School of Advanced Engineering

B. Tech in Civil Engineering

Specializations: Construction Management/ Environmental Engineering/ Transportation Engineering

Programme Handbook

[Contextual Document]

2023-27

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1.0 Abbreviations

Cat	-	Category
Cr	-	Credits *(A credit is equivalent to one lecture hour/ one hour of tutorial/ two hours of Laboratory)*
L	-	Lecture
T	-	Tutorial
P	-	Practical
ENGG	-	Engineering Sciences (including General, Core)
HUM	-	Humanities (including Languages, Social Sciences, and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars, Dissertation, and Internships)
PE	-	Program Elective (includes Specialization courses)
TC	-	Total Credits

AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering-Artificial Intelligence
BIO	-	Biology
CCE	-	Computer Science and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics
UE	-	University Elective (includes Signatory, Exploratory and Open Electives)

2.0 Director/ Dean Message

3.0 Vision and Mission of the University:

Vision of UPES

To be an Institution of Global standing for developing professionally competent talent contributing to nation building.

Mission of UPES

- Develop industry-focused professionals with an international outlook.
- Foster effective outcome-based education system to continually improve teaching-learning and research.
- Inculcate integrative thought process among students to instill lifelong learning.
- Create global knowledge eco-system through training, research & development, and consultancy.
- Practice and promote high standards of professional ethics and develop harmonious relationship with environment and society.

4.0 Vision and Mission of the School

Vision of School

To be a forerunner in engineering education by delivering excellent engineering graduates fortified with sound knowledge and integrity, by performing cutting-edge research and by innovating new technologies to benefit the nation and the world at large.

Mission of School

- To develop industry focused engineers with expertise in the areas of oil and gas, energy, infrastructure, transportation, electronics, automotive design and aviation.
- To sustain a strong focus on delivering excellent engineering and science education by providing exposure to concurrent research and industry trends and by employing innovative pedagogy tools/ techniques.
- To promote research, technology incubation and entrepreneurship to address the most pressing needs of our society and nation.
- To maintain a professional and ethical environment conducive to the intellectual growth of faculty and students, fostering communication, dialogue and sharing of ideas.
- To strengthen our linkages with academic institutes worldwide, industry and alumni network for evolving our programs towards better student outcomes.

5.0 About the Cluster/ Department

The Sustainability Cluster is a congregation of two erstwhile departments of the School of Engineering i.e., Civil Engineering and Health Safety & Environment Engineering. The cluster offers NBA accredited undergraduate, postgraduate, and doctorate levels programs. It has a twenty-six-member professionally qualified faculty team with national and international experience in academics as well as industry. The Cluster has state-of-the-art infrastructure like advanced laboratories, fire training ground, innovative software, and other facilities. The students are involved in live & sponsored projects funded by the government and on consultancy projects. The Cluster has international and national student chapters such as the American Society of Civil Engineers (ASCE), the American Society of Safety Professionals (ASSP), the Fire & Security Association of

India (FSAI) & Green Up club. The Cluster nourishes students for certifications in professional courses like NEBOSH, IOSH, and Lead Auditor: (9001, 14001, 45001, 17025) and Swayam NPTEL. The Cluster has grown with time in expertise and competencies in the core Fire Safety, Sustainability and Civil Engineering curriculum and research, which is reflected in the vision and mission of the cluster.

Research Focus

S.NO	CORE	RESEARCH AREAS
1.	Safety Engineering	Process Safety, Risk Analysis, Construction Safety, Human Factors and Behaviour Based Safety, Engineering, Fire Safety, Occupational Health and Safety
2.	Environmental Engineering	Air, Water, Soil and all topics pertaining to UNSDG.
3.	Civil Engineering	Water resources engg., Transportation Engg., Geotechnical Engg., and Structural Engg.

6.0 Programme Overview

B. Tech Civil Engineering Program at UPES is aligned with the vision to develop competent civil engineering professionals of integrity, who can contribute to the nation building. The program is outlined with the aim of creating highly skilled, technically sound, and motivated engineers, who are well versed with the diversified aspects of civil engineering viz. transportation & construction project planning, environmental design, water resources management, estimation, green buildings, highway design, operation, and management of transportation facilities, etc. The four-year undergraduate core-engineering program designed to contribute to the contemporary advent of technological, digital, and social revolution in the infrastructural development with three choices of specializations of

a. Transportation Engineering

b. Environmental Engineering

c. Construction Management

Salient features of B. Tech Civil Engineering program at UPES:

- Accredited by National Board of Accreditation

- Dual degree opportunity (Complete 2 years at UPES & 2 years abroad) at University of Queensland (UQ), Australia (QS rank of 43), University of Exeter (QS ranked 163), University of Aberdeen UK (QS ranked 220), Indiana University Purdue University Indianapolis (IUPUI) etc.
- The course syllabi are co-designed and co-delivered in collaboration with industry giants like L&T, consultants like Ascela and Tra NXT Advisory.
- By default, membership of American Society of Civil Engineers (ASCE), which will provide them international exposure and affiliation.
- Direct learning from the industry association of Indian Green Building Council (IGBC) by means of their student chapter operational at the UPES.
- State-of-the-art lab facilities focusing on advanced Engineering.
- Industry ready courses in association with industrial Giants
- Up to six months dedicated research experience at national/international premium institutes.
- National and International internships and placements
- Decades old global alumni network
- Funding through SHODH/RISE schemes to support student research activities and projects.
- Lifetime career support to alumni through NEST scheme
- Support for startups through Runway
- Opportunity to get mentored by world's top 2% scientists (Stanford List)

7.0 Programme Educational Objectives

PEO1: Graduates will undertake the applications of civil engineering concepts to provide optimal solutions in civil engineering and infrastructure sector, and other allied engineering and science domain.

PEO2. Graduates will pursue successful career in leading national and global industries in civil engineering sector.

PEO3. Graduates will interact with eminent researchers and undertake innovative research for broader impact development and building themselves as successful researchers/entrepreneurs.

PEO4. Graduates will develop multi-dimensional decision-making approach to acquire prominent leadership position in civil engineering and infrastructure sector.

PEO5. Graduates will contribute to social welfare and sustainable development of the society/environment through professionally ethical decisions.

8.0 Programme Outcomes and Programme Specific Outcomes

Programme Outcomes

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes

PSO1- The student should be able to apply engineering/sciences concepts, analytical and experimental skills to civil engineering systems.

PSO2 The student should be able to plan, analyse and design civil engineering infrastructure projects for sustainable and economic development.

9.0 Academic Integrity Policy

a. University Integrity Policy

b. Course integrity policy

10.0 Overview of Credit Allocation/ Credit Break up

Category-wise Credit distribution

Category	Number of Credits
Major Core (MC)	
Basic Sciences - Core (SCI)	17
Engineering Sciences - Core (ENGG)	78
Major Elective (ME)	15
Signature courses (SC)*	4
Life Skill Courses (LSC)*	15
Exploratory Courses (EC)*	18
Humanities (HUM)	0
Projects (PRJ)	15
Mandatory Non-Credit Courses (NCC)	0
Total	**165**

* Electives

- Major core subjects include those subjects that are mandatory for all similar programs and program specific courses. To be eligible for the degree, students must successfully finish each of the courses.
- Major elective courses provide the students the opportunity to study courses that are more complex and specialized, in their field of specialization.

