Environmentally Safe and Disaster Resilient Infrastructure**		**04**
	6.1	Frame work, statement prediction and assessment of impacts of air, water, noise, cultural and socio-economic environment. Methods of impact analysis, public participation. Environmental protection international and national agencies and legislation, Environment Impact Assessment. Urban Heat Island Effect, Effect of uncontrolled growth of town	
	6.2	Disaster response planning, roles and responsibilities of various agencies Emergency operation support and management Planning for Disaster Prone Areas, Planning requisites for disaster prone areas and preventive measures, Vulnerability analysis	
		Total	**39**

Recommended Books:

1 The Urban and Regional Planning Reader, edited by Eugenie L. Birch, Published by Routledge, 2008; ISBN 978-0-415-319
2 Housing: The Essential Foundations, edited by Dr. Paul Balchin, Paul Balchin, Maureen Rhoden, Edition Routledge, DOI https://doi.org/10.4324/9780203010426, eBook ISBN 9780203010426
3 New Urban Housing by Hilary French, Publisher: Yale University Press, ISBN0300115784 (ISBN13: 9780300115789)
4 Sociology: A Brief Introduction, by Richard T. Schaefer, Publisher: McGraw-Hill Education, ISBN 10:1259425584, ISBN 13: 9781259425585
5 Sociology: Principles of Sociology with an Introduction to Social Thoughts, by Rao C.N. Shankar, S. Chand Publication
6 Projects: Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw-Hill; ISBN0074516280 (ISBN13: 9780074516287)

7 Introduction to Transportation Planning, by B. Bruton, Michael J. Bruton; Published by Hutchinson Radius; ISBN0091580412 (ISBN13: 9780091580414)

Reference Books:

1 Modern Economics by H.L. Ahuja, 19th Revised Edition, Published by S.Chand (G/L) & Company Ltd
2 Economics, An Introductory Analysis by Paul A. Samuelson, William D. Nordhaus, Published July 27th 2004 by Irwin/McGraw-Hill (first published 1948), ISBN0072872055 (ISBN13: 9780072872057)
3 Modelling Transport, by de Dios Ortuzar and Luis G. Willumsen, 4th Edition, Wiley Publication
4 Principles of Urban Transport Systems Planning, by B.G. Hutchinson, Publisher: Scripta Book Co.; ISBN0070315396 (ISBN13: 9780070315396)
5 Traffic Engineering and Transport Planning, L. R. Kadiyali, Khanna Publishers, 1983
6 Remote Sensing and GIS, by Basudeb Bhatta, second Edition, Oxford University press
7 NEPA and Environmental Planning: Tools, Techniques, and Approaches for Practitioners; Charles H. Eccleston; CRC Press
8 Planning for Disaster: How Natural and Manmade Disasters Shape the Built Environment, by William Ramroth; Publisher: Kaplan Business; Original edition; ISBN-13: 978-1419593734.

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course -2 Open Channel Flow	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Civil engineers deal with the analysis and design of irrigation systems which include dams, weirs, barrages, canals, drains and other supporting systems, for which good knowledge of dynamics of open channel flow is very much essential. Hence this course is designed to study different types of flow like uniform flow, non- uniform flow, spatially varied flow, and unsteady flow occurring in open channels. Competencies developed by this course would therefore be useful for students to handle and solve the practical problems/ issues in the field of Water resource management, Water shed Management etc. It is expected that the students will be better equipped to address various engineering problems related to hydrology and hydraulics.

Objectives

1 Understand the nature of flow, explain the basic concepts of uniform flow and to design the best hydraulic sections in open channel.

2 Apply the Energy concepts of fluid in open channel and demonstrate various flow measurement devices in open channels.

3 Develop Dynamic equation to compute the flow profiles for Gradually varied flow and

classify water profiles in prismatic channels with different slope conditions.

4 Illustrate the causes of Rapidly varied flow, predict the formation of hydraulic jump and its applications.

5 Determine different types of spatially varied flow with varying discharges and characteristics of water surface profiles.

6 Study and analyze the temporal flow variations in open channel and the formation of surges.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Uniform Flow**		07
	1.1	Flow through open channel, Types of channels, open and covered channels, Classification of flow in channel, Geometrical properties, velocity distribution in a channel section	
	1.2	Uniform flow in open channels, Discharge through open channel, Manning's and Chezy's Equation, Determination of roughness coefficients,	
	1.3	Determination of Conveyance of a channel, Hydraulic mean depth, Normal depth and Normal velocity, computation of uniform flow	
	1.4	Most economical sections of prismatic channels, condition for maximum velocity in a circular channel, condition for maximum discharge in a circular channel	
2	**Energy-Depth Relationships**		07
	2.1	Specific energy, Specific energy curve, Depth- Discharge diagram, critical depth, critical slope, critical flow, alternate depths	
	2.2	Condition for maximum discharge for a given value of Specific energy	
	2.3	Momentum in open channel flow- Specific force, specific force diagram, Dimensionless specific force diagram,	

	2.4	Critical flow and its computation, Application of specific energy and discharge diagrams to channel transitions	
	2.5	Metering Flumes- Venturi flume, Standing wave flume, Parshall flume, Determination of mean velocity of flow, Measurement of discharge in Rivers	
3	**Non-Uniform Flow: Gradually Varied Flow**		**07**
	3.1	Dynamic equation of Gradually Varied Flow (GVF) in rectangular and wide rectangular channels	
	3.2	Types of slopes- channel bottom slopes and water surface slopes, classification of channel bottom slopes and surface profiles	
	3.3	Characteristics of surface profiles, Backwater curve and drawdown curve	
	3.4	Computation of GVF-Direct Step and Standard step method, Numerical methods, Graphical Integration method	
4	**Non-Uniform Flow: Rapidly Varied Flow**		**07**
	4.1	Rapidly varied flow (RVF), Hydraulic Jump, Momentum equation for the jump	
	4.2	Hydraulic jump in a rectangular channel, Froude Number before and after jump, Classification of jumps, Characteristics of jump in a rectangular channel	
	4.3	Jumps in non-rectangular channel, applications of jump, location of jump, surges in open channel	
	4.4	Use of RVF for flow measurement purpose-Sharp crested weir, Broad crested weir, Ogee spillway, sluice gate	
5	**Spatially Varied Flow**		**06**
	5.1	Importance of Spatially Varied Flow (SVF), Causes, Continuity, Momentum and Energy Equation	
	5.2	Water surface profiles, Applications, Differential Equation for SVF with increasing and decreasing discharge –	
	5.3	Relevant case studies	
	Unsteady Flow		
	6.1	Basic concepts of Gradually varied unsteady flow, Rapidly varied unsteady flow	

6	6.2	Positive and negative surges	**05**
	6.3	Relevant case studies	
		Total	**39**

Recommended Books:

1 Flow in Open channels: K. Subramanya, Tata Mc Graw -Hill Publishing Co. Ltd., New Delhi
2 Flow through Open channels: Rajesh Srivastava, Oxford University Press
3 Flow through Open channels: K. G. Ranga Raju, Tata Mc Graw -Hill Publishing Co. Ltd., New Delhi
4 Fluid Mechanics and Hydraulics: Dr S.K. Ukarande, Ane's Books Pvt. Ltd., (Revised Version 2012)
5 Hydraulics & Fluid Mechanics: Modi P.N. & Seth S.M, Standard book house, New Delhi

Reference Books:

1 Open channel Hydraulics: Chow, V.T., McGraw Hill International, New York
2 Open Channel Flow: Henderson F.M., McGraw Hill International
3 Open Channel Flow: M. Hanif Chaudhry, Prentice Hall of India.
4 Open channel Hydraulics: French, R.H., McGraw Hill International

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course - 1 Computational Structural Analysis	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

This subject deals with the conceptual applications of principles of mechanics of rigid and deformable bodies in Structural Engineering.

Objectives

1 To understand basic concepts of Matrix Methods of Structural Analysis and application of approximation techniques (Numerical Methods) in analysis of Structural Member

2 To analyze the behavior of structural members viz beams/plane trusses/ continuous beams/ portal frames

Detailed Syllabus

Module	Course Module / Contents		Periods
	Basic concepts of structural analysis and methods of solving simultaneous equations		
	1.1	Introduction, Types of framed structures	

1	1.2	Static and Kinematic Indeterminacy, Equilibrium equations	**04**
	1.3	Compatibility conditions, principle of superposition, Energy principles, Equivalent joint loads	
	1.4	Methods of solving linear simultaneous equations- Gauss elimination method, Cholesky method and Gauss- Seidel method.	

2	**Fundamentals of Flexibility and Stiffness Methods**		**07**
	2.1	Concepts of stiffness and flexibility	
	2.2	Local and Global coordinates	
	2.3	Development of element flexibility and element stiffness matrices for truss, beam and grid elements	
	2.4	Force- transformation matrix	
	2.5	Development of global flexibility matrix for continuous beams, plane trusses and Rigid plane frames	
	2.6	Displacement- transformation matrix, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.	
3	**Analysis Using Flexibility Method (Including Secondary Effects)**		**07**
	3.1	Continuous beams, plane trusses and rigid plane frames	
4	**Analysis Using Stiffness Method (Including Secondary Effects)**		**07**
	4.1	Continuous beams, plane trusses and rigid plane frames	
5	**Direct stiffness Method**		**07**
	5.1	Stiffness matrix for truss element in local and global coordinates	
	5.2	Analysis of plane trusses	
	5.3	Stiffness matrix for beam element	
	5.4	Analysis of continuous beams and orthogonal frames.	
6	**Finite Element Method**		**07**
	6.1	Historical Background – Mathematical Modeling of field problems in Engineering	
	6.2	Governing Equations – Discrete and continuous models	
	6.3	Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value	
	6.4	Basic concepts of the Finite Element Method.	

	6.5	One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics.	
		Total	**39**

Recommended Books:

1 Matrix Methods of Structural Analysis, S. S Bhavikatti, WILEY
2 Matrix Analysis of Framed Structures, Weaver, W., and Gere, J.M., CBS Publishers and distributors pvt. Ltd., 2004.
3 Computational Structural Mechanics, Rajasekaran, S., and Sankarasubramanian, G., PHI, New Dehi, 2001.
4 Introductions to Matrix Methods of Structural Analysis, Martin, H, C., McGraw-Hill, New York, 1966.
5 Structural Analysis A Matrix Approach, G. S. Pandit, S. P. Gupta, TATA McGraw Hill
6 Matrix Computer Analysis of Structures, Rubinstein, M.F., Prentice-Hall

Reference Books:

1 Introductory Methods of Numerical Analysis, S S. Sastry, ASIN : 8120345924, Publisher-Prentice Hall India Learning Private Limited.
2 Introduction to the Finite Element Method, Desai Abel, CBS Publishers and distributors
3 Introduction to Finite Elements in Engineering, Chandrupatala, Belugundu, Pearson Education Publisher : Pearson; 4th edition (20 December 2011)
4 Numerical Methods for Engineers, Steven Chapra, Tata McGraw Hill

R-2025- T.E Civil Engineering with Computer Applications

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course -2 Traffic Engineering and Management	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Traffic Engineering Management follows the Transportation Planning and is the specialized branch of the Highway Engineering, which introduces the concepts of characterizing traffic, various modeling approaches, and design of facilities to control and manage traffic. A key feature of the course is that it is well connected with the current design and analysis practice stipulated in national standards, and manuals. Therefore, it deals with the application of scientific principles, tools, techniques and findings for safe, rapid, economical and efficient movement of people and vehicles.

Objectives

1 To understand the concepts of traffic characteristics, traffic surveys to be conducted for planning any transportation network or judging the adequacy of the existing one

2 The application of various statistical tools to the analysis of the large data base emerging out of extensive traffic surveys and transportation and traffic planning.

3 To understand the concept of various features of the intersection infrastructures, their necessity, pros and cons, design or planning principles and subsequently, to design / plan the features such as channelization, island, speed change lanes and parking facility.

4 To understand the concept of highway capacity and such other components such as

Passenger Car Unit and Level of Service affecting the Capacity; and Speed- Flow- Density Relationship and various theories describing these relationships.

5 To understand the importance of Highway Safety and implementation of Traffic System Management (TSM) Measures and subsequent to study the various Traffic Control Devices and aspects of Highway Lighting.

6 To explore the future of traffic engineering in the form of Intelligent Transportation System

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Traffic Characteristics and Surveys**		03
	1.1	Scope, Traffic Elements - Characteristics-vehicle, road user and road - Traffic studies-speed & delay, traffic volume, O & D, parking and accidents - Sample size, study methodology - Data analysis & inferences.	
2	**Application of Statistics in Traffic Engineering**		05
	2.1	Various probability distributions & their applications - Parameter estimation - Hypothesis testing - Random variables	
	2.2	Estimation and analysis of simple regression models - Correlation coefficients - Analysis of correlation coefficients	
	2.3	Application of queuing theory as applied to traffic flow problems for study state conditions	
3	**Intersection Design**		10
	3.1	Types of intersections - Conflict diagrams –Control hierarchy- Design of rotaries (Indo-HCM 2017) & at-grade intersections – Signal design as per IRC:93- Grade separated intersections & their warrants, coordination of signals, types of area traffic control	
	Traffic Flow Theory		

4	4.1	Measurement, microscopic and macroscopic Study of Traffic Stream Characteristic -Flow, Speed and Density; pace – Time diagram, Headways, Speeds, Gaps and Lags; gap acceptance. Fundamental Equation of Traffic Flow, Speed-Flow-Density Relationships, Shock Wave Theory Passenger's car units, Factors affecting PCU and methods to determine PCU, level of service, factor affecting capacity and level of service. Capacity and level of service suggested for different road facilities as discussed in Indo-HCM 2017, review of flow density speed studies, Light hill and Whitham's theory, fundamentals of traffic stimulation modeling.	**10**
5	**Traffic Management and Road safety Audit**		**07**
	5.1	Various measures for traffic systems management and travel demand management-Congestion management -cost effective Management, their scope, relative merits and demerits. (Pedestrians and Cyclist Management) (IRC SP:55-2014)	
	5.2	Highway Lighting: Important definitions, law of illumination, discernment by artificial lighting, mounting height, spacing, lantern arrangements, types of lamps, lighting of some important highway structures.	
	5.3	Accidents: Accident cause, recording system, analysis and preventive measures, accident cost, alternative methodologies for calculation.	
	5.4	Road Safety Audit: Global & Local perspective – Road safety issues – Road safety programmers – Types of RSA, planning, design, construction & operation stage audits – Methodology – Road safety audit measures, road safety audit process as per IRC: SP-88-2010	
6	**Intelligent Transportation System**		**04**
	6.1	Overview of ITS implementations in developed countries, ITS in developing countries. Study of IRC: SP-110-2017	
	6.2	Historical Background, Benefits of ITS – Introduction to Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), Traffic control and monitoring aspects.	

	6.3	Application of ITS: Advanced Traffic Management Systems (ATMS) Advanced Vehicle Control Systems (AVCS), Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS), Automated Highway Systems	
		Total	**39**

Recommended Books:

1 Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2002.
2 Srinivasa Kumar .R ,Introduction to Traffic Engineering,The Orient Blackswan;south Asian Edition,2018.
3 Chakroborty P., Das N., Principles of Transportation Engineering, PHI,New Delhi,2003
4 Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee, 2001
5 Khisty C J,LallB.Kent; Transportation Engineering-An Introduction, Prentice-Hall,NJ, 2005
6 May, A.D., Traffic Flow Fundamentals, Prentice – Hall, Inc., New Jersey,1990.
7 O'Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK
8 Drew, D.R., Traffic Flow Theory and Control, McGraw-Hill, New York.
9 Benjamin J. R., Cornell C. A., Probability Statistics and Decision for Civil Engineers, McGraw-Hill, 1970.
10 Asad J. Khattak , Intelligent Transportation Systems: Planning, Operations, and Evaluation, CRC Press

Reference Books:

1 Transportation Engineering and Planning Papacostas, C. S., Prevedouros, P. D., PHIL earning Pvt. Ltd.
2 Transportation Engineering: Khisty, C.J. and Lall, K.B.; PHI Learning Pvt.Ltd.
3 Introduction to Urban Transport Systems, Planning: Hutchinson, B.G.;McGraw-Hill.
4 Economics of Transportation: Fair and Williams, Harper and Brothers, Publishers, NewYork.
5 Highway Capacity Manual, Transportation Research Board, National Research Council, WashingtonD.C.
6 Relevant IRC Codes amended time to time.

Semester-VI

Course Code	Course Name	Credits
CEC65X	Department Level Optional Course -2 Introduction to Offshore Engineering	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

Offshore Engineering discipline deals with the design and construction of structures intended to work in the ocean environment. The majority of offshore structures are used in the Oil and Gas industry. Offshore construction is the installation of structures and facilities in a marine environment. Civil Engineering graduates will be able to work in the specialized field of ocean and coastal environment.

Objectives

1 To understand the complexities in offshore construction and obtaining resources from the ocean.

2 To addresses the general engineering concepts that are fundamental to offshore engineering.

3 To understand types of sites and platform structures, key engineering systems and ocean environmental monitoring

Detailed Syllabus

Module	Course Module / Contents	Periods
	Introduction:	

1	1.1	History and current state of the art of offshorestructures, Definition of Offshore Structures, Met ocean Engineering: wind, wave and current loads on offshore structures	**05**
2	**Environment & Construction:**		**06**
	2.1	Offshore environment, Construction and launching, offshore project management,	
3	**Ocean Construction:**		**06**
	3.1	Types of Platforms: Jackets, Tension Leg Platforms (TLP), Semisubmersibles, Jack-ups, Concrete Gravity, deep water construction in ocean, offshore site investigations	
4	**Offshore Pipelines:**		**06**
	4.1	Hydrostatic, hydrodynamic analysis and structural design	
5	**Buoys and Mooring systems:**		**08**
	5.1	Buoys and Mooring systems Mooring configurations, advantages and disadvantages	
6	**Design Criteria:**		**08**
	6.1	Introduction to probabilistic design, extreme load & strength & fatigue, basics of anchoring and mooring system, riser system, Scaling laws & Model testing, Challenges in Deepwater testing: deep-water installations, constructions challenges.	
		Total	**39**

Contribution to Outcome

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

1 To know various offshore construction methodologies

2 To addresses the general engineering concepts during construction stages.

3 To handle complexities and key engineering systems in ocean environment

Internal Assessment **20 Marks**

Consisting of two Compulsory Class Tests –
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in first test).
Average of marks will be considered for IAE.

End Semester Examination **80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

Recommended Books:

1. Subrata K. Chakrabarti (2005): Handbook of offshore engineering Volume–I & II, Elsevier, The Boulevard Langford Lane, Kidlington, Oxford OX5 l GB, UK.
2. Deo M C (2013):Waves and Structures, http://www.civil.iitb.ac.in/~mcdeo/waves.html
3. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Load and Resistance Factor Design, 1st Edition, 1993. (TP690.A642 RP2A-LRFD)
4. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design, 21st ed., 2000. (TP690.A642 RP2A-WSD).

Semester-VI

Course Code	Course Name	Credits
CEL601	Design and Drawing of Steel Structures (Lab)	01

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	TOTAL						
-	-	-	-	-	25	-	25	50

Course Objectives:

1 To estimate the design loads on steel structures as per IS 875
2 To analyze the member forces by any suitable method.
3 To design the members for axial, flexure and shear forces.
4 To prepare the detailed design report and fabrication drawings by manual or CAD software.

Course Outcomes:

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

1 Calculate dead, live and wind loads on the structure.
2 Analyze the structure by analytical/graphical method.
3 Use steel table for selecting appropriate section.
4 Design the members for various load combinations.
5 Design the bolted and welded connection.
6 Read and Prepare the detailed fabrication drawing and design report.

The Project shall be given to a group of students consisting of not more than10 students.		
List of the Projects		
Schedule	**Detailed Content**	**Lab Session / Hr.**
Project 1	**Design and drawing of steel roof truss for industrial shed should consist of the following items.**	
1st Week	Introduction, problem statement, Calculation of panel point DL, LL, and WL on truss.	02
2nd Week	Analysis of truss by graphical method/ any software and calculation of design loads in members	02
3rd Week	Design of purlins, Principal rafter, Main Tie, Design of remaining members of truss. etc.	02
4th Week	Design of bolted /welded connections and design of sliding and hinged supports including anchor bolts	02
5th Week	To generate/draw fabrication drawings on full imperial size drawing sheet and design report on A4 size pages.	02
6th Week	To generate fabrication drawings and design report including estimation of steel required.	02
Project 2	**Design and drawing of floor beam system for steel building G+1 should consist of the following items**	
7th Week	Introduction, problem statement and to draw grid floor plan.	02
8th Week	Calculation of DL, LL on slab, beams etc. and to analyze frame for BM and SF.	02
9th Week	Calculation of design loads on columns and footing.	02
10th Week	Design of beams, columns and footings.	02
11th Week	Design of beam end and beam-column connections.	02
12th Week	To generate/draw fabrication drawings on Full imperial size drawing sheet and design report on A4 size pages.	02
13th Week	To generate fabrication drawings and design report including estimation of steel required.	02

Recommended Books:

1 Design of Steel Structure by N. Subramanian, Oxford University Press, New Delhi.

2 Limit state design of steel structures by S. K. Duggal, McGraw Hill Education (India) Pvt. Limited, New Delhi.

3 Design of steel structure by Limit State Method as per IS: 800 - 2007 by Bhavikatti S. S., I.K. International Publishing House, New Delhi.

4 Design of Steel Structures by K. S. Sai Ram, Pearson Education, New Delhi.

5 Limit state design of steel structures as per IS 800/2007. by S. Kanthimathinathan. I.K. International Publishing House, New Delhi.

6 Relevant Indian Specifications, Bureau of Indian Standards, New Delhi.

Reference Books:

1 Design of Steel Structure by Allen Williams

2 Practical Design of Steel Structure by Karuna Moy Ghosh, Whittles Publishing

3 Structural design and drawing by D. Krishnamurthy, CBS Publishers, New Delhi.

4 Teaching Resources Material for steel structures by INSDAG Kolkata.

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BE SEM VII & VIII 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	
CEC701	Design and Drawing of Reinforced Concrete Structures	3		--	39		--	--	39	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
CEC701	Design and Drawing of Reinforced Concrete Structures	20	20	40	60	4	--	--	100

Rationale:

Reinforced concrete construction is widely used for residential, commercial and industrial structures. IS code has specified the use of Limit State Method (LSM) design philosophy for design of structures. During previous semester students have studied design of basic elements by LSM. This course covers complete design of G+3 RCC framed building in addition to other structures like water tank and retaining wall. Prestressed Concrete structures are another class of structures used for bridge girders, long span slabs etc. Civil Engineers must have knowledge of designing and detailing of RCC and PSC structures to make structures safe and serviceable during its life span. The knowledge about response of structures during an earthquake is

prerequisite for Civil Engineers. The course introduces Prestressed concrete and Earthquake Resistant Design of structures with drawing and detailing as per IS Code specifications.

Course Objectives:

1. To explain the LSM design procedure of G+3 RCC framed building by application of IS code clauses including loading calculations, analysis and design of individual elements with detailing of reinforcements.
2. To explain the concepts in the design of water tanks.
3. To explain the concepts in the design of retaining walls.
4. To introduce the basics of structural dynamics, structural behavior under the dynamic load and the effect of damping.
5. To introduce earthquake resistant design approach.
6. To develop the practice of design using charts and tables from SP:16 published by BIS.
7. To introduce concept of Pre-stressed Concrete.

Course Outcomes: (Based on Blooms Taxonomy)

1. Design G+3 RCC framed building using IS code recommendations.
2. Design different types of retaining walls with detailing of reinforcement
3. Design different types of water tanks with detailing of reinforcement.
4. Apply the basic concepts of structural dynamics
5. Evaluate the response of structure during an earthquake and calculate design forces.
6. Explain principles of Pre-stressed Concrete and its losses.

DETAILED SYLLABUS: Total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours
I	Comprehensive Design of Building	1.1 Analysis and design of residential/commercial/industrial (G+ 3) RCC framed building. 1.2 Load transfer mechanism, arrangement of beams, slabs and columns. 1.3 Design of Staircase (Dog legged and Open well type), Slabs (One way and Two way with continuity), Beams (Simply supported, Cantilever, Continuous), Columns (Axially loaded and Eccentrically loaded), Footings (Isolated and Combined).	11

II	Design of Retaining Wall	2.1 Design of Cantilever retaining wall 2.2 Design of Counterfort retaining wall	06
III	Design of Water Tank	3.1 Classification of Water Tank, Permissible Stresses, and Design of circular and rectangular water tanks resting on ground and underground. Codal provisions as per IS 3370:2020. Use of IS coefficient method and approximate method. 3.2 Introduction to design of elevated water tank, frame and shaft type of staging	07
IV	Introduction to Structural Dynamics	4.1 Definition of basic terms used in structural dynamics. Static and dynamic loads, types of dynamic load. 4.2 Introduction to single degree of freedom system (SDOF), evaluation of dynamics response of SDOF system. Approximate method for determination of time period of vibration	06
V	Earthquake Resistant Design of Structures	5.1 Earthquake motion and response of structure. 5.2 Design load calculation by seismic coefficient method. 5.3 Ductile design and detailing as per IS: 13920.	06
VI	Introduction to Pre-stressed Concrete	6.1 03 Prestressed Concrete: basic principles of prestressed concrete, materials used, systems of prestressing. 6.2 Losses in prestress	03

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.2. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand & bro.

3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.

4. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.

5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.

6. Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi

7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.

8. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.

9. 10. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition. Earth9.

10. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

Reference Books

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications

2. Reinforced Concrete: Syal and Goel, Wheeler Publishers.

3. Reinforced Concrete Design: Pillai, S.U. and Menon Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.

4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.

5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.

6. Pre-stressed concrete: N. Rajgopalan, Narosa Publishers.

7. Relevant IS Codes: BIS Publications, New Delhi.

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	
CEC702	Quantity Survey, Estimation & Valuation	3		--	39		--	--	39	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total.					
CEC702	Quantity Survey, Estimation & Valuation	20	20	40	60	3	--	--	100

Rationale:

Any structure, i.e., building, bridge, dam etc. consists of various building materials. Due to rise in the cost of materials, the structure has to be designed so that it is safe, serviceable and economical. Without proper design and estimation, it may lead to the increase in cost of construction and it further affects the economical aspect of the structure. A prior knowledge ofvarious building materials is required for the construction and it controls the cost of the structure, save wastage of labor-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in scheduling of men,

materialsand machine to be used in the project at stages. The scope of the subject includes estimating, costing, analysis of rates, specification, valuation, tender and contracts etc

Course Objectives:

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand Measurement systems for various items of civil engineering structures
2. To draft the specifications for various items of work & determine unit rates of items of works & to prepare the rate analysis for various items of work using DSR for reference.
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork using various methods.
5. To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.
6. To explain the concept of valuation & to determine the present fair value of any constructed building at stated time.

Course Outcomes:

1. Apply the measurement systems to various civil engineering items of work.
2. Draft the specifications for various items of work & determine unit rates of items of works
3. Estimate approximate cost of the structures by using various methods & prepare detailed estimates of various civil engineering structures, including bar bending schedule, by referring drawings.
4. Assess the quantities of earthwork & construct mass haul diagrams.
5. Draft tender notice & demonstrate the significance of the tender as well as contract process.
6. Determine the present fair value of any constructed building at stated time.

DETAILED SYLLABUS: Total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours
I	Introduction	1.1 Importance of Course 1.2 Measurement systems for specific items of civil engineering	03

		structures 1.3 Units of measurement of various items of works 1.4 IS1200: - Introduction, deduction rules for Masonry & Plastering work	
II	Specifications & Rate Analysis	2.1 Types & importance of specifications, rules to be followed for drafting the specifications of important items of work etc. 2.2 Rate analysis, its importance & necessity, Factors affecting rate analysis, Task work, sources of materials, Study of IS 7272 regarding labor output, District Schedule of Rates (DSR) Rate analysis of important items of construction works.	06
III	Estimates	3.1 Approximate Estimate Definition & Purposes of approximate estimates, Methods for preparing approximate estimates & numerical based on methods, Various terms such as administrative approval, technical sanction, Contingencies, Work charged establishments etc. 3.2 Detailed Estimate Definition & purposes of detailed estimate, Data required for preparation of detailed estimate. Introduction of detailed estimate of load bearing structure. Methods of taking out quantities such as long wall & short wall method, Centre line method for R.C.C. framed structure, Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structural elements as per code IS2502.	12
IV	Estimation of Earthwork for Roads & Canals	4.1 Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula,	04

		Trapezoidal formula etc. & numerical based on methods. Introduction of Mass Haul diagram, Terms like lead & lift etc	
V	Tenders & Contracts	5.1 Tenders Definition & types of tenders, Tender notice & its inclusions, Pre-qualification of contractors, Pre-bid meeting, Procedure for submission & opening of tender, acceptance & rejection of tender, Tender validity period, E-Tendering 5.2 Contracts Definition, basic forms such as Valid, void & voidable contract. General types of contracts with their suitability, conditions of contract	06
VI		Valuation 08 6.1 Difference between cost, price & value. Types of value, Valuation & its purposes. Various terms such as depreciation, sinking fund, capitalized value, years purchase etc. Methods for calculating depreciation of building such as Straight-line method, Sinking fund method Freehold Properties, Leasehold Properties, Easement rights 6.2 Methods of valuation such as Rental method, land & building method, Belting method etc. Numerical based on valuation	

Recommended Books:

1) Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
2) Building and Engineering Contracts: Patil, B. S., University Press, Hyderabad.
3) Estimating and costing: Datta, B. N., UBS Publications
4) Relevant Indian Standard Specifications, BIS Publications

5) Professional Practice: Dr. Roshan H. Namavati

6) World Bank approved contract documents

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	
CEL701	Design and Drawing of Reinforced Concrete Structures	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL701	Design and Drawing of Reinforced Concrete Structures	--	--	--	--	25	25	50

Lab Objectives:

1. To explain the LSM design procedure of G+ 3 RCC framed Building by application of IS code clauses including loading calculation, analysis and design of individual elements with detailing of reinforcements.
2. To explain the concept in the design of water tanks.
3. To explain the concept in the design of retaining walls.
4. To introduce the basics of structural dynamics, structural behavior under the dynamic load and the effect of damping.
5. To introduce earthquake resistant design approach.
6. To develop the practice of design using charts and tables from SP:16 published by BIS.
7. To introduce concept of Pre-stressed Concrete

Lab Outcomes: (Based on Blooms Taxonomy)

1. Design G+3 RCC framed building using IS code recommendations.
2. Design different types of water tanks with detailing of reinforcement.

3. Design different types of retaining walls with detailing of reinforcement
4. Apply the basic concepts of structural dynamics
5. Explain response of structure during an earthquake and calculate design forces.
6. Explain principles of prestressed Concrete and its losses.

List of Experiments.

Sr No	List of Assignments / Tutorials	Hrs
01	Project – I – Design of G+3 RCC Framed Building. Drawing of structural plan on Sheet No. 1	02
02	Project – I – Design of Staircase	02
03	Project – I – Design of Slabs and Staircase. Design of one-way & two-way slabs and reinforcement on Sheet No. 2	02
04	Project – I – Design of Beams. Design & detailing of simply supported and continuous beams on Sheet No. 3	02
05	Project – I – Design of Columns. Design and detailing of reinforcement for columns on Sheet No. 4	02
06	Project – I – Design of Footings. Design of isolated and combined footings with detailing on Sheet No. 5	02
07	Introduction to Structural Dynamics (Maximum 5 Questions)	02
08	Earthquake Resistant Design of Structures (Maximum 5 Questions)	02
09	Project – II – Design of Counterfort Retaining Wall using LSM	02
10	Project – II – Detailing of reinforcement of counterfort retaining wall on Sheet No. 6	02
11	Design of Water Tanks using WSM (Maximum 5 Questions)	02
12	Introduction to Prestressed Concrete (Maximum 5 Questions)	02
13	Oral Examination	02

Text Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand& bro.

3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.

4. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.

5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.

6. Prestressed concrete : Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi

7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.

8. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.

9. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

References:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.

2. Reinforced Concrete: Syal and Goel; Wheeler Publishers.

3. Reinforced Concrete Design: Pillai, S.U. and Menon, Devdas, Tata Mc-Graw Hill Publishing House, New Delhi.

4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.

5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.

6. Prestressed concrete : N. Rajgopalan, Narosa Publishers.

7. Earthquake resistant design of structures: Pankaj Agarwal, Manish Shrikhande, PHI, New Delhi.

8. Relevant IS Codes: BIS Publications, New Delh.

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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	
CEL702	Quantity Survey, Estimation & Valuation	--	--	2	--	30	30	--	60	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL702	Quantity Survey, Estimation & Valuation	--	--	--	--	25	25	50

Lab Objectives:

1. Identify current unit rates of various construction materials through market survey & also study District Schedule of Rates (DSR)
2. Prepare rate analysis of few important Items of work
3. Estimate approximate cost of the structures by using various methods & prepare detailed estimates of various civil engineering structures, including bar bending schedule, by referring drawings.
4. Assess the quantities of earthwork & construct mass haul diagrams.
5. Draft tender notice & demonstrate the significance of the tender as well as contract process.

6. Evaluate present fair value of any constructed building at stated time.

Lab Outcomes: (Based on Blooms Taxonomy)

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand measurement systems for various items of civil engineering structures
2. To draft the specifications for various items of work & determine unit rates of items of works by preparing rate analysis
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork by using various methods.
5. To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.
6. To understand the concept of valuation & to determine the present fair value of any constructed building at stated time.

List of Experiments.