Major Core	**Total number of Credits: 165 Credits**				
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
	Basic Sciences - Core (SCI)				
MATH1050	Engineering Mathematics I	3	1	0	4
PHYS1002	Physics	3	1	0	4
PHYS1102	Physics Lab	0	0	1	1
CHEM1013	Chemistry	3	0	0	3
CHEM1113	Chemistry Lab	0	0	1	1
MATH1051	Engineering Mathematics II	3	1	0	4
	Engineering Sciences - Core (ENGG)				
MEPD1003	Workshop Practices	1	0	1	2
MECH1001	Engineering Graphics	1	0	1	2
CSEG1008	Object Oriented Programming	3	0	0	3
CSEG1108	Object Oriented Programming Lab	0	0	1	1
MECH1008	Basic of Mechanical Engineering	2	0	0	2
MECH1002	Engineering Mechanics	3	0	0	3
ECEG1004	Basic Electrical and Electronics Engineering	3	0	0	3
ECEG1104	Basic Electrical and Electronics Engineering Lab	0	0	1	1
CIVL2026	Building Materials and Concrete Technology	3	1	0	4
CIVL2027	Surveying & Remote Sensing	2	1	0	3
CIVL2028	Elements of Fluid Mechanics	2	1	0	3
MECH2123	Fluid Mechanics Lab	0	0	2	1

CIVL2029	Engineering Geology & Groundwater	3	0	0	3
CIVL2130	Building Materials and Concrete Technology Lab	0	0	2	1
CIVL2131	Surveying & Remote Sensing Lab	0	0	2	1
CIVL2032	Water Supply and Sanitation	2	0	0	2
MECH2065	Elements of Hydraulic Engineering	2	1	0	3
MECH2018	Strength of Materials	2	1	0	3
CIVL2125	Solid Mechanics Lab	0	0	2	1
CIVL2033	Computer-Aided Civil Engineering Design Lab	0	0	2	1
CIVL2134	Survey Camp	0	0	0	1
CSEG2049	Programming in Python	0	0	2	1
CIVL3020	Geotechnical Engineering	2	1	0	3
CIVL3120	Geotechnical Engineering Lab	0	0	2	1
CIVL3018	Structural Engineering	2	1	0	3
CIVL3055	Environmental Engineering	3	0	0	3
CIVL3155	Environmental Engineering Lab	0	0	2	1
CIVL3083	Problem Solving Using MATLAB	0	0	2	1
CIVL3022	Transportation Engineering	2	1	0	3
CIVL3122	Transportation Engineering Lab	0	0	2	1
CIVL3062	Design of Concrete Structure	2	1	0	3
CIVL3084	Water Resources Engineering	2	1	0	3
CIVL3085	Advanced Geotechnical Engineering	2	1	0	3
CIVL3169	Structural Design Lab	0	0	2	1
CIVL4034	Design of Steel Structure	2	1	0	3
CIVL4074	Engineering Economics & Estimation	3	0	0	3
CIVL4174	Engineering Economics & Estimation Lab	0	0	2	1
CIVL4084	Building Information Modelling	3	0	0	3
				Total Credits	**98**

Humanities (HUM)				**Total Number of Credits: 165 Credits**	
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
	Total Credits				**0**

Projects (PRJ)				**Total Number of Credits: 165 Credits**	
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
PROJ4135	Research Project-I	0	0	0	2
PROJ4137	Capstone I	0	0	0	2
PROJ4136	Research Project-II	0	0	0	8
PROJ4138	Capstone II	0	0	0	2
INDT4104	Industrial Internship	0	0	0	1
	Total Credits				**15**

Non-Credit Courses		Total Number of Credits: 165 Credits			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
EMPL003	EDGE – Advance Communication	0	0	0	0
INDT3105	Industrial Visit	0	0	0	0
SLLS2001	Social Internship	0	0	0	0
EMPL003	EDGE – Advance Communication	0	0	0	0
EMPL004	EDGE – Advance Communication II	0	0	0	0
				Total Credits	**0**

Exploratory Courses Courses		Total Number of Credits: 165 Credits			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
-	Exploratory Courses 1	3	0	3	3
-	Exploratory Courses 2	3	0	3	3
-	Exploratory Courses 3	3	0	3	3
-	Exploratory Courses 4	3	0	3	3
-	Exploratory Courses 5	3	0	3	3
-	Exploratory Courses 6	3	0	3	3
				Total Credits	**18**

Life Skills Courses		Total Number of Credits: 165 Credits			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
SLSG0102	Critical Thinking	2	0	0	2
SLLS0101	Living Conversations	2	0	0	2
SLLS0103	Leadership & Teamwork	2	0	0	2
SLLS0201	Design Thinking	2	0	0	2
SLSG0205	Start your Start-up	2	0	0	2
SLLS0202	Working With Data	2	0	0	2
SLSG0104	Meta 101	1	0	0	1
SLSG0103	Technologies of the Future	2	0	0	2
				Total Credits	**15**

Signature courses (SC) Courses		Total Number of Credits: 165 Credits			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
SSEN0101	Environment Sustainability and Climate Change	2	0	0	2
SSEN0102	Environment Sustainability and Climate Change (Living Lab	2	0	0	2
				Total Credits	**4**

Major Electives		Total Number of Credits: 165 Credits			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
CIVL3080P	Traffic Engineering and Transportation Planning	3	0	0	3
CIVL3081P	Green Building & Energy Efficiency	3	0	0	3
CIVL3082P	Pavement Design & Performance	3	0	0	3
HSFS3031P	Disaster Management	3	0	0	3
CIVL3086P	Railway and Tunnel Engineering	3	0	0	3
CIVL3087P	Computer Simulation in Transportation Engineering	3	0	0	3

HSFS3044PP	Occupational Health & Safety Engineering	3	0	0	3
CIVL3088P	Emerging Contaminants and Advances	3	0	0	3
CIVL4075P	Metro Rail Transportation Design & Construction	3	0	0	3
CIVL4076P	Intelligent Transportation Systems	3	0	0	3
CIVL4077P	Optimization Techniques in Transportation Engineering	3	0	0	3
CIVL4078P	Environmental Modelling and Simulation	3	0	0	3
CIVL4079P	Geo-environmental Engineering	3	0	0	3
CIVL4080P	Remote Sensing & its applications	3	0	0	3
CIVL4081P	Construction Specifications, Law & Finance	3	0	0	3
CIVL4082P	Forensic Engineering and Rehabilitation of Structures	3	0	0	3
CIVL4083P	Artificial Intelligence in the Built Environment	3	0	0	3
CIVL4075P	Metro Rail Transportation Design & Construction	3	0	0	3
				Total Credits	54

11.0 Programme Structure

The term "Program Structure" refers to a list of courses (Core, Elective, and Open Elective) that make up an academic program, describing the syllabus, credits, hours of instruction, assessment and examination systems, minimum number of credits necessary for program graduation, etc.

B. Tech Civil Engineering

Semester I:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLSG 0102	Critical Thinking and Writing	2	0	0	2	
Theory	SSEN0101	Environment Sustainability and Climate Change	2	0	0	2	Fundamentals of basic ecology, chemistry, and physics
Theory	MATH-1050	Engineering Mathematics I	3	1	0	4	Basic Mathematics (10+2 level)
Theory	PHYS 1002	Physics I	3	1	0	4	12th level Physics
Theory	MEPD 1003	Workshop Practice	0	0	6	2	Workshop practice theory course
Lab	PHYS 1102	Physics Lab	0	0	1	1	Basic knowledge on practical Physics (12th level) for understanding and performing experiments.
Theory	MECH 1001	Engineering Graphics	2	2	0	2	The knowledge

							of simple geometrical theorem and procedures is essential.
Theory	CSEG 1008	Object Oriented Programming	3	0	0	3	Knowledge of the English Language
Lab	CSEG 1108	Object Oriented Programming Lab	0	0	2	1	Basic Knowledge of Computer Science such as fundamentals & logic for solving programs
						Semester Credits	**21**