Sr No	List of Assignments / Tutorials	Hrs
01	Market Survey for rates of materials & items	02
02	Study of District Schedule of Rates & Prepare rate analysis of few important Items of work	02
03	Prepare approximate estimate of residential building	02
04	Prepare detailed estimate (Measurement sheet & Abstract Sheet) of any two of the following • RCC structure • Road work • Cross drainage work	02
05	Work out Steel quantity by using BBS	02
06	Work out earthwork volume in banking & cutting for a Road section	02

07	Draft Tender Notice for proposed construction Project & study tender documents & Conditions of contract	02
08	Prepare Valuation Report of any Civil Engineering Structure	02

.

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	
CEP701	Major Project Lab	--	--	6	--	--	--	--	--	3

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEP701	Major Project Lab	--	--	--	--	25	25	50

References:

1) Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.

2) Estimating and costing: Datta, B. N., UBS Publications

3) Building and Engineering Contracts: Patil, B. S., University Press, Hyderabad.

4) Professional Practice: Dr. Roshan H. Namavati 3.

Lab Objectives:

1. To acquaint the learners to identify problems
2. To accustom the learners to formulate the scope and objectives
3. To familiarize the learners with the process of review of literature
4. To advice the learners to formulate a methodology
5. To accustom the learners to work as a team
6. To appraise the learners on proper documentation of work

Lab Outcomes: (Based on Blooms Taxonomy)

1. Review & comprehend literature in the selected domain
2. Articulate problem statement & identify the objectives
3. Identify existing methods or solutions to solve identified problem
4. Identify modern engineering tools & other resources to solve the problem
5. Formulate methodology to solve the identified problem
6. Effectively communicate their project work by writing reports & presentations.

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Course Code	Course Name	Credits
CEDLO7011	Department Level Optional Course-3: Pre-stressed Concrete	3

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

The course is aimed to make the learners aware about highly mechanized technology in civil engineering construction and to develop the basic understanding of prestressed concrete which is used in a wide range of civil structures like high rise buildings, residential slabs and bridges etc. Prestressed Concrete improves performance/efficiency of the section. It reduces cross sectional dimensions that results in material saving when compared with simple reinforced concrete sections.

Objectives

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1. To make the learner to understand difference between PSC and RCC section in terms of material and method / technique used for construction
2. To make the learner to understand the principle of prestressing, analysis of prestressed concrete sections and losses in prestress.
3. To make candidate able to understand and implement the guidelines of Indian Standard code for analysis and design sections using limit state philosophy.the

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Introduction of Pre-stressed Concrete**		02
	1.1	Basic concept and general principle	
	1.2	Materials used and their properties, need of high strength concrete and steel	
	1.3	Techniques and systems of prestressing	
	1.4	Advantages of Prestressed Concrete	
II	**Analysis of Pre-stressed Concrete Beams**		10
	2.1	Loading stages, permissible stresses in concrete in compression and tension at transfer and service stages as per limit state of serviceability, maximum compression and limit state of serviceability cracking, permissible stresses in steel, stress method of analysis	
	2.2	Load balancing method of analysis, cable profile	
	2.3	Kern points, pressure line, efficiency of section, internal resisting couple method of analysis,	
III	**Losses in Prestress**		06
	3.1	Loss of stresses in steel due to elastic deformation of concrete, creep in concrete, shrinkage in concrete, relaxation in steel, anchorage slip and friction	
IV	**Analysis of Pre-stressed Concrete Beams in Limit State of Serviceability Deflection**		04
	4.1	Deflection at transfer, short time and longtime deflection of uncracked beams, permissible limits	
V	**Analysis and Design of Pre-stressed Concrete Beams in Limit State of Collapse**		10
	5.1	Shear - Principal tension, permissible limit, analysis and design of beams in shear (sections uncracked in flexure)	
	5.2	Flexure - General philosophy of design, assumptions, analysis and	

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		design of beams in flexure	
VI	**Design of Pre-stressed Concrete Beams in Limit State of Serviceability, Maximum Compression and Cracking**		07
	6.1	Suitability of section modulus	
	6.2	Optimum pre-stressing force and corresponding eccentricity	
	6.3	Safe cable zone	

Recommended Books/Code:

1.Prestressed Concrete*: N. Krishna Raju*, Tata McGraw-Hill Publishing Company Limited, 2.New Delhi

3.Fundamentals of Prestressed Concrete: *N.C Sinha* and *S.K. Roy*, S. Chand Publishing

4.Prestressed Concrete: *N. Rajagopalan*, Narosa Publishing House

5.Prestressed Concrete Structures: *P. Dayaratnam*, Oxford and IBH Publishing Co. Pvt. Ltd.

6.Prestressed Concrete*: S. Ramamrutham*, Dhanpat Rai Publishing Company Pvt. Ltd, New 7.Delhi

8.IS code: IS:1343-2012

Reference Books:

1. Design of Prestressed Concrete Structures: T. Y. Lin and N.H. Burns, Wiley India Pvt. Ltd.
2. Design of Prestressed Concrete: *Arthur H. Nilson*, Wiley

Semester VII

Course Code	Course Name	Credits
CEDLO7012	Department Level Optional Course-3: Applied Hydrology & Flood Control	03

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

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

This subject deals with the various processes involved in hydrological cycle and provides in depth understanding of the theories and concepts of surface, subsurface and ground water hydrology. It focuses on types and forms of precipitations. It also explains the application of hydrographs, unit hydrographs and further describes various techniques of estimating stream flows. It further describes the various techniques of estimating streamline flows. It also describes the importance of floods, flood routing and ground water hydrology.

Objectives

1.To explain the various processes involved in the hydrological cycle.

2.To measure rainfall, computation of average rainfall, various water losses etc.

3.To differentiate the various stream flow measurement and its importance.

4.To interpret the hydrograph and unit hydrographs, applications of unit hydrograph concept.

5.To evaluate various flood control methods, estimate design flood, and flood routing

6.To describe the concepts of ground water movement, steady and unsteady flow

towards fully penetrating wells and well yields.

Detailed Syllabus

Module	Sub-Modules/ contents	Periods
	1.1 Introduction: Hydrological cycle, scope of hydrology, water budget equation, data sources.	
I	**1.2 Precipitation:** Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area -Duration relationship, Intensity-Duration - Frequency relationship, Probable Maximum Precipitation.	**8**
II	**2.1 Abstractions from Precipitation:** Evaporation and transpiration, evapo-transpiration, interception, depression storage, infiltration and infiltration indices, determination of water losses. **2.2 Stream Flow Measurement:** Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.	**6**
III	**3.1 Runoff:** Catchment, watershed and drainage basins, Factors affecting runoff, rainfall-runoff relationship, runoff estimation, droughts	**6**

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IV	**4.1 Hydrograph Analysis:** Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.	**7**
V	**5.1 Floods:** Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk- reliability and safety factor. Flood routing: Hydrologic and hydraulic routings.	**6**
VI	**6.1 Ground Water Hydrology**: Yield, transmissibility, Darcy's law, Dupuitt's theory of unconfined flow, steady flow towards fully penetrating wells (confined and unconfined). Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.	**6**
	Total	**39**

Recommended books:

1. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN- 978-93-83656-89-9

2. Irrigation and Water Power Engineering: B.C. Punmia, Pande B.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi

3. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House,Delhi, ISBN 978-81-87401-29-0.

4. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.

5. Engineering Hydrology: *K. Subramanya*, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

6. Hydrology: *H. M. Raghunath*, New Age International Publishers, New Delhi

7. Elementary Hydrology: *V. P. Singh*, Prentice Hall

8. Engineering Hydrology: Principles and practice*: V. M. Ponce*, Prentice Hall

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Semester VII		
Course Code	**Name of the Course**	**Credits**
CEDLO7013	**Department Level Optional Course 3: Appraisal & Implementation of Infrastructure Projects**	**03**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme								
Theory					**TW/ Pract/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

For any Civil Engineering project, a range of alternative schemes meeting project goals are feasible. Thus to identify the most suitable out of it, project evaluation has to be carried out in terms of financial viability, environmental impact, utility to the society, engineering feasibility, profitability, etc. This course is intended to make students aware of this evaluation (appraisal) criterion for any Civil engineering project. Students will understand the importance of feasibility studies and get acquainted to the process of preparing a project report, both being crucial role players while deciding the viability of a project. The professional construction engineering practice will be rendered meaningful if students learn about ways to raise project funds, their effective planning and optimum utilization. This course is devised to help students in understanding financial and economic aspects of a project.

Objectives

1. To know the procedure of feasibility studies for any infrastructure project.
2. To learn the procedure of appraisals required for deciding the worthiness of any

project.

3. To learn the procedure of forecasting demand and know the uncertainties involved.
4. To know the components and importance of technical & managerial appraisal.
5. To get acquainted with decision making tools like Break even analysis, SWOT analysis etc.
6. To get acquainted with different methods of project finance and implementation.

Detailed Syllabus			
Module	**Sub-Modules/ Contents**		**Hrs**
I.	**Construction Projects and Report Preparation**		**03**
	1.1	Classification of construction projects. Project Formulation and phases involved in it.	
	1.2	Feasibility studies, SWOT analysis. Preparation of Project report.	
II.	**Project Appraisal**		**06**
	2.1	Importance and phases in a project development cycle for major infrastructure projects.	
	2.2	Importance of Appraisal, its need and steps involved in it.	
III.	**Market Appraisal**		**09**
	3.1	Importance and methods of carrying out demand analysis. Sources to gather project related information and ways to carry out market survey.	
	3.2	Methods to forecast demands. Uncertainties involved in demand forecasting.	
IV.	**Technical and Managerial Appraisal**		**06**
	4.1	Method to study the technical appraisal/viability of a project in terms of its location, type of land and intended use of building, technology requirements of the project, Size and complexity of tools and plants, raw materials to be used and their impact on the vicinity, energy requirements, water supply and disposal of effluents if any.	
	4.2	Study of managerial requirements of a project, Desirable organisational structure and hierarchy to manage as well as implement the project, Method of assessment of entrepreneurs.	
	Financial analysis and Economic Appraisal		

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V.	5.1	Various costs related to a project, Methods to determine the profitability of a project, Break even analysis.	**09**
	5.2	Economic appraisal: Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.	
VI.	**Project Financing and Implementation**		**06**
	6.1	Types and Sources of finance in local, National and International context. Issues related to project financing.	
	6.2	Agencies involved in the implementation of a project. Methods of implementation like Built, operate and Transfer and its other variants like B.O.O, B.O.O.T, B.L.T, EPC ,etc.	
		Total	**39**

Recommended Books:

1) Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
2) Infrastructure Development & Financing in India - N. Mani (New Century Publications).
3) Infrastructure & economic development - Anu Kapil (Deep &Deep Publications).
4) Construction Management: Planning and finance - Cormican D.(Construction press, London).
5) Engineering Economics – Kumar (Wiley, India).
6) Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).
7) The cost management toolbox; A Managers guide to controlling costs and boosting profits. - Oliver, Lianabel (Tata McGraw Hill).

Course Code	Course Name	Credits
CEDLO 7014	**Department Level Optional Course 3: Analysis of Offshore Structures**	**03**

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Offshore Engineering discipline deals with the design and construction of structures intended to work in the ocean environment. The majority of offshore structures are used in the Oil and Gas industry. Offshore construction is the installation of structures and facilities in a marine environment. Civil Engineering graduates will be able to study analysis and design in the specialized field of ocean and coastal environment.

Objectives

The objectives of this course are

1. To Explain The Types And Materials Used In Offshore Structures.
2. To Provide An Understanding Of The Structural Response Of Offshore Structures Based On Both Component And System
3. To Address The General Engineering Analysis And Design Concepts Of Offshore Structures

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Detailed Syllabus		
Module	**Course Modules / Contents**	**Hrs.**
I	**Types of offshore structures** Types of offshore structures, planning and design aspects, Overview of functional, environmental and accidental loads for marine structures, with emphasis on wind - and wave induced loads.	**05**
II	**Materials and their behaviour** Hydrodynamic interaction, Effects and dynamic response, Materials and their behaviour under static and dynamic loads, allowable stresses, various design methods and codes, design consideration, design loads.	**06**
III	**Analysis of offshore structures** Basics of Hydrodynamics, Structural dynamics, Advanced structural analysis techniques, Statistics of extremes: Airy Wave Theory, Higher order wave theories, Irregular Sea States, Short and long term statistics of wind; static wind load, Aerodynamic admittance function and gust factor.	**06**
IV	**Estimation of wave forces** The Morison's equation, wave force, lift force on members, wave slam, maximum force and moments using linear theory, Vertical Piles, Horizontal Bracings, Diagonal Front Face Bracings, Diagonal Side Face Bracings, wave forces on large diameter members, Froude-Krylov Theory, Diffraction Theory, Drift force, Spectral and statistical analysis of wave forces.	**06**
V	**Vibrations** Mass-spring system, Free Vibrations with Damping, Forced Vibrations, Forced Damped Vibrations, Torsional Vibrations, Elements of single d.o.f. system, Dynamics of multi d.o.f. systems, Eigen values and vectors; Iterative and transformation methods; Mode superposition, Fourier series and spectral method of response of single d.o.f. systems, Vibration of bars, beams, Behavior of concrete gravity platform as a rigid body on soil as a continuum	**10**
	Corrosion and allowances	**06**

VI	Corrosion and other allowances, consideration of stress concentration, Ingredient materials and protective measure, Behavior of concrete gravity platform as a rigid body on soil as a continuum	
	Total	**39**

Recommended Books:

1.Subrata K. Chakrabarti (2005): Handbook of offshore engineering Volume–I & II, Elsevier, The Boulevard Langford Lane, Kidlington, Oxford OX5 l GB, UK.

2.Deo M C (2013): Waves and Structures, http://www.civil.iitb.ac.in/~mcdeo/waves.html

3.American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Load and Resistance Factor Design, 1st Edition, 1993. (TP690.A642 RP2A-LRFD)

4.American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design, 21st ed., 2000. (TP690.A642 RP2A-WSD).

5.Brebbia C.A. and Walker, “Dynamic Analysis of offshore structures", Newness butterworth, London, 1978.

6.Sarpakaya T. and Isaacson M., “Mechanics of Wave Forces on Offshore Structures", Van Nostrand Rainhold, NewYork, 1981.

Course Code	Course Name	Credits
CEDLO7015	Department Level Optional Course-3 Advanced Construction Technology	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

In today's times the construction activities are undergoing lots of changes/developments due to internal and globalized market demands of quality and faster completion of project works using modern techniques, use of modern and waste materials, and through mechanized construction. Today, we require high-capacity machines with better output and greater efficiency to make construction process less stressful. This course has been designed so that civil engineers would be able to use advanced construction technology. Student will be introduced to some emerging technologies in the field of Civil engineering which will make them more industry ready.

Objectives

1. To study and understand the latest construction techniques applied to engineering construction for sub structure.
2. To summarize the students about various techniques of super structure construction.
3. To give an experience in the implementation of new technology concepts which are applied in field of advanced construction in special structures.
4. To know the different methods of some advanced construction techniques and

ground improvement techniques.

5. To present the new technology related to dredging system and its concepts related advanced construction technology.
6. To study different methods of rehabilitation and strengthening in construction to successfully achieve the structural design.

Detailed Syllabus

Module		Course Module / Contents	Periods
I		**Sub Structure Construction**	06
	1.1	Box jacking, Pipe jacking, Underwater drilling, blasting, and concreting. Underwater construction of diaphragm walls and basement	
	1.2	Driving well and caisson, sinking cofferdam, cable anchoring, and grouting. Driving diaphragm walls, sheet piles	
	1.3	Laying operations for built-up offshore system, Shoring for deep cutting, large reservoir construction, and well points. Dewatering for underground open excavation.	
II		**Super Structure Construction for building**	06
	2.1	Vacuum dewatering of concrete flooring, Concrete paving technology	
	2.2	Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections, Erection techniques of tall structures, large span structures, launching techniques for heavy decks, in- situ prestressing in high rise structures, post-tensioning of the slab, aerial transporting, Handling, and erecting lightweight components on tall structures	
III		**Construction of Special Structures**	06
	3.1	Erection of lattice towers - Rigging of transmission line structures, Construction sequence in cooling towers, Silos, chimneys, skyscrapers. Construction sequence and methods in domes, Support structure for heavy equipment and machinery in heavy industries, Erection of articulated structures and space decks.	