Semester II:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLLS0101	Living Conversation	2	0	0	2	
Lab	SSEN0102	Environment Sustainability and Climate Change (Living Lab)	2	0	0	2	Fundamentals of basic Environment Sustainability and Climate Change
Theory	MATH1051	Engineering Mathematics II	3	1	0	4	Math 1026
Theory	CHEM1013	Chemistry	3	1	0	3	12th level Chemistry
Theory	MECH1008	Basic of Mechanical Engineering	2	0	0	2	Physics, Mathematics and Engineering Mechanics
Theory	MECH1002	Engineering Mechanics	3	0	0	3	Basic Knowledge of physics. Basic Knowledge of Mathematics
Theory	ECEG1004	Basic Electrical and Electronics Engineering	3	0	0	3	
Lab	CHEM1113	Chemistry Lab	0	0	3	1	Basic Knowledge of Physics and Chemistry
Lab	ECEG1104	Basic Electrical and Electronics Engg Lab	0	0	2	1	
						Semester Credits	**21**

Semester III:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLLS0201	Design Thinking				2	
Project	SLLS2001	Social Internship				0	

Theory		Exploratory 1				3	
Theory	CIVL2026	Building Materials and Concrete Technology	4	0	0	4	Basic knowledge of civil engineering materials and sustainability
Theory	CIVL2131	Surveying & Remote Sensing	2	1	0	3	Knowledge of mathematics and basic physics
Theory	CIVL2028	Elements of Fluid Mechanics	2	1	0	3	Basic knowledge of Mathematics
Theory	CIVL2029	Engineering Geology & Groundwater	2	0	0	3	Knowledge of Basic Geography
Lab	CIVL2130	Building Materials and Concrete Technology Lab	0	0	2	1	Knowledge of mathematics, mechanics of solids and concrete technology theory
Lab	CIVL2131	Surveying & Remote Sensing Lab	0	0	2	1	Knowledge of mathematics and basic physics
Lab	MECH2123	Fluid Mechanics Lab	0	0	2	1	Knowledge of Fluid Mechanics
						Semester Credits	**21**

Semester IV:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLLS0202	Working with data	0	0	0	2	
Theory		Exploratory 2	0	0	0	3	
Theory	CIVL2032	Water Supply and Sanitation	2	0	0	2	Knowledge of Mathematics and Chemistry
Theory	MECH2065	Elements of Hydraulic Engineering	3	0	0	3	Knowledge of Mathematics, Knowledge of Introduction to Fluid Mechanics
Theory	MECH2018	Strength of Materials	2	1	0	3	Engineering Mechanics
Lab	MECH2018	Solid Mechanics Lab	0	0	2	1	Basic Knowledge of Engineering Mechanics, Ability to find support reactions and Mathematics
Lab	CIVL2033	Computer-Aided Civil Engineering Design Lab	0	0	2	1	Engineering Drawings
Project	CIVL2134	Survey Camp	0	0	0	1	Knowledge of surveying
Theory		Specialization Course I	3	0	0	3	
Lab	CSEG2049	Programming in Python	0	0	2	1	Basic knowledge

							of computer system and elementary mathematics
Semester Credits							20

Semester V:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Project	SLLS0103	Leadership and teamwork	0	0	0	2	
Theory		Exploratory 3	0	0	0	3	
Theory	CIVL3020	Geotechnical Engineering	2	1	0	3	Knowledge of Mechanics and Mathematics
Theory	CIVL3018	Structural Engineering	2	1	0	3	Mechanics of Solids, Structural Analysis I
Theory	CIVL3055	Environmental Engineering	3	0	0	3	Knowledge of Mathematics and Chemistry. Water Supply and Sanitation
Lab	CIVL3120	Geotechnical Engineering Lab	0	0	2	1	Knowledge of Mechanics
Lab	CIVL3155	Environmental Engineering Lab	0	0	2	1	Knowledge of Mathematics and Chemistry Water Supply and Sanitation
Theory		Specialization Course II	3	0	0	3	
Lab	CIVL3083	Problem Solving Using MATLAB	0	0	2	1	Basic knowledge of computer system and elementary mathematics
						Semester Credits	**20**

Semester VI:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLSG0205	Start your start up	2	0	0	2	
Theory		Exploratory 4	3	0	0	3	
Theory	CIVL3022	Transportation Engineering	3	0	0	3	Knowledge of Surveying, Basic Knowledge of dynamics, Knowledge of construction materials
Theory	CIVL3062	Design of Concrete Structure	3	1	0	3	Knowledge of Structural Analysis, Concrete Technology, Mechanics of Solids, Mathematics

Theory	CIVL3084	Water Resources Engineering	2	1	0	3	Knowledge of Mathematics, Knowledge of Introduction to Fluid Mechanics
Theory	CIVL3085	Advanced Geotechnical Engineering	0	0	2	1	Basic knowledge of Engineering Mechanics and Engineering Mathematics
Theory	CIVL3122	Transportation Engineering Lab	0	0	2	1	Knowledge of road construction materials
Theory	CIVL3169	Structural Design Lab					Knowledge of Structural Analysis, Design of Concrete Structure
Theory		Specialization Course III	3	0	0	3	
Project	INDT3105	Industrial Visit	0	0	0	0	Major subjects of Civil engineering
						Semester Credits	**21 +1 =22**

Semester VII:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	SLSG0103	Technologies of the future	2	0	0	2	
Theory	SLSG0104	Meta 101	1	0	0	1	
Theory		Exploratory 5	3	0	0	3	
Theory	CIVL4034	Design of Steel Structure	3	0	0	3	Knowledge of Structural Analysis, Mechanics of Solids, Mathematics
Theory	CIVL4074	Engineering Economics & Estimation	2	1	0	3	Basic knowledge of Mathematics Basic knowledge of Civil engineering materials & processes
Theory		Specialization Course IV	3	0	0	3	
Theory		Specialization Course V	3	0	0	3	
Lab	CIVL4174	Engineering Economics & Estimation Lab	0	0	2	1	Basic knowledge of Mathematics Building materials and construction
Project	INDT4104	Industrial Internship	0	0	0	1	Major subjects of Civil engineering
Project	PROJ4135	Research Project-I	0	0	4	2	Knowledge of civil engineering
Project	PROJ4137	Capstone I	0	0	4	2	Knowledge of civil

							engineering courses
						Semester Credits	**24**

Semester VIII:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
Theory	CIVL4084	Building Information Modelling	2	0	1	3	Building materials, Engineering principle, Construction technology
Project	PROJ4136	Research Project-II	0	0	4	8	Knowledge of civil engineering
Project	PROJ4138	Capstone II	0	0	4	2	Knowledge of civil engineering courses
Theory		Exploratory 6	3	0	0	3	
						Semester Credits	**16**

Specialization Tracks

The students enrolled in B. Tech. Civil Engineering (4 year) would have an option to specialize in one the following emerging areas:

1. Construction Management
2. Environmental Engineering
3. Transportation Engineering

Transportation Engineering

The student must complete a minimum of **15** credits in the chosen area of specialization.

List of elective courses in specialization tracks

Major Elective 15 Credits						
Track 1 : Construction Management						
Cat	**Course Code**	**Course Title**	**L**	**T**	**P**	**TC**
Theory	CIVL3081P	Green Building and Energy Efficiency	3	0	0	3
Theory	HSFS3031P	Disaster Management	3	0	0	3
Theory	CIVL3089P	Advanced Concrete Technology	3	0	0	3
Theory	CIVL4081P	Construction Specifications, Law & Finance	3	0	0	3
Theory	CIVL4082P	Forensic Engineering and Rehabilitation of Structure	3	0	0	3
Theory	CIVL4083P	Artificial Intelligence in the Built Environment	3	0	0	3
Theory	CIVL3081P	Green Building and Energy Efficiency	3	0	0	3
Track 2 : Environmental Engineering						
Theory	CIVL3081P	Green Building and Energy Efficiency	3	0	0	3
Theory	HSFS3031P	Disaster Management	3	0	0	3
Theory	CIVL3088P	Emerging Contaminants and Advances	3	0	0	3
Theory	CIVL4079P	Environmental Modelling and Simulation	3	0	0	3
Theory	CIVL4079P	Geo-Environmental Engineering	2	1	0	3
Theory	HSFS3044PP	Occupational Health & Safety Engineering	3	0	0	3
Theory	CIVL4080P	Remote Sensing & its Application	3	0	0	3
Track 3: Transportation Engineering						
Theory	CIVL3080P	Traffic Engineering and Transportation Planning	3	0	0	3
Theory	CIVL3082P	Pavement Design and Performance	3	0	0	3
Theory	SPL	Railway and Tunnel Engineering	3	0	0	3
Theory	CIVL4075	Metro Rail Transportation Design & Construction	3	0	0	3
Theory	CIVL4076P	Intelligent Transportation Systems	3	0	0	3
Theory	CIVL4077P	Optimization Techniques in Transportation Engineering	3	0	0	3

Civil Minor course requirement list

Students from other departments in the university have the option to take a minor degree from the Civil Engineering stream. The list of course requirements to obtain a Civil Engineering minor degree is as follows. Total credit for minor requirement is minimum twenty-Four.

Mandatory Courses- 24 Credits*			
Course Code	**Course Name**	**credit**	**Prerequisite**
CIVL2130	Building Materials and Concrete Technology	4	Knowledge of mathematics, mechanics of solids and concrete technology theory
CIVL3055	Environmental engineering	3	Knowledge of Mathematics, Chemistry, Engineering Hydrology and Environmental Engineering I
CIVL3018	Structural engineering	3	Mechanics of Solids, Structural Analysis I

CIVL3020	Geotechnical engineering	3	Knowledge of Mechanics and Engineering Mathematics
CIVL3022	Transportation Engineering	3	Knowledge of Surveying, Basic Knowledge of dynamics, Knowledge of construction materials
CIVL2032	Water Resources Engineering	3	Knowledge of Mathematics, Knowledge of Introduction to Fluid Mechanics
RP	Research project	2+3=5	Knowledge of civil engineering

12.0 List of Electives

A. Programme Electives

- Specialization (Transportation Engineering)

  Specialization course I: Traffic Engineering and Transportation Planning

  Specialization course II: Pavement Design & Performance

  Specialization course III: Railway and Tunnel Engineering

  Specialization course IV: Metro Rail Transportation Design & Construction

  Specialization course V: Computer Simulation in Transportation Engineering

  Specialization course VI: Intelligent Transportation Systems

  Specialization course VII: Optimization Techniques in Transportation Engineering

- Specialization (Environmental Engineering)

  Specialization course I: Green Building & Energy Efficiency

  Specialization course II: Disaster Management

  Specialization course III: Emerging Contaminants and Advances

  Specialization course IV: Environmental Modelling and Simulation

  Specialization course V: Geo-environmental Engineering

  Specialization course VI: Occupational Health & Safety Engineering

  Specialization course VII: Remote Sensing & its Applications Engineering

- Specialization (Construction Management)

  Specialization course I: Green Building & Energy Efficiency

  Specialization course II: Disaster Management

  Specialization course III: Advanced Concrete Technology

  Specialization course IV: Construction Specifications, Law & Finance

Specialization course V: Forensic Engineering and Rehabilitation of Structures
Specialization course VI: Artificial Intelligence in the Built Environment

- Minor

  If the student completes all courses from any basket, he/she receives a minor.

B. University Electives

- Signature Courses- School for Life Courses/ Life Skill Courses
  - Critical Thinking
  - Living Conversations
  - Leadership & Teamwork
  - Design Thinking
  - Start your Start-up.
  - Working With Data
  - Meta 101
  - Technologies of the Future

- Exploratory Courses

  If the student takes up courses from different baskets, that is regarded as an exploratory course.

- Exploratory course 1
- Exploratory course 2
- Exploratory course 3
- Exploratory course 4
- Exploratory course 5
- Exploratory course 6

SEMESTER I

Course Code	Course name	L	T	P	C
SLSG 0102	**Critical Thinking**	**2**	**0**	**0**	**2**
Pre-requisites/Exposure					
Co-requisites	**--**				

Course Objectives

The objectives of this course are:

I. To introduce the essential tools and approaches of critical thinking.
II. To realize how the fallacies and biases hinder the process of critical thinking and how to overcome them.
III. To understand and the various components and conventions of critical writing and create appropriate documents.

Course Outcomes

On completeing this module, the student should be able to:

CO1: Identify, understand and define the various arguments in different contexts
CO2: Draw logical conclusions
CO3: Introspect and reflect on their thought processes
CO4: Identify the errors in reasoning
CO5: Listen, read and write critically

Catalog Description

The ability to think clearly and rationally is important in whatever we choose to do. Critical thinking is the ability to think clearly and rationally about what to do or what to believe and includes the ability to engage in reflective and independent thinking. Critical Thinking and Writing skills are important to help the one progress in their professional and personal life effectively. This course aims to introduce the various tools and methods available to develop their critical thinking. It will equip students to utilize critical thinking concepts and strategies in learning, and apply those skills for effective written communication, thus developing the ability to think critically and communicate effectively.

Course Contant

Unit 1 – Heading – (11 Lecture Hour)

Module-1 Understanding the process of critical thinking

- What is critical thinking: definition and theories
- Importance of Critical Thinking
- Critical thinking Structures
- Metacognitive skills; understanding our minds

Unit 2 – Heading – **(11 Lecture Hour)**

Module-2 Barriers to critical thinking

- The critical thinking model
- Information Literacy
- Cognitive Biases
- Logical Fallacies

Unit-3 **(11 Lecture Hour)**

Module-3 Approaches for Critical Thinking

- Arguments and Rationality
- Reasoning and Persuasion
- Six Thinking hats
- Simplification

Unit-4 **(12 Lecture Hour)**

Module-4 Critical thinking and writing

- Critical thinking and clear writing
- Presenting and communicating ideas

Textbooks / Reference Books

1. Lewis Vaughn, The power of critical thinking, effective reasoning about ordinary and extraordinary claims, second edition, Oxford University Press
2. Walter Sinnott Armstrong and Robert Fogelin, Understanding Arguments: An Introduction to Informal Logic. 8th Ed., Wadsworth Cengage Learning.
3. Edward de Bono, Six Thinking Hats, ISBN 0-316-17831-4
4. Richard Paul and Linda Elder, The miniature guide to critical thinking, concepts and tools, the foundation for critical thinking
5. Encourage critical thinking with 3 questions: https://www.youtube.com/watch?v=0hoE8mtUS1E
6. Wile E Coyote Into- Introduction to critical thinking: https://www.youtube.com/watch?v=xOjl3jm-GrA
7. Psychologist Diane Halpern on Critical Thinking: https://www.youtube.com/watch?v=rn_7aJP5BTw

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**QUIZ**	**E-PORTFOLIO**	**PROJECT**	**Total**
Weightage (%)	20%	30%	50%	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1									2	2		3			
CO2									2	2		3			
CO3									2	2		3			
CO4									2	2		3			
CO5									2	3		3			
Average									**2**	**2.25**		**3**			

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
SSEN0101	Environment Sustainability and Climate Change	2	0	0	2
Pre-requisites/Exposure	Fundamentals of basic ecology, chemistry and physics				
Co-requisites					

Course Objectives (CO) :

I. To Develop a critical understanding of the nature, cause and impact of human activities on the environment.
II. Critically engage with concepts of ecosystems, biodiversity and sustainability.
III. Research, analyse, identify problems, develop insights, and frame sustainable solutions to living issues faced by the global and local communities.
IV. Learning by doing, engaging, exploring and experimenting.