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	3.2	Roof truss: erection problems Building / Industrial component, Equipment and tackles used for erecting these. Plate girder Launching a portion of bridge girder, large span lattice girder. Erection of chimney**,** Erection of overhead tank.	
IV	**Advancement in Construction techniques**		08
	4.1	Building construction techniques: Zero energy building, green building, pre- engineering building, Solar Paints, Building Integrated Photovoltaic (BIPV), Earthquake Resisting Controls-Isolation and Dissipation.	
	4.2	Coastal construction techniques: Sound Proofing walls, water-resistant roofs, high-performance doors and windows, air and moisture barriers.	
	4.3	Road construction techniques: 3D Printing, Road Printer, smart roads	
	4.4	Ground improvement techniques: Advanced piling techniques - Stone Column, Vibro Floatation, Grouting, Geotextile application, Micro Piles, and Soil Nailing. Vertical drains-Sand Drains, Pre-Fabricated Vertical Drains. Thermal Methods- soil heating and soil freezing.	
V	**Dredging**		06
	5.1	Dredging System, Mechanism, Hydraulic dredger in waves, dredging equipment, Water & Booster System, dredging in the navigation system, Agitation dredging system, silt dredging system, water injection system,	

		Pneumatic dredging system, Amphibious & scrapper dredging system.	
	5.2	Advantages & Disadvantages of Various Dredging Systems, Production Cycle for Dredgers, Application, Capacity of dredgers, & its economical use, dredging economics	
VI	**Rehabilitation and Strengthening Techniques**		07
	6.1	Seismic retrofitting, strengthening of beams, strengthening of columns, strengthening of the slab, strengthening of a masonry wall, Protection methods of structures, Mud jacking and grouting for foundation, Micro piling and underpinning for strengthening floor and shallow profile, Subgrade waterproofing, Soil Stabilization techniques	
	6.2	Repair of steel structures, bridge, building, towers etc., monuments and historical structures. Prevention of water leakage in structures; Underwater repair; Durability of repairing material. Maintenance of underground railways.	
		Total	39

Recommended Books:

1 Roy Chudley and Roger Greeno , Construction Technology , Prentice Hall, 2005.
2 Dr. B.C. Punamia (2008); “Building Construction” Laxmi Publications (P) Ltd.ISBN13: 978- 8131804285. 666p.
3 S. S. Bhavekatti (2012); “Building Construction” Vikas Publishing House Pvt Ltd. ISBN-13: 978-9325960794. 356p.
4 Peter. H. Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.
5 S. P. Arora and S. P. Bindra (2010); “Textbook of Building Construction”, Dhanpat Rai & Sons publication, ISBN-13: 978-8189928803. 688p
6 Sushil Kumar (2010); “Building Construction” Standard Publishes-Distributors. ISBN-13: 978-8180141683. 796p.
7 S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand

Reference Books:

1 Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

2 Peurifoy, Construction Planning, Equipment and methods –-Tata McGraw Hill Publication

3 Mahesh Varma , Construction Equipment Planning and Applications –

4 R. Chudley (revised by R. Greeno), Building Construction Handbook, Addison Wesley, Longman Group, England, 3rd ed.

5 S.S. Ataev, Construction Technology, Mir Publishers, Moscow

6 Robertwade Brown, "Practical foundation engineering hand book", McGraw Hill Publications.

7 Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons

8 Jerry Irvine, Advanced Construction Techniques, CA Rocketr

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Course Code	Course Name	Credits
CEDLO7016	Department Level Optional Course-3: Pavement Materials, Construction and	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Highway and airways mode of transportation contributes to the economical, industrial, social and cultural development of any country. For the design and construction of highway and airfield, it is imperative to know the properties of the materials such as soil, aggregates and bitumen used in the construction of pavements. The various tests are required to be conducted to evaluate the properties of these materials for the scientific design of the pavements and economic utilization of the different materials. The course also deals with the soil survey, stresses in soil and various ways and means of improving the soil and implementing techniques of improvement. The course also deals with the various surface and sub-surface drainage.

Objectives

1. To give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards. To study the soil classification for highway engineering purpose as per different classification system.
2. To understand the concept of stresses in soil. To enable the student to identify the basic deficiencies of various soil deposits and to arrive upon the various ways and means of improving the soil and implementing the techniques of improvement.
3. To understand the requirements of aggregates as per IRC code.

4. To learn bituminous types and mix designs.
5. To understand the different types of distresses in pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements. To study the construction of the concrete roads and low volume roads
6. To learn basic principles of super pave technology of bituminous mixes

Detailed Syllabus

Module	Course Module / Contents		Periods
I	Soil		05
	1.1	Soil-Classification methods	
	1.2	Tests on Soil: CBR test, effect of lateral confinement on CBR and E value of Subgrade soil, Consistency, Engineering Properties and Modulus of sub-grade reaction of soil, estimation of modulus of subgrade reaction, Static and cyclic plate load test, correction for plate size, correction for worst moisture content.	
	1.3	Soil classification as per HRB.	
II	Stresses in Soil		08
	2.1	Theories of elastic and plastic behavior of soils, Cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus.	
	2.2	Stabilized Soils: Method of sampling and Preparation of Stabilized Soils for testing, Relation for Moisture content and Dry Density of Stabilized mixes, UCS of Stabilized soil, test for: soil bituminous, soil lime and soil fly ash mixes. (IRC: SP:89 (Part II)-2018)	
III	Aggregates		04
	3.1	Classification, requirements, Blending of aggregates, Importance of aggregate shape factor in mix design	
	3.2	Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials),	
	Bitumen, Tar and Bituminous Mix Design		

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IV	4.1	Binders: Requirements, criteria for selection of different binders, Temperature susceptibility, Bituminous emulsion and Cutbacks, fillers, extenders Polymers, Crum rubber, and rubber modified bitumen and anti-Stripping agents on pavement performance.	09
	4.2	Bituminous Mix Design: selection of different grade of bitumen, skid qualities, types of bituminous surfaces, bituminous mix design, Marshall Stability test, design aspect of paving concrete. Experimental characteristics of road aggregate.	
V	Evaluation and strengthening		09
	5.1	Flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkelman beam deflections, skid resistance and measurement	
	5.2	Highway construction: Construction of WBM roads, Bituminous pavements, cement concrete roads, Reinforced concrete pavements construction.	
	5.3	Quality control (QC) and Quality assurance (QA) during construction of various pavements.	
	5.4	Low-Cost Roads (Rural Areas) (IRC-SP-20-2002) Classification of low-	

		cost roads, construction of low-cost roads.	
Introduction to Super pave Technology			
VI	6.1	Methods of selection of suitable ingredient for super pave method, Gyratory compaction, rolling thin film oven, pressure aging vessel, rotational viscometer, dynamic shear rheometer, bending beam rheometer, direct tension test.	04
	6.2	Use of super pave perform and grade binder specifications. Comparison between Marshal Mix method and Super pave method.	

Recommended Books:

1 Highway Engineering: *Khanna, S.K., Justo, C,E.G. and Veeraragavan, A.*,Nem Chand and Brothers, Roorkee (10th Revised Edition, 2014)

2 Principles and Practices of Highway Engineering; *Dr. L. R. Kadiyali and Dr. N. B.Lal*, Khanna Publishers, New Delhi.

3 Principles of Transportation and Highway Engineering: *Rao, G.V.*, Tata Mc-Graw Hill Publications, New Delhi

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Course Code	Course Name	Credits
CEDLO7021	Department Level Optional Course-4 Foundation Analysis and Design	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Practical	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Foundation design is an important aspect of the vast field of civil engineering in general and geotechnical engineering in particular. A foundation designer has many diverse and important encounters with foundation design problems. The knowledge of foundation design is essential in design problems related to buildings, bridges, highways. tunnels, canals, or dams. The suitability of various types of foundations

i.e. shallow foundation, pile foundation, well foundation etc. depends upon the bearing capacity of the soil, the pattern of stress distribution in the soil beneath the loaded area, the probable settlement of the foundation, effect of ground water, effect of vibrations, the magnitude of loads and ground water conditions etc. This course provides some important geotechnical aspects of the analysis and design of foundations.

Objectives

1 To estimate the vertical stresses in soil and to study the various practical applications.
2 To understand the design concepts for shallow foundations
3 including strip and raft foundations and to understand applications of geocells.
4 To study the load carrying capacity and design of pile foundation.
5 To understand different types of well foundations and concept of floating foundations.
6 To analyze cantilever sheet piles including anchored sheet piles and to

7 understand braced cuts system
8 To learn different types of machine foundations and understand the design philosophy.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Estimation of Stresses in Soils**		04
	1.1	Boussinesque and Westergaard's theories	
	1.2	Newmark Chart	
	1.3	Practical applications.	
II	**Shallow Foundation**		06
	2.1	Determination of bearing capacity of shallow foundation by IS Code method	
	2.2	Settlement analysis of shallow foundation by IS code method	
	2.3	Geotechnical design of shallow foundation on rock and weathered rock	
	2.4	Geotechnical design of raft foundation.	
	2.5	Improvement in the bearing capacity of footings using geocells	
III	**Pile Foundation**		07
	3.1	Introduction, necessity of piles, types of pile foundations.	
	3.2	Load carrying capacity of single and group piles	
	3.3	Pile load test as per IS 2911 (Part I & Part II)	
	3.4	Geotechnical Design of single pile and pile cap as per IS 2911 and IRC 78	
IV	**Floating Foundation and Well Foundation**		06
	4.1	Introduction to floating foundation, floatation, bottom elastic heave	
	4.2	Design of floating foundation on piles	
	4.3	Introduction to well foundation, forces acting on well foundation.	

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V	**Sheet piles and Braced cuts**		08
	5.1	Cantilever sheet piles including anchored sheet piles in cohesionless and cohesive soils, lateral earth pressure diagram, computation of embedment depth	
	5.2	Difference in open cut and retaining wall theories, apparent earth pressure diagram	
	5.3	Design of reinforced soil retaining walls	
	5.4	Estimation of strut loads in braced cuts placed in cohesionless and cohesive soils.	
VI	**Machine Foundations**		08
	6.1	Introduction, Dynamic soil properties as per IS 5249	
	6.2	Types of machine vibrations	
	6.3	Basic principles of machines foundation	
		Total	**39**

Recommended Books:

1. Terzaghi K. and Peck R. B., "Soil Mechanics in Engineering Practice", Wiley and Sons, 1996.
2. Alamsingh, "Soil Mechanics and Foundation Engineering", Vol I & Vol II, Standard book House, 2013.
3. Holtz, R.D. & Kovacs, W.D., "An introduction to geotechnical engineering", Prentice Hall, 1981.
4. Taylor D.W., "Fundamentals of soil mechanics, Asia publications Bombay, 1967.

M., "Shallow Foundation- Bearing Capacity & Settlement" Taylor & Francis, 2009.
M., "Principles of Foundation engineering", PWS Publishing Company, 2012.

Reference Books:

1. Bowles J. E., Foundation Analysis and Design, McGraw-Hill Book Co, 2001.
2. Shamsher P. and Sharma H., Pile Foundations in Engineering Practice, Wiley and Sons, 1990.
3. Ranjan, Gopal & Rao, A.S.R., "Basic and applied soil mechanics", New Age International Pvt. Ltd., 2004
4. Kramer S. L. Geotechnical Earthquake Engineering, Prentice Hall, 1996
5. Swami Saran, Soil Dynamics and Machine Foundation (2nd Ed,), Galgotia Publication Pvt Ltd.
6. Duncan C. Wyllie, "Foundations on Rock" CRC Press; 2nd edition 2019.
7. N.V. Nayak, "Foundation Design Manual" Dhanpat Rai Publications, 2018.

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R-2025- T.E Civil Engineering with Computer Applications

Course Code	Course Name	Credits
CEDLO7022	Department Optional Course-4 Solid and Hazardous Waste Management	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Management of solid and Hazardous waste is a challenge for all developed and developing nations. Measures like proper collection, segregation, treatment, and solid waste disposal needs more attention in today's world. To achieve sustainable development proper solid waste management should be subjected to various types of waste treatments for obtaining value added products. Robust implementation of planned facilities for reuse, recycling, maximum resource recovery from various waste facilities, combined with safe residual waste disposal through sanitary landfills, incineration and novel methods of composting is initiated.

Objectives

1. To describe functional elements of solid waste management and its need.
2. To explain the segregation and transportation of municipal solid waste.
3. To recognize waste disposal methods and energy recovery techniques.
4. To comprehend the necessary knowledge and concepts of landfill for disposal.
5. To demonstrate hazardous waste management through its safe handling and disposal.
6. To identify assorted types of solid waste

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Municipal Solid Waste Management**		06
	1.1	Sources, Types, Quantities, Composition, sampling of wastes, Properties of wastes, Numericals related to moisture content, density and Energy content, Problems and issues of solid waste management - Need for solid waste management- Awareness programme, Legal issues related to solid waste disposal	
	1.2	Functional Elements of SWM- waste generation (factors affecting), storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.7R concept	
II	**Waste Segregation, Storage, Collection and Transport**		06
	2.1	Segregation - wet and dry method, Volume reduction at source, Recycling and Reuse of waste, Methods of collection - House to House collection, On site storage of municipal solid waste, Hauled container and stationary container system, Collection routes; Optimization of transportation routes, Numericals on container and collection systems.	
	2.2	Transfer station -Significance, Site selection, Types, Material Recovery facility	
	Waste processing techniques and Energy Recovery		

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III	3.1	Waste transformation- Biological and Thermal Biological Conversion Technologies – Composting, Factors affecting for composting, Various Composting Methods as Indore and Bangalore, Vermi, Mechanical and In vessel composting, Numericals on aerobic and anaerobic composting	06
	3.2	Thermal conversion technologies – Incineration, Pyrolysis, Gasification, Refuse derived fuel	
IV	**Landfills for Disposal of Waste**		07
	4.1	Landfill Classification-Sanitary, Secure and Bioreactor, Design criteria for landfill site selection, operation and maintenance, Landfill methods -Trench, Area, Slope	
	4.2	Leachate generation, Characteristics and it's control methods. Landfill gas management and landfill closure	
	4.3	IoT in solid waste management	
V	**Hazardous Waste Management**		07
	5.1	Sources, Characteristics and classification of hazardous wastes, Storage, Handling, Collection, Transportation and Minimization, Need for Hazardous Waste Management	
	5.2	Treatment and Disposal	

		Hazardous Site remediation – onsite and offsite Techniques. Hazardous waste management using secure landfill, Disposal practices in Indian Industries, Hazardous Waste Management Rules 2016.	
VI	**Assorted Solid Wastes**		
	6.1	**Biomedical waste** Need for Biomedical Waste Management, Sources, Classification, Storage and Segregation- Color coding, Collection and Transportation, Treatment and Disposal. Latest Biomedical waste management rules. **Electronic Waste** Types, Component separation, Collection, Recycling and Recovery, E- waste management techniques and Latest E-waste management rules	07
	6.2	**Plastic Waste** Problems related to plastic wastes, Plastic waste management- Recycling & recovery, Energy production, Plastic waste management- Rules and Regulation **Construction and Demolition waste** Composition, Recycling and reduction, Proper Management	

Recommended Books:

1. Integrated Solid Waste Management: Techobanglous, Thisen and Vigil, McGraw Hill International.
2. Hazardous Waste Management: Lagrega, Buckingham and Evans, McGraw Hill International.
3. Solid Waste Management in Developing Countries: A.D. Bhide, Nagpur publications.
4. Environmental Pollution Control Engineering: C.S. Rao, Wiley Eastern, Manual of solid waste of management, CPHEEO.
5. E-Waste: Implications, Regulations, and Management in India and Current Global Best Practices, Rakesh Johri, The Energy and Resources Institute.
6. Biomedical Waste Management in India: Jugal Kishore and G. K. Ingle, Century Publications
7. Advances in Construction and Demolition Waste Recycling Management, Processing and Environmental Assessment, Fernando Pacheco-Torgal, Yining Ding, Francesco Colangelo, Rabin Tuladhar, Alexander Koutamanis.
8. Plastics Waste Management, Disposal Recycling and reuse, Marcel Dekker, Inc. New York, 1993- Nabil Mustafa.
9. CPHEEO, "Manual on Municipal Solid Waste Management" Central Public Health and Environmental Engineering Organization, Government of India, New Delhi , 2000.
10. MSW Rules 2016," Swachh Bharat Mission and Smart Cities Program of India.
11. Hazardous and other Wastes Management Rules,2016

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R-2025- T.E Civil Engineering with Computer Applications

Course Code	Course Name	Credits
CEDLO7023	Department Level Optional Course-4: Ground Improvement Techniques	03

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

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

A geotechnical engineer often needs to design new structures or repair the structures on or in problematic soils in engineering practices. The types of soil at construction sites are not always totally favorable for supporting civil engineering structure such as buildings, bridges, highways, tunnels, retaining walls, dams, offshore structures and many more. Soil needs to be treated using ground improvement techniques to enhance the soil strength. Specific types of soil improvement techniques are required for different problematic soils and situations, such as expansive and collapsible soils, liquefiable soils, karst deposits, foundation on dumps and sanitary landfills, earthquake prone areas, etc. This course will deal with different ground improvement techniques, their principles, effectiveness, design issues and areas of applications.

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Objectives

1 To enable students to identify problematic soils, associated issues and need for ground improvement.

2 To make the students understand shallow and deep compaction techniques, importance of pre- compression and vertical drains.