Course Outcomes

CO-1:Understand the concepts of ecology, sustainability, climate change and environment related to everyday life.

CO-2: Distinguish and relate different types of biodiversity and natural resources and their impact on sustainable development.

CO-3: Analyse various aspects of environment and adopt eco-friendly technologies to facilitate conservation and regeneration of natural resource.

CO-4: Build environmental awareness through a wide range of curricular and co-curricular activities at the University and later in a professional/vocational practice.

Catalog Description:

This course aims at sensitizing students to the environment and the balance of natural and manmade ecosystems. Develop empathy and concern for the environment and evolve as conscious participants in resolving issues affecting local and global environment. The course seeks to build an interdisciplinary approach and analytical skills, with an element of creativity towards achieving a sustainable future. Under this programme we shall be provide indepth knowledge in various area such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development.

Course Content

Unit 1 Humans and the Environment **(4 lecture hours)**

The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change.

The emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.

Unit 2 Natural Resources and Sustainable Development (6 lecture hours)

Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable, and non-renewable.

Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges.

Water resources: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water.

Soil and mineral resources: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation.

Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment.

Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

Unit 3 Environmental Issues: Local, Regional and Global (6 lecture hours)

Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena.

Pollution: Impact of sectoral processes on Environment, Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Transboundary air pollution; Acid rain; Smog.

Land use and Land cover change: land degradation, deforestation, desertification, urbanization.

Biodiversity loss: past and current trends, impact.

Global change: Ozone layer depletion; Climate change.

Unit 4 Conservation of Biodiversity and Ecosystem (6 lecture hours)

Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories.

Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance.

Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters, and climate change.

Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.

Unit 5 Environment Pollution and Health (6 lecture Hours)

Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution.

Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards.

Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.

Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.

Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.

Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Unit 6 Climate Change Impact Adaptation and Mitigation (6 lecture Hours)

climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent.

Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change.

Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and *Intended Nationally Determined Contributions* (INDCs); Climate justice.

Unit 7 Environment Management (6 Lecture Hours)

Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.

Environmental management system: ISO 14001

Life cycle analysis; Cost-benefit analysis

Environmental audit and impact assessment; Environmental risk assessment

Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme.

Unit 8 Environment Treaties and Legislation (6 Lecture Hours)

1. An overview of instruments of international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification, and entry into force; binding and non-binding measures; Conference of the Parties (COP)

2. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; Convention on International Trade in Endangered Species of 6ild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions

3. Major Indian Environmental Legislations: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements

Major International organisations and initiatives: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN),World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

Unit 10 Living Lab Case Studies and Field Work 30 hours

The students are expected to be engaged in some of the following or similar identified activities:

- Discussion on one national and one international case study related to the environment and sustainable development.
- Field visits to identify local/regional environmental issues, make observations including data collection and prepare a brief report.
- Documentation of campus biodiversity.

• Campus environmental management activities such as solid waste disposal, water management, and sewage treatment

Reference Books

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.

1. Headrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.

2. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)

4. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)

3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.**University Grants Commission 11.**

4. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)

5. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.

6. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.

7. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.

8. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/

9. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).**University Grants Commission 13**

10. Denle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.

11. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.**University Grants Commission 15**

12. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5

13. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp-content/uploads/2020/02/convention-V-16-CURVE-web.pdf

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE
Weightage (%)	30	20	50

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table :

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2										
CO2	2	1			1						
CO3	3	1		1	2			1			2
CO4	2	2		1	1			1			1
Average	2.25	1.3		1	1.3			1			1.5

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

MATH-1050	**Engineering Mathematics-I**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basic Mathematics (10+2 level)				
Co-requisites	--				

Course Objectives

I. To enable the students, apply matrix theory in engineering problems.
II. To help the students develop the skills related to multivariate calculus.
III. To enable the students, understand the application of vector calculus in engineering problems.
IV. To enable students, approximate the function of one variable by infinite series.

Course Outcomes

CO1. Find the solution of a system of linear equations.
CO2. Apply the techniques to handle the functions of several variables for calculus.
CO3. Demonstrate the basic concepts of vector calculus with relevant applications.
CO4. Find the infinite series approximation of a periodic and non-periodic function of one variable.

Catalog Description

Mathematics is a natural complementary discipline for learning, understanding and appreciating many fundamental science and engineering concepts. It helps us to develop logical thinking and to find the right way to solve problems. The purpose of this course is to provide participants with the skills, knowledge required to perform fundamental mathematical procedures and processes for solution of engineering problems, particularly the use of matrices, multivariable calculus, vector calculus. The approximation techniques for periodic and non-periodic functions using infinite series are important for engineering disciplines while matrices are foundations for computer science.

Course Content

Unit I: Matrices (9 Lecture Hours)
Elementary transformation, Inverse of matrix , linearly independent vectors, rank of a matrix, solution of system of linear equations, Eigenvalues and Eigenvectors, characteristic equation, Cayley-Hamilton Theorem, Diagonalization of matrices, Orthogonal transformation and quadratic to canonical forms.

Unit II: Multivariable Calculus (12 Lecture Hours)
Partial derivatives, Euler’s Theorem and its Applications, total derivative, Jacobians, extrema of functions of two variables, Method of Lagrange multipliers.

Beta and gamma function, Multiple Integration: double and triple integrals, change of order of integration, change of variables, Applications: areas, volumes, center of mass and Gravity (constant and variable densities).

Unit III: Vector Calculus **(15 Lecture Hours)**

Vector and scalar functions and fields, Gradient of a scalar field, Directional derivative; Divergence and curl of a vector field. Line Integrals, Path Independence of Line Integrals; Surface Integral; Volume Integral, Applications of Green's theorem, Gauss' divergence theorem & Stoke's theorem.

Unit IV: Fourier Series and Transform **(9 Lecture Hours)**

Taylor's and Maclaurin's series, Periodic Functions, Fourier Series expansion of functions of period $2l$, Half Range Sine and Cosine series, Fourier transform.

Textbooks

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications. ISBN: 9788126531356.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000. ISBN: 8174091955
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications. ISBN: 9788184875607.
4. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill. ISBN: 9780071070089.

Reference Books:

1. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010. ISBN : 978-81-318-0803-0
2. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", Pearson, 2002. ISBN: 978-0201531749
3. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008. ISBN: 978-0-07-061678-3
4. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005. ISBN: 978-1285463247
5. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005. ISBN: 9780071070591

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	0	0	0	0	0	0	1	-	-	-
CO2	3	3	2	1	1	0	0	0	0	0	0	1	-	-	-
CO3	3	3	2	1	1	0	0	0	0	0	0	1	-	-	-
CO4	3	3	2	1	1	0	0	0	0	0	0	1	-	-	-
Average	**3**	**3**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**-**	**-**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course code	Course name	L	T	P	C
PHYS 1102	**Physics**	**3**	**1**	**0**	**4**
Pre-requisites/Exposure	**12^{th} level Physics**				
Co-requisites	**12^{th} level Mathematics**				

Course Objectives

I. Understand the concepts of Interference, Diffraction and Polarization and apply these concepts in performing measurements using optical devices such as grating, Newton's rings, etc.

II. Understand the fundamentals of LASER and its use as a light source as well as its applications in optical fibre communication, holography and sensing.

III. Apply the Maxwell equation to learn various properties of dielectric and magnetic materials.

IV. Construct a quantum mechanical model to explain the behaviour of a system at the microscopic level.

Course Outcomes

At the end of this course, student should be able to

CO1. To recognize various optical phenomena such as interference, diffraction and polarization, and apply the knowledge in identifying and understanding optics-based devices such as lasers and its significance in optical fibre communication.