3 To make the students understand different soil stabilization techniques.

4 To make the students learn the concepts, purpose and effects of grouting.

5 To make the students understand application of stone column technique.

6 To provide students the concept of reinforced earth, soil nailing and ground anchors.

Detailed Syllabus

Module	Course Module/ Contents	Periods
I	**Introduction**	**07**

	Different types of problematic soils and concerns (inadequate mechanical properties, swelling and shrinkage - expansive soils, collapsible soils, marshy and soft soils, organic/ peaty soils, loose sandy or gravelly deposits, liquefiable soils, karst deposits, foundation on dumps and sanitary landfills, old mine pits, etc.); Need for ground improvement; Control of ground improvement works; Ground improvement techniques for different soil types (principles, applicability to various soil conditions, material requirements, equipments required, results likely to be achieved and limitations); Grain size ranges for different treatment methods; Classification of ground modification techniques; Factors affecting the selection of ground improvement techniques; Benefits/objectives of ground improvement techniques, Emerging trends in ground improvement techniques (Types and brief discussion on constructive use of waste materials, low cost technologies with soil and additives, Geosynthetics, biotechnical stabilization, etc.) **Note:** Refer IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"	
II	**Compaction and Consolidation**	**07**
	Shallow compaction: laboratory and field methods of compaction, compaction curve, advantages of compaction, effect of compaction; Deep compaction: objectives, brief discussion on dynamic compaction (types of dynamic compaction, evaluation of improvement), dynamic consolidation, dynamic replacement, Vibro-compaction or, Vibro-floatation, Vibro replacement, blasting; Precompression and vertical drains: Precompression or preloading (principle, settlement without and with Precompression), accelerated consolidation by sand drains, free strain and equal strain cases, design of sand drain layout; Brief	

	discussion on prefabricated vertical drains (PVDs), advantages of PVDs over sand drains	
III	**Stabilization of Soil**	**05**
	Methods of stabilization; mechanical stabilization; lime, cement, fly-ash, bitumen, chemicals and polymer stabilization; Electrokinetic stabilization	
IV	**Grouting**	**06**
	Grouting technology, grout materials, choice of a grout material, classification, general relationship between permeability and groutability; Particulate grouts: characteristics of grout materials, characteristics of grout slurries; Non- particulate grouts: types of chemical grouts, salient features of chemical grouts, grout properties (mechanical properties, chemical properties, economic factors), penetrability and performance aspect of coarse and fine grouts, limits of groutability based on grain size distribution; Various applications of grouting. **Note:** Refer IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"	
V	**Stone Columns**	**07**

	Some important features of stone column treatment: influence of soil type, influence of construction methodology, treatment depth, area of treatment; Basic design parameters: stone column diameter, pattern, spacing, equivalent diameter, replacement ratio, stress concentration factor; Failure mechanisms; Design considerations; Estimation of load capacity of a stone column (unit cell concept); Settlement analysis by the reduced stress method; Granular blanket; Field loading tests; Installation techniques of stone columns: non-displacement method, displacement method, vibro-replacement method; Vibrofloat and rammed stone columns; Methods of improving the effectiveness of stone column **Note:** Refer IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"	
VI	**Reinforced Earth and Anchors**	**07**
	Theory of reinforced earth concept; Design principles of reinforced earth through Mohr circle analysis; Necessity of reinforced earth; Materials; Introduction to Geosynthetics: scope and definitions, multiple functions of Geosynthetics (Separation, Filtration, Drainage, Reinforcement, Protection (Cushion), Barrier/Containment/Waterproofing, Erosion Control), areas of applications; Introduction to soil nailing and ground anchors; Capacity of shallow horizontal strip anchor by using Mononobe-Okabe method.	
	Total	**39**

Recommended Books:

1. P. P. Raj (2016). "Ground Improvement Techniques", Second edition, Laxmi Publications

(P) LTD.

2. M. R. Hausmann (1990). "Engineering Principles of Ground Modification", McGraw-Hill Inc.,US.
3. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards, New Delhi, (2003).
4. Nihar Ranjan Patra (2012). "Ground Improvement Techniques", Vikas Publishing.
5. S. L. Kramer (2013). "Geotechnical Earthquake Engineering", Pearson.
6. B. M. Das (1990). "Earth Anchors", Elsevier.**Reference Books and IS Codes:**

1. IS 13094 (1992): "Selection of ground improvement techniques for foundation in weak soils – Guidelines"

2. IS 14343:1996 "Choice of Grouting Materials for Alluvial Grouting – Guidelines"

3. IS 15284-1 (2003): "Design and construction for ground improvement - Guidelines, Part 1: Stone columns"

4. R.M. Koerner (1984). "Constructional and Geotechnical Methods in Foundation Engineering (McGraw-Hill series in construction engineering and project management), McGraw-Hill Inc.,US.

5. FHWA Report No. Rd 83/026, (1983) Design and Construction of Stone Columns, Vol I.

6. B. M. Das (2011). "Principles of Foundation Engineering", 7th edition, Cengage Learning.

7. R.M.Koerner (1999). "Designing with Geosynthetics", 4th Edition, Prentice Hall, Jersey.

R-2025- T.E Civil Engineering with Computer Applications

Semester – VII							
Course Code		**Course Name**					**Credits**
CEDLO7024		**Department Level Optional Course-4: Green Building Constructions**					**03**
Contact Hours			**Credits Assigned**				
Theory	**Practical**	**Tutorial**	**Theory**		**Practical**	**Tutorial**	**Total**
03	--	--	03		--	--	03
Theory					**Term Work/Practical/Oral**		**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**
IAT I	**IAT II**	**Total**					
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Globally, buildings are responsible for a huge share of energy, electricity, water and materials consumption. As of 2018, buildings account for 28% of global emissions or 9.7 billion tonnes of CO_2. The United Nations' 2020 global status report and other sources detail that around 35 - 40% of globally generated energy was used by buildings; which also contributed to 33% of worldwide emissions. If new technologies in construction are not adopted during this time of rapid growth, emissions could double by 2050, according to the United Nations Environment Program. Green building construction practices aim to reduce the environmental impact of building as the building sector has the greatest potential to deliver significant cuts in emissions at little or no cost. As civil engineering graduates, it is of utmost importance to have a deep understanding of the concepts and technologies involved in the sustainable development with respect to the construction industry. It is also further desirable for the graduates to have an in-depth knowledge of the green rating systems as well as green auditing & green retrofitting – which will have tremendous scope in the future.

Objectives

1. To outline the environmental impact of buildings
2. To explain the concepts of sustainable development and green building

3. To summarize the features of green buildings
4. To explain green building rating systems
5. To describe green audit
6. To explain green retrofitting

Detailed Syllabus			
Module	**Course Modules / Contents**		**Duration**
I	**Introduction**		**3**
	1.1.	Environmental impact of buildings, concept of sustainable development, concept of green buildings, necessity of green buildings, benefits of green buildings	
	1.2.	Overview of features of green building – design and construction efficiency, water efficiency, energy efficiency, materials efficiency, indoor environmental quality, waste reduction, operations and maintenance	
	1.3.	Examples of green buildings	
II	**Site Selection, Planning and Design**		**8**
	2.1.	Site preservation	
	2.2.	Passive architecture	
	2.3.	Soil erosion control	
	2.4.	Natural topography and on-site vegetation	
	2.5.	Preservation of transportation of trees on-site	
	2.6.	Heat island reduction	
	2.7.	Optimization in structural design	
	2.8.	Innovation in design process	
III	**Water Conservation and Energy Efficiency**		**10**
	3.1.	Rainwater harvesting	
	3.2.	Water efficient plumbing fixtures	
	3.3.	Irrigation systems	
	3.4.	Wastewater treatment and reuse	
	3.5.	Water metering	
	3.6.	Wastewater reuse during construction	
	3.7.	Minimum and enhanced energy efficiency	
	3.8.	Commissioning plan for building equipment and systems and post-installation	
	3.9.	On-site and off-site renewable energy	
	3.10	Energy Metering and Management	
	Green building materials and indoor environmental quality		

IV	4.1.	Sustainable building materials	**10**
	4.2.	Use of certified green building materials, products & equipment	
	4.3.	Segregation of waste, organic waste management and handling of waste materials	
	4.4.	Fresh air ventilation	
	4.5.	CO_2 monitoring	
	4.6.	Day lighting	
	4.7.	Minimizing of indoor and outdoor pollutants	
	4.8.	Low-emitting materials	
	4.9.	Occupant well-being facilities	
	4.10	Indoor air quality testing, after construction and before occupancy	
	4.11	Indoor air quality management	
V	**Green building rating systems**		**4**
	5.1.	Introduction to green building rating systems	
	5.2.	Overview of various green building rating systems	
	5.3.	Indian Green Building Council (IGBC) rating system – overview, benefits of new green buildings, overview of certification process and project checklist	
VI	**Green audit and green retrofitting**		**4**
	6.1.	Green audit: pre-audit, on-site audit and post-audit report	
	6.2.	Case study of any one green building audit	
	6.3.	Green retrofit – overview, components of green retrofit: integrated design, occupant behaviour, lighting retrofits, HVAC retrofits, window retrofits, green roof retrofits	

Recommended Books:

1. Green Building: Principles and Practices by Dr. Adv. Harshul Savla (Notion Press)
2. The Idea of Green Building by A. K. Jain (Khanna Publishers)
3. Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination by Karthik Karuppu (Notion Press)

4. Green Building Materials & Implementation by Dr. V. Murugesh (Notion Press)
5. Green Building Fundamentals by G. Harihara Iyer (Notion Press)

Reference Books/Links:

1. Indian Green Building Council (IGBC) web-site: https://igbc.in/igbc/
2. Leadership in Energy & Environmental Design (LEED) web-site: https://www.usgbc.org/leed
3. Green Building: Principles & Practices in Residential Construction by Abe Kruger and Carl Seville (Delmar Cengage Learning)
4. Green Building through Integrated Design by Jerry Yudelson (McGraw Hill)
5. Green Building Handbook: Volume 1: A Gude to Building Products and their Impact on the Environment by Tom Wooley, Sam Kimmins, Rob Harrison and Paul Harrison (Routledge Publishers)

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R-2025- T.E Civil Engineering with Computer Applications

Semester VII

Course Code	Course Name	Credits
CEDLO7025	Department Level Optional Course- 4: Legal Aspects in Construction	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Practical	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	-	-	20	100

Rationale

Construction industry is one of the most regulated industries in the World and subjected to various laws, rules, and regulation and ethical standards. A civil Engineering graduate must be able to understand and interpret these laws and navigate through these environments with utmost certainty and responsibilities.

The syllabus of this course has been designed to give preliminary introduction to Civil Engineering about legal aspects in construction industry. Along with this, the course intend to help students understand various aspects of contracts, tenders and roles & responsibilities of various involved individual and parties.

Objectives

1 To explain needs of various laws and legislation related to Construction Industry.

2 To summarize application of various Contracts and their forms (Documents)

3 To describe application of various Tenders and their forms (Documents)

4 To understand needs & Methods of arbitration and dispute resolution mechanism

5 To explain needs health, safety and labour laws associated with Construction

Industry

To describe needs of Environmental protection and ethics in Construction Industry.Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Introduction to Legal Aspects in Construction Industry**		6
	1.1	Need of laws in the construction industry. Role of Builders, Engineers, Architects and Contractors.	
	1.2	Need for legislation. Important Laws related to construction industry: Indian Contract Act 1872, Labour laws, The Building and Other Construction Workers Act, 1996, The Environment (Protection) Act, 1986.	
II	**Contracting in Construction**		8
	2.1	Contract: Definition, Purpose and Sanctity of Contract, Classification of Construction Contracts and their advantages and disadvantages: Lump-Sum Contract, Unit Price Contract, Cost-Plus Contract and Target Contract. Types of Documents (Forms) in a Construction Contract.	
	2.2	Contract Management: Indian Contract Act- 1872, Breach of Contract and Professional ethics to be followed by Contracting Parties.	
III	**Tendering in Construction**		6
	3.1	Tender: Definitions. Requisites of a Valid Tender Types of Tendering: Open Tendering, Selective Tendering and Negotiated Tendering.	
	3.2	Tender Documents, Scrutinization process, Award, acceptance, Bidding models & bidding strategies. E-Tendering process of PWD.	
	Arbitration and Dispute Resolution		
	4.1	Claims & disputes, Standard methods of resolving disputes.	

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IV	4.2	Dispute Resolution Board (DRB) – Necessity, formation, Functioning, Advantages etc	6
	4.3	Arbitration & conciliation Act -1996 – Arbitration agreement, Arbitration process, duties & powers of an arbitrator, rules of preparing evidence, Publication of an award.	
V	**Health, Safety and Labour Laws**		6
	5.1	Safety rules on construction sites. Roles and responsibilities of owner, contractor and engineers on site.	
	5.2	Important laws: BOWC Act 1996	
	5.3	Minimum Wage Act, 1948	
	5.4	GST Tax Act 2017	
VI	**Environmental Protection and Ethics**		7
	6.1	Impact of construction industry in global warning and climate change. Environmental impact assessment report and case study of any recent infrastructure project.	
	6.2	Paris agreement 2020 and Indian's Climate target as per Paris agreement.	
	6.3	Ethical responsibilities of Civil Engineers, contractors and other parties in construction.	

Recommended Books:

1 Manual for Procurement of Works 2019 GoI, Ministry of Finance
2 PWD manual for E-tendering 2018 PWD, India
3 Construction contracts and claims - Simon M.S., McGraw Hill, New York
4 Construction contracts Management- NICMAR Publication India
5 Estimation and contracts B.S. Patil

Reference Books:

1 Construction contracts and claims - Simon M.S., McGraw Hill, New York
2 Construction contracts Management- NICMAR Publication India

Course Code	Course Name	Credits
CEDLO7026	Department Level Optional Course-4: Environmental Impact Assessment	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Environmental impact assessment is the formal process used to predict the environmental consequences (positive or negative) of a plan, policy, program, or project prior to the decision to move forward with the proposed action. An impact assessment may propose measures to adjust impacts to acceptable levels or to investigate new technological solutions. This subject covers the study of environmental assessment process, environmental auditing and provisions of various environmental acts of India.

Objectives

1 Students will learn about sustainable development
2 Students will learn different steps within environmental impact assessment
3 Students will learn how to use of EIA for various projects
4 Students will learn the need to assess and evaluate the impact on environment.
5 Students will learn about Environmental Audit
6 Students will learn Major principles of environmental impact assessment

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Detailed Syllabus

Module	Course Module / Contents	Periods
I	**Environmental impact assessment** What is it, Environmental attitudes, Brief history of EIA, Significance of EIA, Role of EIA in planning and decision making process, objectives of EIA.	5
II	**Environmental assessment process** Assessment methodology, Socioeconomic impact assessment, Air quality impact analysis, Noise impact analysis, Energy impact analysis, Water quality impact analysis, Vegetation and wild life impact analysis, Cumulative impact assessment, Ecological impact assessment, Risk assessment.	8
III	**Environmental Impact Assessment Process** Basic concept behind EIS, Stages in EIS production: Screening, scoping, prediction, evaluation, reducing impact, monitoring, conclusions, typical EIS outline	5
IV	**Rapid EIA** Rapid EIA, when it is carried out, advantages and disadvantages	6
V	**Environmental Auditing** Definition, aims and objectives, audit principles, incentives to undertake audit, partial environmental audits, stages of implementing environmental audits, scope of audit	7
VI	**Provisions of various environmental acts of India** various environmental acts of India, Case studies	8

Recommended Books:

1 Corporate Environmental Management: Welford R, University Press
2 Environmental Assessment: *Jain R K*, Mc-Graw Hill
3 Environmental Impact Assessment: *Harry W Conter*, Mc-Graw Hill
4 Environmental Impact Assessment – Handbook: *John G Rau* and *D C Wooren*, Mc-GrawHill.
5 Introduction to Environmental Impact Assessment, A Chadwick, Taylor & Francis , 2007

6 Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

7 Environmental Impact Assessment, Larry Canter, McGraw-Hill Publications

Reference Books:

1 Strategic Environmental Assessment,R.Therirvel, E. Wilson, S. Hompson, D. Heaney, D.Pritchard, Earthscan, London , 1992

2 A Practical Guide to Environmental Impact Assessment, Paul, A Erickson,Academic Press , 1994

3 Handbook of Environment Impact Assessment by Judith Petts; McGraw Hill publications

4 Environmental Impact Assessment: Theory & Practice, Wathern, P, Publishers-Rutledge, London, 1992.

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R-2025- T.E Civil Engineering with Computer Applications

Subject Code	Subject Name	Credits
CEDLO7027	Department Level Optional Course-4: Advanced Design of Steel Structures	03

Teaching Scheme

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

Evaluation Scheme

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

The civil engineering structures are subjected to different types of loading and their combination. Many of the structure are made of steel , these structure are design by working stress method and limit state method . The design method of different component are given in the syllabus are based on limit state method and working state method.

Objectives

1 To understand the design philosophies of Working stress and Limit state methods and

2 design of moment resistant connections.

3 To explain the design concept of gantry girder

4 To understand the analysis and design concept of round tubular structures

5 To describe the design concept of different type of steel water tank

6 To explain the design concept of lattice tower

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7 To describe the design concept of steel chimney.