CO2. Understand the properties of dielectric and magnetic materials under the influence of electric and magnetic fields.

CO3. To apply the fundamentals of Quantum Mechanics to understand behaviour of microscopic objects.

Catalog Description

Almost all disciplines of engineering and technology have origins in basic principles of physics. In this course, we will try to address the one of the most fundamental question i.e. what is light. This question will be treated in both classical and quantum framework along with their implications as well as limitations. The wave nature of light as well as some of its important applications such as polarization, lasers, optical communication etc. will be studied in first unit. The second unit deals with very important class of engineering materials namely di-electric and magnetic materials along with their wide range of application. In third unit the focus will be to develop an understanding of the origin of transverse and longitudinal waves. In the last part of the course, we will systematically study the development of 'modern physics', more specifically the quantum mechanics. The theoretical development of wave mechanics their limitations along with their contribution to revolutionize the modern world will also be studied as part of the course.

Course Content

Unit 1: (20 lectures hours)

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhoffer and Fresnel Diffraction, Fraunhoffer diffraction at single slit and multiple slits; diffraction grating, characteristics of diffraction grating and its applications.

Polarization: Introduction Polarization by reflection, polarization by double refraction, scattering of light, circular and elliptical polarization, optical activity.

Fiber Optics: Introduction, Optical Fiber as a dielectric wave-guide, total internal reflection, numerical aperture and various fiber parameters, losses associated with optical fibers, step index and graded index fibers, applications of optical fibers

Lasers: Introduction to interaction of radiation with matter, principle of working of laser: population inversion, pumping, population inversion, types of lasers, application of lasers

Unit 2: (20 lectures hours)

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics.Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

Unit 3: (20 lectures hours)

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.

Textbooks

1. Mehta N., (2009) Text Book of Engineering Physics Part-1. PHI Learning Pvt. Ltd.
   ISBN: 9788120333611.
2. Beiser A., Mahajn S., Chaudhury S. R., (2009) Concepts of Modern Physics, 6th ed. McGraw Hill Education Pvt. Ltd. ISBN: 9780070151550.
3. Vasudeva A.S., (2010) Modern Engineering Physics (Revised Edition), S. Chand & Company Ltd. ISBN: 9788121917575.
4. Jain A. K, Malik H. K., (2016) Engineering Physics, Tata McGraw-Hill Education Pvt. Ltd. ISBN: 9780070671539.

Reference Books

1. Griffith D.J. (2012) Introduction to Electromagnetics, PHI Learning, 4th edition, ISBN: 9780138053260
2. Pillai S.O., (2009) Solid State Physics, 6th ed. New Age International Pvt. Ltd. ISBN: 9781906574109.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**IA**	**MSE**	**ESE**
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
Average	2.67	1.5	-	-	-	-	-	-	-	-	-	1	-	-	-

1=weakly mapped **2= Moderately mapped** **3=Strongly mapped**

Course Code	Course name	L	T	P	C
MEPD 1003	**Workshop Practice**	**0**	**0**	**6**	**2**
Pre-requisites/Exposure	**Workshop practice theory course**				
Co-requisites	**--**				

Course Objectives

I. To impart knowledge and skill of components in the field of basic workshop practices.

II. To deal with different hand and machine tools required for manufacturing simple components.

III. To impart the knowledge regarding the various basic manufacturing processes required in day-to-day life.

IV. To familiarize the students with the pr\operties and selection of different engineering material.

V. To impart knowledge of dimensional tolerances with different manufacturing processes.

Course Outcomes

On completion of this course, the students will be able to:

CO1: Remember and identify basic tools and equipment used in engineering workshop.

CO2: Understand the basic principles of various manufacturing processes

CO3: Apply and relate the knowledge of manufacturing processes in fabrication of Engineering products.

Catalog Description

Workshop technology is the backbone of the real industrial environment that helps to develop and enhance relevant technical hand skills required by the engineers working in the various engineering industries and workshops. This course intends to impart basic knowledge of various hand tools and their use in different sections of manufacturing. Irrespective of branch, the use of workshop practices in day-to-day industrial as well domestic life helps to solve the problems. The workshop experiences would help to build the understanding of the complexity of the industrial job, along with time and skills requirements of the job. The students are advised to undergo each skill experience with remembrance, understanding and application with special emphasis on attitude of enquiry to know why and how for the various instructions and practices imparted to them in each shop.

Course content:

UNIT 1 (**4 Lecture Hours)**

Manufacturing Methods, Forming process –hot working and cold working processes – types. Machining advanced manufacturing processes- introduction to non-conventional machining processes and its needs.

UNIT 2: (**2 Lecture Hours)**

Fitting operations & power tools, limits, fits and tolerance. Types of power tools.

UNIT 3 : (**2 Lecture Hours)**

Metal casting patterns-types, allowances, molding sand-its properties, types of molds and cores, melting equipment.

UNIT 4 **(3 Lecture Hours)**

Welding (arc welding & gas welding), brazing, Gas welding.

UNIT 5 **(1 Lecture Hours)**

Carpentry Types of woods,defects of wood, seasoning of wood, types of carpentry tools. Additive manufacturing –additive v/s subtractive manufacturing, need, advantages and applications of additive manufacturing, introduction to 3 D printing.

List of Experiments

Experiment No: 01

Prepare lab layout of the workshop with layout of all shops: carpentry, fitting, machine, welding, smithy, sheet metal and foundry shop.

Experiment No: 02

To fabricate a T-lap joint of given dimensions using common carpentry tools.

Experiment No: 03

To fabricate a cross lap joint of given dimensions using common carpentry tools.

Experiment No: 04

To develop a square fitting model of given dimensions by using fitting tools.

Experiment No: 05

To learn lathe operation and develop a step turning model of given dimensions by using lathe machine.

Experiment No: 06

To develop a model of given dimension by using facing, turning, grooving, parting and knurling operations.

Experiment No: 07

To learn welding operation and develop a T- joint, V-butt joint and Lap joint using electric arc welding process.

Experiment No: 08

To develop a rectangular tray in sheet metal shop using various hand tools for working with sheet metal

Experiment No: 09

To develop a chisel using common smithy hand tools.

Experiment No: 10

To develop a cope and drag mould in foundry shop

Text Books / Reference Books

1. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
2. Engineering Practices Lab Manual, Jeyapoovan, SaravanaPandian, Vikas publishers
3. Dictionary of Mechanical Engineering, GHF Nayler, Jaico Publishing House.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Examination Scheme:

Components	**Quizzes/Tests, Assignments**	**Lab Evaluation**	**ESE**
Weightage (%)	35	35	30

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	1	-	1	-	-	-	1	-	-	-	-	-	-	-
CO 2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	3	-	-	-	2	-	-	2	-	-
CO 4	1	-	-	-	2	-	-	-	-	-	-	-	-	-
Avera ge	**1**	**-**	**1**	**-**	**2.5**	**-**	**1**	**-**	**2**	**-**	**-**	**2**	**-**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course code	Course name	L	T	P	C
PHYS 1102	**PHYSICS LAB**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Basic knowledge on practical Physics (12th level) for understanding and performing experiments.**				
Co-requisites	**Data interpretation and basic knowledge on graphical analysis.**				

Course Objectives

I. To impart hand-on skills in performing experiments, data acquisition and interpretation of the data.
II. To design the circuits and study about various experimental procedures involved.
III. Significance of the experimental results to understand and verify theoretical formulation and prediction.
IV. To develop curiosity and creative ability through experimentation and investigation based on the virtual experiments.

Course Outcomes

At the end of this course student should be able to

CO1. Demonstrate the dual nature of light by verifying the various phenomena associated with it.

CO2. Apply the concepts of electromagnetics to study the various electrical and magnetic properties of Materials.

CO3. Evaluate and compare the universal constants by using the principle of modern physics.

CO4. Design virtual Physics based experiments to illustrate the Hysteresis.

Catalog Description

The laboratory practice has been an important part of professional and engineering undergraduate education, an ideal platform for active learning. The purpose of the Physics practical sessions is to give students hands-on experience with the experimental basis of engineering physics and, in the process, to deepen their understanding of the relations between experiment and theory. The focus of this course is to improve the skills of the students in collecting, analyzing, interpreting, and presenting findings and data.

Course Content

Experiment No: 01 Sonometer

Aim: To determine the frequency of AC mains by using a sonometer.

Experiment No: 02 Hall Effect

Aim: To study the Hall effect and hence determine the Hall coefficient (R_h) and carrier density (n) of a given semiconductor material.

Experiment No: 03 Faraday's Laws

Aim:

a. To study the induced emf as a function of velocity of the magnet passing through the coil (Faraday's Law).
b. To study the charge delivered due to electromagnetic induction.

Experiment No: 04 Circular Coil

Aim: To study the variation of magnetic field with distance along the axis of a current carrying circular coil and hence estimate the radius of the coil.

Experiment No: 05 Photoelectric Effect (Virtual lab)

Aim: To study the characteristics of photocurrent vs voltage at different frequency.

Experiment No: 06 Newton's Rings

Aim: To determine the wavelength of a given light by forming Newton's Rings.

Experiment No: 07 Diffraction Grating

Aim: To determine the wavelength of a given light by using a Diffraction grating in its normal incidence position.

Experiment No: 08 Optical Fibre

Aim: To determine the Numerical Aperture of an optical fibre and study about the bending losses.

Experiment No: 09 Planck 's constant

Aim: To find the Planck is constant by using LEDs.

Experiment No: 10 Presentation

Aim: Presentation related to any science concept.

Text Books

1. H. Singh, Practical Physics, S. Chand & Company LTD., ISBN: 8121904692.
2. S. L. Kakani, S. Kakani, Applied Physics-Theory & Practicals, Viva Books, ISBN: 9788130924892.
3. C. L. Arora, Practical Physics, S. Chand & Company LTD., ISBN: 9788121909099, 8121909090.

Reference Books

1. Gupta, Kumar, Practical Physics, Pragati Prakashan, ISBN: 9789386633569.
2. I. Prakash, R. Krishna, A. K. Jha, Practical Physics, Kitab Mahal, ISBN: 8122504167, 9788122504163
3. P. R. Sasi Kumar, Practical Physics, Prentice Hall of India Pvt Ltd, ISBN: 9788920344341

Modes of Evaluation: File /Viva-voce / presentation

Examination Scheme: Continuous Evaluation

Components	Continuous Assessment	Total
Weightage (%)		100

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
Average	**2**	**3**	**1**	-	-	-	-	-	-	-	-	**1**	-	-	-

1. Weak Mapped **2. Moderate Mapped** **3. Strong Mapped**

Course code	Course name	L	T	P	C
MECH 1001	Engineering Graphics	2	2	0	2
Pre-requisites/Exposure	The knowledge of simple geometrical theorem and proceduresis essential.				
Co-requisites	--				

Course Objectives

I. Increase ability to communicate with people.
II. Enhance knowledge, imagination and drawing skill.
III. Learn basics of design software Solid works skills.
IV. Draw the accurate and precise line drawing.
V. Prepare the student for future Engineering positions.

Course Outcomes

At the end of this course student should be able to

CO1. Remember the conventions of engineering graphics such as types of lines, dimensioning, method of projection etc.

CO2. Demonstrate understanding of fundamental concepts of engineering graphics.

CO3. Apply knowledge of orthographic and isometric projections to solve problems related to points, lines, planes and solids.

CO4. Develop and model basic mechanical components.

Catalogue Description

Engineering graphics builds the foundation of analytical capabilities for solving a greatvariety of engineering problems involving diagrams. It also has numerous real time application in almost all branches of engineering. This subject helps the student to enhance their knowledge, imagination and drawing skill. The purpose of the study of the engineering graphics is to develop the ability to visualize an object with physical and dimensional configurations. With its extensive coverage, the step-by-step approach and handy drawing tips. The subject support for students to draw the accurate and precise line drawing.

Course Content

UNIT I: Fundamental Of Engineering Graphics And Projections

(06 Lecture Hours)

Introduction to drawing instruments, sheet layout and sketching, Lines, Lettering and Dimensions. Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

UNIT II: Projection Of Point (03 Lecture Hours)

Introduction to orthographic Projection, Projection of points situated in 1st, 2nd, 3rd and 4th quadrant.

UNIT III: Projection Of Line **(03 Lecture Hours)**

Line parallel to one or both the planes, line perpendicular to one plane and parallel to other, line inclined to one of the planes.

UNIT IV: Projection Of Planes **(03 Lecture Hours)**

Types of plane, Projection of planes parallel to one of the references. Projections of planes inclined to one of the reference plane and perpendicular to the other.

UNIT V: Projection Of Solids **(03 Lecture Hours)**

Introduction and types of solid, Projections of solids in simple positions, Inclined to one plane. Projections of spheres and problem solving.

UNIT VI: Projection Of Solids **(03 Lecture Hours)**

Introduction and Section of prisms, Pyramids, Cylinder, Spheres, Cones.

UNIT VII: Section Of Solids **(03 Lecture Hours)**

Introduction of isometric axes, lines and planes, Isometric drawing of different objects.

UNIT VIII: Surface Development and Perspective Projection

(03 Lecture Hours)

Methods of development, Developments of lateral surfaces; Principle of perspective projections, Definition of perspective elements.

UNIT IX: Computer Graphics **(03 Lecture Hours)**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

Text Books

1. Bhatt, N. D. (2014) *"Engineering Drawing"*, Charol Publication
2. Gill, P. S. (2009) *"Engineering Drawing"*, Kataria Publication
3. Dhawan, R. K. (2011) *"Engineering Drawing"*, S Chand.

Reference Books

1. Morling, K. *“Geometric and Engineering Drawing”*, Third Edition, Elsevier 32 Jamestown Road London NW1 7BY 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA.

Modes Of Evaluation: Quiz/Assignment/ Written Examination

Examination Scheme:

Components	**IA**	**MSE**	**ESE**
Weightage (%)	30	20	50

Relationship Between the Program Outcomes (Pos), Program Specific Outcomes (Psos) and Course Outcomes (Cos)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	-	-	-	-	2	-	1	-	2	-
CO2	3	3	3	2	3	-	-	-	-	2	-	1	-	1	-
CO3	3	3	3	2	3	-	-	1	-	2	-	1	-	3	-
CO4	3	3	3	2	3	-	-	1	2	2	-	1	-	1	-
Avg	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**1**	**2**	**2**	**-**	**1**		**1.75**	

1=Weakly mapped **2=Moderately mapped** **3=Strongly mapped**

Course code	Course name	L	T	P	C
CSEG 1008	**Object Oriented Programming**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of the English Language**				
Co-requisites	**Knowledge of Word processing using MS Word, basic IT skills**				

Course Objectives

I. To help the students to understand and identify the functional units of a Computer System.

II. To enable students to understand the concepts of procedure-oriented programming using C Language.

III. To empower students with the expertise of experimentation using C programming skills.

IV. To expose students with the ability to design programs involving decision structure, loops and functions.

V. To equip students with necessary engineering skills such as solving engineering problems through implementing concepts of arrays, pointers, structures and union in C programming language.