Detailed Syllabus

Module	Sub – Modules / Contents	Periods
I	**Introduction to Steel Structure and Moment Resistant Beam End Connections:**	**07**
	Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM) , Limit state method and design of simple riveted connection. Design of moment resistant bolted and welded beam end connections by limit state method	
II	**Gantry Girder :**	**06**
	Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.	
III	**Round Tubular Structural Members :**	**06**
	Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports	
IV	**Elevated Steel Tanks and Stacks :**	**08**
	Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation,	
V	**Lattice Tower:**	**06**
	Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower,	
VI	**Steel Chimney :**	**06**
	Forces acting on chimney, design of self supporting welded and bolted chimney and components including design of foundation.	

Recommended Books:

1 Design of Steel Structures : N Subramanian, Oxford- University Press
2 Design of Steel Structures: Punamia, A. K. Jain & Arun Kumar Jain . Laxmi Publication
3 Design of Steel Structures: Dayaratnam, Wheeler Publication, New Delhi.
4 Design of steel structures: Krishnamachar B.S, & Ajitha Sinha D.

Reference Books:

1. Design of Steel Structures: Mac. Ginely T.
2. Design of Steel Structures: Kazimi S. M. & Jindal R. S., Prentice Hall of India.
3. Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York.
4. Design of Steel Structures: Arya and Ajmani, New chand & Bros.
5. Relevant IS codes, BIS Publication, New Delhi
6. Steel structures, Controlling behavior through design: R. Englekirk, Wiley
7. LRFD Steel Design : William T. Segui, PWS Publishing
8. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord and James. Stallmeyer, McGraw-Hill

R-2025- T.E Civil Engineering with Computer Applications

Course Code	Course Name	Credits
ILOC7011	**Institute Level Optional Course – I : Product Life-cycle Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and
4. developing a product
5. To familiarize the students with Virtual Product Development

Module	Detailed Contents	Hrs
I	**Introduction to Product Life-cycle Management (PLM):** Product Life-cycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10

II	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The	09

	Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	
III	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
IV	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
V	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
VI	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

References:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer- Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Life-cycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7012	**Institute Level Optional Course – I : Reliability Engineering**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Module	Detailed Contents	Hrs
I	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08

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II	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
III	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
IV	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
V	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
VI	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

References:

1. L.S. Srinath, “Reliability Engineering”, Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7013	**Institute Level Optional Course – I : Management Information System**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

1 The course is blend of Management and Technical field.
2 Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3 Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4 Identify the basic steps in systems development

Module	Detailed Contents	Hrs
I	**Introduction To Information Systems (IS):** Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
II	**Data and Knowledge Management**: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7

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III	**Ethical issues and Privacy**: Information Security. Threat to IS, and Security Controls	7
IV	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
V	**Computer Networks Wired and Wireless technology**, Pervasive computing, Cloud computing model.	6
VI	**Information System within Organization**: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. **Acquiring Information Systems and Applications**: Various System development life cycle models.	8

References:

1. Kelly Rainer, Brad Prince,Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7014	**Institute Level Optional Course – I: Design of Experiments**	**03**

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	--	--	--	100

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Module	Detailed Contents	Hrs
I	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
II	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08

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III	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
IV	**Two-Level Fractional Factorial Designs**	07

	4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	
V	**Response Surface Methods and Designs** 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07
VI	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rdedition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7015	**Institute Level Optional Course – I : Operations Research**	**03**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Module	**Detailed Contents**	**Hrs**

I	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	14

	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
II	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
III	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte- Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
IV	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
V	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
VI	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7016	**Institute Level Optional Course – I : Cyber Security and Laws**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To understand and identify different types cyber crime and cyber law
- To recognized Indian IT Act 2008 and its latest amendments
- To learn various types of security standards compliances

Module	Detailed Contents	Hrs
I	**Introduction to Cyber crime:** Cyber crime definition and origins of the world, Cyber crime and information security, Classifications of cyber crime, Cyber crime and the Indian ITA 2000, A global Perspective on cyber crimes.	4
II	**Cyber offenses & Cyber crime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cyber crimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues,	9

	Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
III	**Tools and Methods Used in Cyber line** Phishing, Password Cracking, Key loggers and Spy-wares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
IV	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
V	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
VI	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

References:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White

Publications, Mumbai

5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7017	**Institute Level Optional Course – I : Disaster Management and Mitigation Measures**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To describe role of individual and various organization during and after disaster
5. To explain application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Module	Detailed Contents	Hrs
I	**Introduction** **1.1** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03

II	**Natural Disaster and Manmade disasters:** 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
III	**Disaster Management, Policy and Administration** 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co- ordination of in disaster management, rescue operations-how to start with and	06

	how to proceed in due course of time, study of flowchart showing the entire process.	
IV	**Institutional Framework for Disaster Management in India:** 4.1 Importance of public awareness, Preparation and execution of emergency management programme.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
V	**Financing Relief Measures:** 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
VI	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and Don'ts in case of disasters and effective implementation of relief aids.	06

References:

1.Disaster Management' by Harsh K.Gupta, Universities Press Publications.

2.Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.

3.'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.

4.'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.

5.'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.

6.'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications

7.Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7018	**Institute Level Optional Course – I : Energy Audit and Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Module	Detailed Contents	Hrs
I	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04

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II	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
III	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings.	10

	Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	
IV	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
V	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
VI	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press

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Semester VII		
Course Code	**Course Name**	**Credits**
ILOC7019	**Institute Level Optional Course – I : Development Engineering**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

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Module	Detailed Contents	Hrs.
I	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
II	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee- linkage between Panchayati Raj, participation and rural development.	04
III	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the	06

	weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
IV	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	**04**
V	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	**10**
VI	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	**04**

Reference

1.ITPI, Village Planning and Rural Development, ITPI, New Delhi
2.Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3.GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4.Planning Commission, Five Year Plans, Planning Commission
5.Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6.Planning Guide to Beginners Weaver, R.C., The Urban Complex, Doubleday.

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	
CEC801	Construction Management	3	0	--	39			--	39	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
CEC801	Construction Management	20	20	20	60	3	--	--	100

Rationale:

This course is intended to teach students the management skills to be applied during all the stages of Civil Engineering Project. The professional construction engineering practice will be rendered meaningless if service is not offered with a scientific approach and managerial practices. This course deals with the techniques to be applied for planning and scheduling projects, optimizing time-cost and other resources in construction, monitoring & ensuring quality and safety aspects in projects

Course Objectives:

1 To understand the basic functions and construction management.

2 To apply scheduling techniques such as CPM & PERT

3 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.

4 To understand allocating the resources and project monitoring

5To know about safety and quality aspect of construction works.

Course Outcomes: (Based on Blooms Taxonomy)

1 Explain & apply the knowledge of management functions like planning, scheduling, Executing & controlling the construction projects.

2 Prepare feasible project schedule by using various scheduling techniques.

3 Gain knowledge of managing various resources & recommend best method of allocating resources to the project

4 Develop optimum relationship between time & cost for construction project

5 Implement quality & safety measures on construction sites during execution of Civil Engineering projects.

6 Describe the importance of labour acts.

DETAILED SYLLABUS: Total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours
I	Introduction to Construction Management	1.1 Concept and Principles of Management, contribution by eminent personalities like F.W.Taylor, Henry Fayol and Elton Mayo towards growth of management thoughts. 1.2 Significance, objectives & functions of construction management	03
II	Construction Projects	2.1 Role and unique features of Construction industry in economic development of country	03

		2.2 Construction projects- Classification, Characteristics, Project life cycle 2.3 Roles and responsibilities of various agencies associated with a Construction project	
III	Construction project planning & Scheduling	3.1 Stages of planning in the view of owner / department as well as contractor. 3.2 W.B.S, Bar Charts its limitations and its uses, Milestone charts 3.3 Network-Terminology, Network Rules, Fulkerson's rule, Precedence network. 3.4 C.P.M- Activity & event with their types, activity times, event times, Critical path, forward pass, backward pass, float & its types. 3.5 P.E.R.T- Assumption underlying PERT analysis time estimates, slack& its types, probability of completing the project	12
IV	Resources Management & Allocation	4.1 Material Management- Importance, objectives and functions of material management. Inventory control, A-B-C analysis and E.O.Q. 4.2 Human Resource Management- Importance, objectives and functions 4.3 Resources Allocation Methods- Resource levelling and Smoothening	08
V	Project Monitoring & Cost Control	5.1 Network Updating- Purpose and frequency of updating. 5.2 Time and cost optimization in construction projects - Compression & decompression of network. 5.3 Common causes of time over run & cost overrun & Corrective	08

VI	Construction Safety, Quality Control & Labour Acts	6.1 Common causes of accidents on construction sites, costs of accident and precautionary measures to avoid accidents. 6.2 Introduction to O.S.H.A. Occupational health hazards & Health Campaign in construction industry. 6.3 Concept of Quality and quality control. 6.4 Importance of labour acts as applicable to Indian construction labour such as Payment of wages act, Minimum wages act, Workmen's compensation act.	05

Recommended Books:

1 Construction Engineering and Management: S. Seetharaman.

2 Construction Planning & Management – Dr. U. K. Shrivastava.

3 Construction Projects planning and Management: P. S. Gahlot and Dhir New Age International (p) Publishers

4 Construction Project Management: Chitkara K. K. Tata McGraw Hill

5 Handbook of Construction Management: P K Joy, Macmillan, India

6 Critical Path Methods in Construction Practice: Antill J M &Woodhead R W, Wiley

Reference Books:

1. Construction Hazard and Safety Handbook: King &Hudson, Butterworth
2. Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill
3. NPTEL: Civil Engineering-NOC: Principles of construction https://nptel.ac.in/courses/105/104/105104161/ Online References:

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	
CEL801	Construction Management	--	2	--	--	--	--	--	30	1

Lab Objectives:

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
CEL801	Construction Management	--	--	--	--	25	25	50

1 To understand the basic functions and construction management.

2 To apply scheduling techniques such as CPM & PERT

3 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.

4 To gain knowledge of time-cost optimization & effective utilization of resources on construction sites.

5 To know about safety and quality aspect of construction works.

Lab Outcomes: (Based on Blooms Taxonomy)

1 Summarize & apply the knowledge of management functions like planning, scheduling, Executing & controlling the construction projects.

2 Prepare feasible project schedule by using various scheduling techniques.

3 Gain knowledge of managing various resources & recommend best method of allocating resources to the project.

4 Develop optimum relationship between time & cost for construction project.

5 Implement quality & safety measures on construction sites during execution of Civil Engineering projects.

6 Explain the importance of labour acts.

List of Assignments.

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment No. 1: Principles, Functions, and contribution of eminent personalities towards Management	2
02	Assignment No. 2: Project classifications, Unique features of construction, Various agencies involved in construction industry	2
03	Assignment No. 3: Bar Charts, its limitations and uses. Numerical on development of networks and calculation of floats using CPM technique	2
04	Assignment No. 4: Assumptions underlying PERT analysis, time estimates, slack & its types, probability of completing the project	2
05	Assignment No. 5: Numerical on Resource Allocation Methods - Resource levelling and Smoothening	2
06	Assignment No. 6: Procedure and Numerical on Time and Cost Optimization in construction projects - Compression & Decompression of network	2
07	Assignment No. 7: Network Updating - Purpose and frequency of updating. Numerical on Project Updating	2
08	Assignment No. 8: Construction Safety, Quality Control & Labour Acts	2

Reference Books:

1 Construction Engineering and Management: S. Seetharaman.

2 Construction Planning & Management – Dr. U. K. Shrivastava.

3 Construction Project Management: Chitkara K. K. Tata McGraw Hill.

4 Construction Projects planning and Management: P. S. Gahlot and Dhir New Age International (p) Publishers

5 Critical Path Methods in Construction Practice: Antill J M &Woodhead R W, Wiley9

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Course Code	Course Name	Credits
CEDLO8014	**Department Level Optional Course-5: Pavement Design**	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

The pavements are classified according to mode of transportation (highway and airways) and structural behaviour (flexible and rigid). The design of any pavement warrants the proper analysis thereof. The course deals with the various methods of the analyses and design of pavements.

Objectives

1 To study the different types of pavements depending upon the mode of transportation, factors affecting pavement design, and methods.

2 To understand the concept of analysis of stress, strain and deflection in pavement.

3 To enable the students to understand and analyse the mechanics related to flexible pavements as applicable for highways.

4 To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations. To enable the students to understand and analyses the concrete pavements as applicable for highways.

5 To enable the students to understand and analyse the mechanics related to flexible and concrete pavements as applicable for airports.

6 Evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements and introduce pavement management

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Detailed Syllabus

Module	Course Module / Contents		Periods
I	Introduction		04
	1.1	Classification of Pavement, Pavement structure and functional attributes, factors affecting pavement design.	
	1.2	Types of wheel loads for highways and airports, development of design method for highway and airport pavements	
II	Stresses in Pavement		06
	2.1	Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF,ESWL	
	2.2	Stresses in Rigid pavement: load and temperature stresses, combined stresses.	
III	Flexible Pavement Design		08
	3.1	Empirical methods using no soil strength criteria, empirical method based no soil strength criteria: CBR method as specified by IRC-37 -1970, 1984, 2001, 2012, 2018.	
	3.2	Road note 29 methods, AASHTO method, Asphalt institute method. Fatigue and rutting as a failure criterion.	
	3.3	Introduction to use of software for flexible pavement design.	
IV	Rigid Pavement Design		08
	4.1	Load and temperature stresses in rigid pavements Westergaard's, Bradburry's and Picket's concepts	
	4.2	Design steps as per IRC-58-2012,2015 method	
	4.3	Design of joints in rigid pavements	
	4.4	Introduction to use of software for rigid pavement design	
	Design of Airport Pavements		
	5.1	Factors affecting, types of wheel loads , aircraft loading, gear	

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V		configuration and tyre pressure , development of design method	08
	5.2	Design Methods: Corps of Engineer's method, FAA method CDOT method, Asphalt institute method. PCA methods	
	5.3	Joints and reinforcement requirement.	
	Design of Overlay		05
VI	6.1	Design aspects of flexible and rigid overlays design of overlays (IRC-81- 1997)	
	6.2	Introduction to pavement management systems: Components of pavement management systems	

Recommended Books:

1 Principles and Practice of Highway Engineering: *L.R.Kadiyali*, Khanna publications.

2 Highway Engineering: *Khanna S.K. and Justo* C.E.G. Nem Chand (Revised 10th Edition, 2014)

3 Principles, Practice and Design of Highway Engineering (Including Airport Pavements): *Sharma, S.K.*, S. Chand Technical Publications (3rd Revised Edition, 2013)

4 Pavement Design: *Yoder* and*Witzech*, McGraw-Hill, 1982.

Reference Books:

1 Rajib Mallick & Tahar El-Korchi, *Pavement Engineering: Principles and Practice*, CRC Press , 2nd Edition, 2013

2 A. T. Papagiannakis, Eyad A Masad, *Pavement Design and Materials*, John Willey and Sons , 1st Edition 2008

3 Relevant Latest IRC, ASTM, AASHTO and other Codes, Manuals and Specifications

4 R Srinivasa Kumar, Pavement Design , University Press.

5 Pavement Analysis and Design: *Yang H. Huang*, Prentice Hall, New Jersey, 1993

Course Code	Course Name	Credits
CEDLO8015	Department Optional Course 5: Industrial Waste Treatment	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Industrial wastewater is much more polluted than the domestic wastewater and hence has to be treate with the efficient choice of treatment units by preventing pollution of natural streams and rivers Wastewater treatments may not suffice only with primary treatments until they are modified an supplemented by additional techniques because of toxic chemicals. Industries are therefore generall prevented by legal aspects, from discharging their untreated effluents. It becomes mandatory fo industries to treat their wastewater in their individual treatment plant or common effluent treatment plan before discharging their waste on land, lake, river, municipal sewer, streams as the case may be.

Objectives

1. To enable the students to understand quality, characteristics, toxicity of industrial wastewater and its effects on streams.
2. To enable the students to understand the impact of industrial wastewater on natural streams.
3. To enable the students to understand waste minimization techniques for industrial wastewater.

4. To enable the students to understand the necessary knowledge and concepts of biological treatment and advanced/emerging techniques.
5. To enable the students to understand various industrial manufacturing process, effluents and treatments.
6. To enable the students to understand legislative framework for the remediation of industrial wastewater through environmental audit, environmental impact assessment and common effluent treatment plant.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	**Introduction to industrial waste and treatments:** Sources and types of industrial waste-water, Effects of industrial waste-water on streams and waste-water treatment plants. Population equivalence, generation rates, characterization, important contaminants of concern from industries. Toxicity and Bioassay tests. Regulation for protection of streams. BOD Numericals.		06
II	**Stream Protection Measures:** Stream and effluent standards, stream sampling, stream sanitation, Procedures for improving stream water quality, zones of pollution, oxygen sag curve, Streeter Phelps Equation and numerical.		06
III	**Waste minimization:**		06
	3.1	Minimizing effects of industrial waste water: Volume reduction and Strength reduction	
	3.2	Equalization, Neutralization, Proportioning, Precipitation, Coagulation and flocculation. Flotation - Oil separation and Emulsion breaking.	
	Waste-water treatments for industries		

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IV	4.1	**Biological treatments:** Aerobic and Anaerobic biological treatment methods (Ponds, lagoons, UASB, RBC). Sludge dewatering techniques- Filter Press, Vacuum Filtration, Sludge thickening, Membrane filtration and Centrifuge.	06
	4.2	**Advanced treatments:** Need for advance technologies, Automated Chemostat Treatment (ACT) Soil Biotechnology (SBT) Reed Bed Technology (RBT) Ozonation	
V		**Industries and waste-water management:** Raw material, Manufacturing process and flow-sheets, sources of effluents, characteristics, ETP, byproduct recovery for following industries: ● Sugar ● Distillery ● Tannery	10

	● Dairy ● Paper and Pulp ● Metal Processing Industry (Electroplating)		
VI	**Legal Aspects, Environment Management Tools and Common Treatment Facility for industries**		05
	6.1	Environmental Impact Assessment, Case Study.	
	6.2	Environmental Audit for industries.	
	6.3	Common Effluent Treatment Plants (CETPs): Flow chart, Location, Need, Operation & Maintenance Problems and Economical aspects. Case study.	

Recommended Books:

1 Industrial Pollution Control by Eckenfedlar W.W, 2017
2 Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy,

T.M.H. Edition, New Delhi, 1995.
3 Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi.
4 Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
5 Wastewater Treatment for Pollution Control and Reuse Hardcover – 1 July 2017, Soli. J Arceivala , Shyam. R Asolekar.
6 Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
7 Water Supply and Sewerage: E.W. Steel.
8 Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
9 Introduction to Environmental Engineering: P. Aarne Vesilind, Susan M. Morgan, Thompson.
10 Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
11 Basic Principles of Wastewater Treatment Book ,Marcos Von Sperling
12 Industrial Waste Water Treatment Book, A. D. Patwardhan
13 Waste Water Treatment , M.N. Rao and Dutta

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Semester VIII		
Subject Code	**Subject Name**	**Credits**
CEDLO8016	**Department Level Optional Course-5: Soil Dynamics**	**03**

Teaching Scheme						
Contact Hours			**Credits Assigned**			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme								
Theory					**Term Work/ Practical/Oral**			**Total**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

In basic geotechnical engineering course normally various static loads are considered in the theories and analysis of soil. But practically many geotechnical applications require the knowledge of the behavior. properties and response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings. Some of the structures which are subjected to dynamic loadings are machine foundations, shallow and deep foundations, retaining structures, slopes, subgrade soil below railway, pavement, runway etc. This course provides the fundamental theoretical and computational aspects of dynamics for some important geotechnical problems and structures.

Objectives

1. To study fundamental concepts of vibrations, degrees of freedom and damping systems.
2. To study phenomena like liquefaction and their effects.
3. To study principals of machine foundation design and dynamic earth pressure theories on Retaining wall.
4. To learn test methods of evaluating dynamic properties of soil.
5. To know the earth pressure on retaining walls.

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Detailed Syllabus		
Module	**Sub- Modules/Contents**	**Hrs**
I.	**Introduction to Soil Dynamics**	**04**
	1.1 Introduction to vibration (simple harmonic motion), Types of waves **1.2** Introduction to the concept of degree of freedom **1.3** Introduction to dynamic soil properties (IS4249) **1.4** Scope and objective, Nature and types of dynamic loading, Importance of soil dynamics.	
II.	**Dynamic approach in different components**	**05**
	2.1 Wave propagation in elastic rods, in an elastic finite medium and in semi- elastic half space **2.2** Wave generated by surface footing	
III.	**Liquefaction of Soil**	**08**
	3.1 Introduction to liquefaction of soils and its basic terminologies, criterion and factors affecting liquefaction of soil. **3.2** Liquefaction studies in triaxial shear, field studies on liquefaction **3.3** Evaluation of liquefaction potential using analytical method and SPT.	
IV.	**Machine Foundation**	**06**
	4.1 Principles of machine foundation design, criteria for satisfactory machine foundation, degree of freedom of a block foundation, analysis of vertical and sliding vibration of a machine foundation **4.2** Practical design considerations and codal provisions.	
V.	**Dynamic behavior of Machine Foundation**	**05**
	5.1 Mass of soil participating in vibration. **5.2** Vibration isolation and screening methods, improvement of distressed machine foundation.	
VI.	**Dynamic behavior of Retaining Wall**	**11**
	6.1 Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils. **6.2** Basics of dynamic earth pressure on retaining walls conventional gravity type, reinforced soils, distribution of pressure, and point of application of the resultant, simple examples.	
Total teaching Hours		**39**

Recommended books:

1. Soil Dynamics: *Shamsher Prakash*, McGraw-Hill book company
2. Principles of Soil Dynamics: *Braja, M.Das*, PWS-Kent Publishing Company
3. Dynamics of Bases and Foundations: *Barkan, D.D.*, McGraw-Hill Book company
4. Geotechnical Earthquake Engineering", StevenL.Kramer ,PrenticeHalllnc.
5. Vibrations of Soils and Foundations", E.E.Richartetal ,PrenticeHallInc.
6. Relevant IS codes

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Course Code	Course Name	Credits
CEDLO8021	Department Optional Course 6: Repairs, Rehabilitation and Retrofitting of Structures	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Structures need strengthening and repairs due to variety of reasons. Now a days different materials, techniques and machineries are used to improve the structures and prolong their serviceable life. A structure needs regular maintenance to perform satisfactorily during its lifetime. This subject deals with damage assessment, preparing a strengthening strategy of RCC , steel structures, Seismic Retrofitting and maintenance of heritage structures.

Objectives

1.To understand the concept of Repair of repair and its need.

2.To understand various causes of deterioration of concrete structure and Distresses monitoring techniques.

3.To understand various materials of repairs and their properties.

4.To understand various methods of repairs of concrete structure.

5.To understand various methods of repairs of steel structure.

6.To understand seismic retrofitting and maintenance of heritage structures.

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Detailed Syllabus

Module	Contents		Periods
1	**Introduction**		03
	1.1	Need for repair, rehabilitation and maintenance of structure. Repair Management. Sustainable development.	
	1.2	Maintenance and it's importance, life cycle cost of structure	
	1.3	Heritage structure and need for their Rehabilitation	
2	**Damage Assessment**		08
	2.1	Causes of deterioration of concrete: Physical , Chemical and Mechanical causes.	
	2.2	Distresses monitoring, Visual inspection, Non Destructive Testing using Rebound hammer, Ultra sonic pulse velocity, Semi destructive testing, Probe test, Pull out test, Chloride penetration test, Carbonation, Carbonation depth testing, Corrosion activity measurement.	
	2.3	Types of cracks: Diagonal Cracks, Horizontal Cracks, Splitting Cracks, Corrosion Cracks, Plastic shrinkage cracks, thermal cracks	
	2.4	Crack Measurement techniques: Steel Ruler, Magnified Graticule , Plastic Tell Tale Glass Tell Tale Brass Screws and Caliper Displacement Transducer	
3	**Repair of Concrete Structures**		06
	3.1	Methods of crack repairs: Epoxy injection, Routing and Sealing of Cracks, Stitching Prestressing steel Drilling and Plugging Method Gravity Filling Method	
	3.2	Repair Materials: Essential parameters for repair materials.. Materials for repair: Materials for Surface Preparation, Chemical Rust removers for corroded reinforcement, Passivators for reinforcement protection, Bonding Agents, Structural Repair Materials, Non-structural Repair Materials, Injection grouts, Joint sealants,Surface coatings for protection of RCC. Premixed Cement concrete/mortars, Polymers/latex modified cement mortars, Epoxy resins	

	3.3	Corrosion repair methods: Cathodic Protection, Chloride Removal	
4	**Rehabilitation and Retrofitting Methods**		**10**
	4.1	Repair Stages: Concrete Removal and Surface Preparation, Fixing formwork, Bonding / passivating coat and repair application.	
	4.2	Repair Methods: Repairs using mortars/modified mortars, Epoxy based material repairs, Shotcrete, Ferro-cement, Plate bonding, RCC Jacketing Propping and Supporting, Fibre Wrap Technique.	

	4.3	Foundation Rehabilitation Methods: Shoring, Raking shores, Flying shores, Dead shores. Underpinning. Slab jacking.	
5	**Repair of steel structures**		**06**
	5.1	Types and causes for deterioration - Preventive measures - Repair procedure - Brittle fracture - Lamellar tearing - Defects in welded joints -	
	5.2	Design and fabrication errors - Distress during erection - Causes and remedies	
	5.3	Repair methods for structures.	
6	**Seismic Retrofitting and Maintenance of Heritage Structures**		**06**
	6.1	Earthquake damages of buildings, their retrofitting and restoration. Effects of earthquakes.	
	6.2	Methods of seismic retrofitting, restoration of buildings Special care in repair and rehabilitation of heritage structures.	
		Total	**39**

Recommended Books:

1. CPWD Handbook on Repair and Rehabilitation of RCC buildings, Govt of India Press, New Delhi
2. Santhakumar A.R., “Concrete Technology” Oxford University Press, 2007, New Delhi
3. Bhattacharjee J, Concrete Structures Repair Rehabilitation and Retrofitting- 2019 , CBS Publishers & Distributors Pvt. Ltd.

Reference Books:

1. Raikar, R.N., “Learning from failures - Deficiencies in Design, Construction and Service” R and D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
2. Maintenance, Repair & Rehabilitation and Minor Works of Buildings P.C.Varghese, PHI Publications

3. P.K.Guha , Maintenance & Repairs of Buildings, New Central Book Agency (P) Limited,
4. R.Dodge , Concrete structures Concrete Structures Protection Repair and Rehabilitation, woodson

Course Code	Course Name	Credits
CEDLO8022	Department Optional Course 6: Physico - Chemical Treatment of Water and Waste Water	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

This course introduces the principles and physico-chemical methods to control water and wastewater pollution. The aim of the course is to give a more fundamental and theoretical understanding of the specific unit processes, providing a better understanding of the principles of how they function and the degree of treatment that can be achieved. Students should be conversant with the sedimentation, coagulation, filtration, disinfection, advanced physico-chemical processes of water and wastewater. They should be conversant with de-watering and disposal of sludge.

Objectives

1. To study the impact of water and waste-water treatment on the environment.
2. To develop the rational approach towards the design of preliminary treatments.
3. To design primary treatment units.
4. To Explain and apply chemical unit techniques.

5. To impart knowledge about the advanced treatment for water and waste-water.
6. To study sludge de-watering & disposal techniques.

Detailed Syllabus

Module	Course Module / Contents	Periods
I	**Quality, Quantity of Water and Waste-water**	6
	Characteristics of water and waste-water, conventional water and waste- water treatment, Sampling and analysis, Health and environmental concerns, Components of waste water flows, sources, strategies for reducing interior water use and waste water flow rates, waste water reclamation and reuse	
II	**Preliminary Treatment of Water and Waste-water**	6
	Screens: significance, Classification of screens, Design for head loss, Grit chambers: Gravity settling, stoke's law, Classification and Design Skimming Tank design and flotation	
III	**Primary Treatment of Water and Waste-water**	8
	Sedimentation: Significance, Types of sedimentation tanks, Zones of settling, Design parameters, Design of sedimentation tank, Tube settlers **Filtration:** Mechanisms of filtration, hydraulics of filtration, different types of filters, filter clogging, filter washing, Design criteria of Rapid sand filter	
IV	**Chemical units-Techniques:**	6
	Role of chemical unit processes in water and waste water treatment, **Coagulation:** Fundamentals, coagulant aids, polyelectrolytes, Design of flash mixer, power requirement **Flocculation:** Types of flocculation and flocculators, Design of flocculator, power requirement	
	Advanced Physico-chemical Processes:	08

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V	Softening, methods of softening, Chemical precipitation, Desalination, solar distillation, Reverse osmosis, Electrolysis Disinfection, Disinfection using chlorine and UV. Estimation of Chorine doses, Use of various forms of chlorine Removal of heavy metals, neutralization, Chemical oxidation of BOD and COD, Removal of colour, Gas stripping, Adsorption and Ion Exchange, Reverse osmosis, Membrane filtration, Activated carbon treatment	
VI	**Sludge De-watering and Disposal** Sources of sludge, Estimation of bulk density of sludge, Principles of dewatering, Methods and suitability, thickening of sludge, Chemical conditioning, Elutriation of sludge, Vacuum and pressure filtration, sludge drying beds, Design of sludge drying beds	05

Recommended Books:

1.
astewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy,

T.M.H. Edition
2. Water Supply Engineering: S. K. Garg, Khanna Publication.
3. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering:
S. K. Garg, Khanna Publishers.
4. Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
5. Industrial Pollution Control by Eckenfedlar W.W
6. Wastewater Treatment for Pollution Control and Reuse Hardcover – by Soli. J Arceivala (Author), Shyam. R Asolekar (Author)
7. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
8. Water Supply and Sewerage: E.W. Steel.
9. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
10. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
11. Basic Principles of Wastewater Treatment Book by Marcos Von

Sperling
12. Industrial Waste Water Treatment Book by A. D. Patwardhan
13. Environmental Engineering: Peavy,H.S., RoweD.R.,
14. CPHEEO Manual on Water Supply and Treatment.
15. CPHEEO Manual on Sewage and Treatment

Course Code	Course Name	Credits
CEDLO8023	Department Level Optional Course-6: Transportation System Engineering	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

Transportation contributes to the economical, industrial, social cultural development of any country. The adequacy of Transportation system of a country indicates its economic social development. Three basic modes of transportation include land, water and air. The land mode further includes highways and railways. This course is developed so as to impart the basic principles behind Railway Engineering, Airport Engineering, Water Transportation Engineering, Public Transportation system in respect of various types of materials used, function of component parts and planning principles.

Objectives

1 To enable the students to study the various elements of Transportation system in the country, NUTP and its Environmental consideration.
2 To study, plan and design different elements of airports and understand aircraft movement controls.
3 To explain and design various geometric elements of railways and study the elements of modern rails.
4 To Explain different components of water transport such as Ports, Harbors and

Docks.

5 To study and Explain planning elements of public transport systems.

6 To Explain different components of bridges, planning of bridges and analyzing different hydrological elements of bridge.

Detailed Syllabus

Module	Course Module / Contents		Periods
I	Introduction to Transportation System		05
	1.1	Role of transportation system in development of country, Different modes of transportation; their merits and demerits, present scenario of each mode in India. Different modes of Public Transportation modes available in Mumbai and Suburban areas with advantages and disadvantages of each.	
	1.2	Urban Transport: National Urban Transport Policy, Sustainable Transportation, Transit Oriented Development.	
	1.3	Environmental Guidelines for Transportation Infrastructure Projects: Environmental Impact Assessment, Identification of Impacts, Measures for offsetting adverse impacts.	
II	Air Transportation System		10
	2.1	Introduction: Aircraft: Types and components Airport: Site selection, classification, obstruction, zones and zoning laws, Environmental impacts and guidelines for Airport projects	
	2.2	Airport components: Requirements and functions of each Terminal building: Layout and planning, gate positions and gate capacity, blast consideration Apron and holding apron Taxiway: Design Runway: Configuration, orientation, wind rose diagram, basic runway length and corrections to runway length, Aircraft parking and hangars Airport drainage: Requirements and types	
	2.3	Aircraft movement control: Lighting and marking of runway, taxiway and other areas Air traffic control aids, en-route aids and landing	

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		aids	
	2.4	Planning of Heliports: Characteristics of Helicopter, Selection of site, Size of landing area, Obstruction clearance requirements, Marking and Lighting of Heliports.	
III	Rail Transportation System		08
	3.1	Introduction: Alignment of Railway lines, Engineering Surveys for new railway lines. Introduction to Railway Track Components: Requirements and functions of each	
	3.2	Geometrics- Gradient: Types Curves: Widening on curves, cant and cant deficiency Turnout: Components and design	
	3.3	Yards: Types and functions, Signaling- classifications,	

		interlocking of signals and points	
	3.4	Modern Rails: Characteristics of MAGLEV, Metro rails and mono rails, modernization of track and railway station, high speed trains (Bullet trains) and high-speed tracks	
IV	Water Transportation System		04
	4.1	Harbour: Classification, functions and requirements Harbour Infrastructures: Types of breakwaters, jetty, dock fenders, piers, wharves, dolphin, mooring accessories	
	4.2	Docks: Repair facilities, wet docks, lift docks, dry docks, gates for graving docks, floating docks	
	4.3	Port facility: Transit shed, warehouses, cargo handling, container handling	
V	Public Transportation System		06
	5.1	Introduction: Para Transit system, Street Transit system, Rapid Transit System.	
	5.2	Route and Schedule: Properties of good route set, stopping policy and Stop location, Properties of good schedule.	
	5.3	Capacity of Transit system: Capacity of Rapid Transit system, Capacity of Street Transit system.	
VI	Bridge Engineering		06
	6.1	Introduction: History and classification of bridge, Components of bridge, Requirement of Ideal bridge, Site selection and selection of alignment of bridges, Various loads on bridges	
	6.2	Low-cost Bridges: Introduction to Causeways, Culverts, Floating bridges etc.	
	6.3	Bridge superstructure and its types, Bearings and Joints on bridges Piers, abutments, Wing walls and approaches, Types of bridge foundations	

	6.4	Bridge Hydrology: Flood Discharge, Waterway, Economic span, Scour depth, Afflux.	

Reference Books:

1 Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book Co.

2 Indian Railway Track: *Agarwal, M. M.*, Suchdeva Press New Delhi.

3 Planning Design of Airport: *Horonjeff Mckelrey*, Tata Mc-Graw Hill India Publishing House, New Delhi.

4 Docks & Harbour Engineering, Bindra S.P., Dhanpat Rai Publications,

5 Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House

6 Transportation Engineering and Planning: C.S. Papacostas and P.D. Prevedouros;
Prentice Hall India Learning Pvt. Ltd., New Delhi

7 Transportation Engineering: *Khisty, C.J. and Lall, Kent, B.;* Prentice Hall India
Learning Pvt. Ltd., New Delhi

Course Code	Course Name	Credits
CEDLO8024	Department Level Optional Course-5: Smart Building Materials	03

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

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Rationale

A safe, comfortable, and sustainable built environment is highly desirable, as we spent most of our time in offices, factories, or homes. So smart building materials can play a vital role. Smart materials that are able to respond to an external stimulus have received great attention, especially in last two decades. These materials can change their dimensions, solubility, color, and shape, etc., upon a specific trigger. A wide range of smart materials including alloys, composites, gels, and polymers have been investigated for various applications from aerospace industry to medical technologies and now a days in the buildings and infrastructures. Smart materials can be designed with various responses and actuation mechanism based on the requirements of applications. Study of the importance and working principles of the smart materials is todays need. The concept of “smart” or “intelligent” materials, systems, and structures has been around for many years. A great deal of progress has been made recently in the development of structures that continuously and actively monitor and optimize themselves and their performance through emulating biological systems with their adaptive capabilities and integrated

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designs. The field of smart materials is multidisciplinary and interdisciplinary, and there are a number of enabling technologies-materials, control, information processing, sensing, actuation, and damping and system integration across a wide range of industrial applications.

Objectives

1. To study the importance of smart materials and technology
2. To Explain the types, properties of smart materials and learn to select appropriate materials.
3. To develop smart technology using smart materials
4. To Describe requirements of structural health monitoring
5. To understand the smart concrete
6. To learn applications of smart materials and technology via case studies.

Detailed Syllabus

Module	Course Modules / Contents	Periods
I	**Introduction to Smart Building Materials & Technology** History, importance and need, merits and demerits of smart building materials. Smart Structure system, Components, Importance of smart structures.	**02**

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II	**Fundamentals of Smart Materials** Types and characteristics of smart materials:- **Property-changing materials:** Thermo-chromics, Photochromics, Mechanochromics, Chemochromics, Electrochromics, Liquid crystals, Suspended particle, Electrorheological, Magnetorheological **Energy-exchanging materials**: Electroluminescents, Photoluminescents, Chemoluminescents, Thermoluminescents, Light-emitting diodes, Photovoltaics, **Energy-exchanging (reversible) materials:** Piezoelectric, Pyroelectric, Thermoelectric, Electrorestrictive, Magnetorestrictive. **Miscellaneous Materials:** Shape Memory alloy, optical fiber, Construction chemicals, Sealants etc. Review of material, effect, working principle, advantages and disadvantages, application in Smart Structures, Use of alternative materials for structural steels and rebars.	**09**
III	**Energy Efficient Materials, Durability and Technology** Use of solar energy, wind energy, Smart window, Smart paints, Smart Wall skin, Smart roof. Green buildings and Green Material, Intelligent buildings. FRP rebars and its properties, smart lighting. Service life, Life cycle concept for structures and selection of materials for durability and sustainability. Use of Thermal and Sound Insulation systems and materials.	**06**
IV	**Smart Structural Health Monitoring**	**09**
	Important structural sensing parameters, Basic sensing system, Different types of sensors for monitoring stress, strain, temperature, moisture, displacements, vibration, corrosion etc. Active and passive structural health monitoring system. Specifically for buildings and bridges.	

V	**Smart Concrete:** Transparent concrete, Polymer modified concrete and mortars, self-healing concrete, self-compacting concrete, light weight concrete, pervious concrete, fiber reinforced concrete, temperature controlled concrete, coloured concrete- Constituents, Proportions, material properties, Importance and its application, Electrically conductive concrete, fire/ heat resistant concrete, acid resistant concrete, Ultra high performance concrete and its application in bridge engineering.	**08**
VI	**Applications of Smart Materials and Technology:** Structural health monitoring of buildings, bridges geotechnical and transportation structures, Different types of sensors their working and principles, Repairs and Rehabilitations, Modern Construction, Energy efficient Buildings- A case study.	**05**
		39

Recommended Books:

1.D. Michelle Addington, Daniel L. Schodek, “Smart Materials and New Technologies For the architecture and design professions”, Harvard University. ISBN0750662255.
2.Vinod K. Wadhawan, “Smart Structures: Blurring the Distinction between the Living and the Nonliving”, Oxford University place, ISBN 978–0–19–922917–8.
3.Nilesh Y. Jadhav, Green and Smart Buildings Advanced Technology Options, Springer Nature, ISBN 978-981-10-1002-6.

4. Mel Schwartz, Encyclopaedia of Smart Materials, Vol. 1 and Vol. 2, John Wiley & Sons, Inc.
5. James Sinopoli, Advanced Technology for Smart Buildings, ARTECH HOUSE, Boston, London.
6. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
7. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.
8. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003.
9. Structural health monitoring of civil infrastructure Systems, Edited by Vistasp M. Karbhari and Farhad Ansari, CRC Press Boca Raton Boston New York Washington, DC, Woodhead Publishing Limited, New Delhi.
10. HuaPeng Chen and Yi-Qing Ni Structural Health Monitoring of Large Civil Engineering Structures, John Wiley & Sons Ltd, 2018.
11. SP-7 (National Building Code of India), Bureau of Indian Standards.

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Semester-VII		
Subject Code	**Subject Name**	**Credits**
CEDLO8025	**Department Level Optional Course 6: Structural Dynamics**	**3**

Contact Hours			Credits Assigned			
Theory	**Practical**	**Tutorials**	**Theory**	**Practical**	**TW/Tutorials**	**Total**
3	**--**	**--**	**3**	**--**	**--**	**3**

Evaluation Scheme

Theory					Termwork/Practical/ Oral/Tutorials			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW/TU	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	**100**

Course Objective

- To expose the students to the basic theory of structural dynamics, structural behaviour under vibratory load and the effect of damping.
- To study the difference between static load and different types of dynamic loads.
- To study the free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system subjected to different dynamic loads.
- To study the dynamic degrees of freedom and calculation of the frequencies and mode shapes for lumped mass for discrete Two DOF systems,
- To study the modal analysis of Two DOF systems and analysis of systems with distributed mass for continuous system.

Detailed Syllabus

Module	Contents	Hrs
I	**Introduction to structural Dynamics- Definition of Basic Problem inDynamics.** Static vs. Dynamic loads. Different types of dynamics loads	**4**

II	**Introduction to single Degree of freedom (SDOF) Systems.** Undamped vibration of SDOF system natural frequency and period of vibration. Damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement. Forced vibration, response to periodic loading, response to pulsating forces,dynamic load factor. Response of structure subjected to General dynamic load, Duhamel's IntegralNumerical. Evaluation of Dynamics Response of SDOF system. Equivalent stiffness of spring in series and parallel.	**8**

III	**Introduction to Distributed mass system**. Distributed mass system idealized as SDOF system, use of Rayleigh's method. Response of SDOF system subjected to ground motion	**4**
IV	**Lumped mass multi-degree of freedom (Two DOF) system, coupled anduncoupled system** Direct determination of frequencies of vibration and mod shape. Orthogonality principle. Vibration of Two DOF systems with initial conditions Approximate method of determination of natural frequencies of vibration andmode shapes – Energy methods	**9**
V	**Earthquake analysis – Introduction.** Seismicity of a region, causes of earthquake Intensity of earthquake, Richter Scale, Measurement of Earthquake groundmotion, Seismogram, construction of seismograph Application of modal analysis concept to seismic disturbance, Introduction to Response spectrum method.	**8**
VI	**I.S code provisions for seismic analysis of buildings.** Approximate method of earthquake analysis– Seismic co-efficient methodand its limitation. Introduction to time history analysis.	**6**

Recommended Books:-

1. Craig R.R.: 'Structural Dynamics-An Introduction to Computer Methods', *John Wiley and Sons.*
2. Anil K. Chopra: 'Dynamics of Structures', *Prentice Hall India Pvt. Ltd.*
3. Cloguhand Penzein: 'Dynamics of Structures' *TataMc-Graw Hill Pvt. Ltd.*
4. John M. Biggs: 'Structural Dynamics', *Tata Mc-Graw Hill.*
5. Mario Paz: 'Structural Dynamics Theory and Computation', *CBS Publisher.*

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Course Code	Course Name	Credits
CEDLO8026	**Department Level Optional Course 6: Ground water Engineering**	03

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

Theory					Term Work/Practical/Oral			
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	Total
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	-	-	-	100

Rationale

This subject deals with the various processes involved in ground water Engineering which provides in depth understanding of the theories and concepts of hydrological parameters, well hydraulics, ground water quality etc. It also explains the concept of basin water management concept and its evaluation.

Objectives

1 To introduce the student to the principles of hydrological parameters
2 To Explain to the students the principles of Well Hydraulics.
3 To introduce the student the concept of ground water quality and conservation.
4 To introduce the student the concept of basin management

Detailed Syllabus

Module	Course Module / Contents		Hr
	Hydrogeological Parameters		
	1.1	Introduction – Water bearing Properties of Rock – Type of aquifers -	

I		Aquifer properties	6
	1.2	permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation	
	1.3	GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity – Dupuit Forchheimer assumption	
	1.4	Steady Radial Flow into a Well	
II	**Well Hydraulics**		8
	2.1	Unsteady state flow - Theis method - Jacob method	
	2.2	Chow's method – Law of Times – Theis Recovery	
	2.3	Bailer method – Slug method - tests - Image well theory	
	2.4	Partial penetrations of wells – Well losses	
	2.5	Specific Capacity and Safe yield	
	2.6	Collector well and Infiltration gallery	
III	**Groundwater Management**		6
	3.1	Need for Management Model – Database for Groundwater Management – Groundwater	
	3.2	Balance study – Introduction to Mathematical model – Model Conceptualization	
	3.3	Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity	
	3.4	Analysis – Uncertainty – Development of a model	
IV	**Groundwater Quality**		7
	4.1	Ground water chemistry - Origin, movement and quality - Water quality standards	
	4.2	Drinking water – Industrial water – Irrigation water	
	4.3	Ground water Pollution and legislation	
	4.4	Environmental Regulatory requirements	
	Groundwater Conservation		5
	5.1	Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT)	

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V	5.2	Aquifer Storage and Recovery (ASR)Seawater Intrusion and Remediation	
	5.3	Ground water Basin management and Conjunctive use	
	5.4	Protection zone delineation, Contamination source inventory and remediation schemes Name of Module 6 Management of Groundwater	
VI	6.1	Concept of basin management	7
	6.2	Ground water basin investigations	
	6.3	Basin management and conjunctive use	
	6.4	Basin yields	

Recommended Books:

1 Numerical Ground Water Hydrology: A.K. Rastogi, Penram International Publishing, Mumbai,2007

2 Ground Wter Hydrology: D.K.Todd, John Wiley &Sons, New York, USA, 1980

3 Ground water Hydrology by A. K. Rastogi

4 Hydrology- Principles, Analysis, Design: H.M.Raghunath, New Age International Publishers.

5 Engineering Hydrology: C.S.P.Ojha, R.Berndtsson, &P.Bhunya:, Oxford University Press

Reference Books:

1 Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.

2 Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998

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Subject Code	Subject Name	Credits
ILOC8011	Institute Level Optional Course – II : Project Management	03

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Module	Detailed Contents	Hrs
I	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
II	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6

III	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	**8**
IV	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan.	**6**

	Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
V	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	**8**
VI	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	**6**

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8012	**Institute Level Optional Course – II : Finance Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	**100**

Objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Module	Detailed Contents	Hrs
I	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds- Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	**06**

II	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	**06**
III	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios;	**09**

	Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
IV	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion— Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	**10**
V	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	**05**
VI	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8013	**Institute Level Optional Course – II : Entrepreneurship Development and Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	**100**

Objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Module	Detailed Contents	Hrs
I	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	**04**

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II	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	**09**
III	Women's Entrepreneurship Development, Social entrepreneurship- role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	**05**
IV	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships,	**08**
	National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	
V	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	**08**
VI	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	**05**

References:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company

3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective,

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8014	**Institute Level Optional Course – II : Human Resource Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To introduce the students with basic concepts, techniques and practices of the human resource management.
- To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
- To familiarize the students about the latest developments, trends & different aspects of HRM.
- To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

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Module	Detailed Contents	Hrs
I	**Introduction to HR** Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
II	**Organizational Behavior (OB)** Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision- making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	7
III	**Organizational Structure &Design** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	6

	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
IV	**Human resource Planning** Recruitment and Selection process, Job-enrichment, Empowerment - Job- Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
V	**Emerging Trends in HR** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
VI	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labour Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial

relations, 5th Ed, 2013, Himalaya Publishing

6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8015	**Institute Level Optional Course – II : Professional Ethics and CSR**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	**Total Marks**
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To understand professional ethics in business
- To recognized corporate social responsibility

Module	Detailed Contents	Hrs
I	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
II	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
III	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job	06

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	Discrimination; Extent of Discrimination; Reservation of Jobs.	
IV	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
V	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP)	08
VI	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. **Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.**

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8016	**Institute Level Optional Course – II : Research Methodology**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Module	Detailed Contents	Hrs
I	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4** **Issues** and Problems in Research **1.5** Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	**09**

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II	**Types of Research** **2.1.** Basic Research **2.2.** Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5.** Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
III	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
IV	**Research Methodology** **4.1** Meaning of Research Methodology	**08**
	4.2. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	
V	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
VI	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

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SemesterVIII		
Course Code	**Course Name**	**Credits**
ILOC8017	**Institute Level Optional Course – II : IPR & Patenting**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
- To get acquaintance with Patent search and patent filing procedure and applications

Module	**Detailed Contents**	**Hr**
I	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05

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II	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
III	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
IV	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
V	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
VI	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8018	**Institute Level Optional Course – II : Digital Business Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			Total Marks
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
IAT I	IAT II	Total.						
20	20	40	60	2.5 Hours	--	--	--	100

Objectives:

- To familiarize with digital business concept
- To acquaint with E-commerce
- To give insights into E-business and its strategies

Module	Detailed content	Hrs
I f	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts ference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09

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II	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
III	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
IV	**Managing E-Business**-Managing Knowledge, Management skills for e- business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce	06

	Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
V	**E-Business Strategy**-E-business Strategic formulation-Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
VI	**Caterializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

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References:

1. A textbook on E-commerce**,** Er. Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective - DOI:10.1787/9789264221796-enOECD Publishing

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Semester VIII		
Course Code	**Course Name**	**Credits**
ILOC8019	**Institute Level Optional Course – II : Environmental Management**	**03**

Teaching Scheme

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

Evaluation Scheme

Theory					Term work / Practical / Oral			**Total Marks**
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	TW	PR	OR	
IAT I	**IAT II**	**Total.**						
20	20	40	60	2.5 Hours	--	--	--	100

Module	**Detailed Contents**	**Hrs**
I	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
II	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
III	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
IV	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
V	Total Quality Environmental Management, ISO-14000, EMS certification.	05

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VI	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

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	
OJT899	Internship	--	--	12	--	--	--	--		6

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT I	IAT II	Total				
OJT899	Internship	--	--	--	--	25	25	50

Lab Objectives:

1. To acquaint the learners to analyse the problem.
2. To accustom the learners to apply various techniques and methods.
3. To familiarize the learners about interpreting the results and discuss the issues.
4. To advice the learners to write and infer conclusions of the project.
5. To accustom the learners to work as a team.

6. To apprize the learners on proper documentation of work

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1: Perform on analytical, experimental or numerical method to solve identified problem

2: Produce alternative design solution to meet the functional requirements of the defined problem.

3: Represent the data in Tabular or graphical forms so as to facilitate, analysis & explain of the data.

4: Express Engineering principles & manage the finance required for the execution of the Project.

5: Infer at results, conclusion with its validation, also propose the future scope of work on the identified problem.

6: Communicate effectively their project work by writing reports and publishing technical papers based on entire project work.