Course Outcomes

At the end of this course student should be able to

CO1: Comprehend the fundamentals of Computers with concepts of algorithm, flowcharts and develop efficient algorithms for solving a problem.

CO2: Interpret the Control of flow statements and decision constructs with C programming techniques.

CO3: Identify the various concepts of Programming like Arrays, Structures and Unions and Strings.

CO4: Apply concepts of functions and pointers to resolve mathematical problems.

CO5: Analyse the real-life problem and write a program in ‘C’ language to solve the problem.

Catalogue Description

To enable students to understand the concepts of procedure oriented programming using C Language and empower students with the expertise of of experimentation using C programming

Course Content

Unit I: (9 Lecture Hours)

Introduction – Generation and classification of computers, Basic computer organization, Number system (Binary, Octal, Decimal, Hexadecimal conversion problems), Need for logical analysis and thinking, Algorithm, pseudocode, flowchart.

Unit II: (10 Lecture Hours)

C Programming Basics – Problem formulation, Problem Solving, Introduction to C Programming fundamentals, Structure of a C Program, Compilation and Linking processes, Constants, Variables, Data types – Expressions using operators in 'C', Managing input and output operations, Decision making and branching, Looping statements, solving simple scientific and statistical problems.

Unit III: (8 Lecture Hours)

Arrays and Strings: Arrays – initialization, Declaration one dimension and two-dimensional arrays. String and string operations, string arrays, simple programs – sorting, searching, matrix operations.

Unit IV: (8 Lecture Hours)

Functions and Pointers – Functions – definition of function, Declaration of function, Pass by value, Pass by reference, Recursion. Pointers – Definition, Initialization, Pointers arithmetic, Pointers and arrays.

Unit V: (10 Lecture Hours)

Structure and Union – Introduction - need for structure data type, Structure definition, Structure declaration, Structure within a structure, Array of Structures, Self-referential structure, notion of Linked List. Union, Storage class Specifiers, Preprocessor Directives, File Handling.

Textbooks

1. E.Balagurusamy,"Programming in ANSI C",Tata McGraw Hill Edition Pvt. Ltd.,15th Edition.
2. Thareja Reema, "Computer Fundamentals & Programming in C", Oxford Press.
3. Kanetkar Yashwant, "Let Us C", BPB Publications.

References

1. Schildt Herbert, "The Complete reference C".
2. Gottfried Byron, "Programming with C", Schaum's Series.
3. Venugopal K.R. and Prasad S. R., "Mastering 'C'"
4. http://learn.upes.ac.in Blackboard – LMS

Note: Also refer to the Web-links/Resources in Blackboard and NPTEL videos.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**IA**	**MSE**	**ESE**
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

PO/CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG.	**1.5**	**1.5**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course code	Course name	L	T	P	C
CSEG 1108	**Object Oriented Programming Lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Basic Knowledge of Computer Science such as fundamentals & logic for solving programs**				
Co-requisites	**Basic Knowledge of Mathematics.**				

Course Objectives

I. The overall objective of the modules is that the student should be able to understand basic computer fundamentals and functional units of computers with basic skills development in C Programming.

Course Outcomes

CO1. Identify the functional units of computer system.

CO2. Understand the concepts of procedure-oriented programming using C.

CO3. Implement the basic concepts of C programming language.

CO4. Design programs involving decision structures, loops and functions.

CO5. Implement the concepts of arrays, pointers, structures in C programming language.

Catlog Description

Knowledge about the C programming knowledge is the building block of the students to build their programming skills. And enable the students to enhance the programming skills of the students and make them comfortable to adopt the new language for programming in future.

List of Experiments

Sl. No.	Experiment	Contents
1.	**Experiment-1 and 2**	Basic understanding of Linux/Unix commands
2.	**Experiment-3 and 4**	Basics of flow charts, Algorithms
3.	**Experiment -5 and 6**	Understanding introduction to C programming
4.	**Experiment- 7 and 8**	Control Statements using if.. if.. else, switch… case
5.	**Experiment- 9 and 10**	Looping using while,do..while and for
6.	**Experiment- 11 and 12**	Array
7.	**Experiment- 13 and 14**	Strings
8.	**Experiment- 15 and 16**	Functions
9.	**Experiment- 17 and 18**	Pointers
10.	**Experiment- 19 and 20**	Structure and union
11.	**Experiment- 21 and 22**	File handling

Text Books / Reference Books

Ref. 1. Balagurusamy, E (2007), *ANSI C*, New Delhi: TMH

Ref. 1. Introduction to Computers, Peter Norton, TMH, fifth Ed.

Ref. 2. Programming in ANSI C, E Balaguruswamy, TMH

Ref. 3. Let us C Yashavant Kanetkar, Ninth Ed. BPB

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**IA**	**MSE**	**ESE**
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	2		1	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-		-	-	-	-	-	-	-
Avg.	**1.5**	**1**	**1.5**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

SEMESTER II

Course code	Course name	L	T	P	C
SLLS0101	LIVING CONVERSATIONS (LIFE SKILL 1)	2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objectives of this course are:

I. Encourage critical self-reflection to develop empathy and clarity of expression forexchange of individual and organizational ideas and information.
II. Enable qualities of deep listening and clear and concise communication skills.
III. Apply and practice varied platforms and tools of communication both formal andinformal.
IV. Appreciate and practice collaborative communication in a given environment and context.

Course Outcomes:

Knowledge & Understanding:

CO1. Understand the importance of being empathetic and the role of clarity in the expression.

CO2. Identify appropriate strategies to improve one's ability to express, listen and to understand people in a given situation and context.

CO3. Use speaking, writing and listening skills to create more effective and productive professional and personal relationships

CO4. Build collaborative relationships that emphasize cross cultural understanding.

Skills and Attributes:

CO5: Use a range of basic and advanced communication skills, both verbal and non-verbal toengage, inquire, ideate, collaborate and co-create.

CO6: Choose and employ appropriate practice tools in the execution of a project/coursework.

CO7: Critique and articulate responses to group and individual work undertaken by selfand by others.

Catalog Description:

Living Conversations is a life skill course that empowers and enables learners to exchange, empathize, express, ideate, create and collaborate in any given situation - professional or personal. It aims at enabling students to converse confidently and participatein a variety of discussions appropriately in different situational and cultural contexts, making them an influential communicator.

Course Content

Unit - 1 Basics of Communication (6 lectures hours)

Introduction to the course, Importance, use and its application in life (personal as well as professional), Basics of Communication with Practical Examples (need – principles – process – model), Introducing Types of Communication (Verbal & non-verbal), Types of non-verbalcommunication & its importance in overall communication.

Unit – 2 Setting Communication Goals & Avoiding Breakdowns

(4 lectures hours)

Communication goals, creating value in conversations, Internal & external factors impacting our conversations, Communication breakdowns and how to address them.

Unit – 3 Communication Styles (4 lectures hours)

Recognizing your style and the styles of others, closing communication gaps, being flexible without compromising one's identity.

Unit - 4 Listening for Improved Understanding (4 lectures hours)

Importance, Active & Passive listening, Barriers, Benefits, Features & Examples of Active Listening, Verbal and non-verbal signs of active listening skills, Tools & Tips for Practicing Active Listening.

Unit – 5 Emoting, Enunciating & Expressing (4 lectures hours)

Intonation, Enunciation & clarity, Expressions – verbal and written), Calibrating the variance between what you want and what you express, Speaking through silence.

Unit – 6 Cross-cultural Communication: navigating beyond boundaries

(8 lectures hours)

Developing greater sensitivity to cultural differences, Building greater accountability and trust on virtual teams, Uncovering hidden assumptions, Recognizing filters in oneself and others. Project and e- portfolio submission.

Text Books / Reference Books:

Textbooks

- Hargie, Owen (ed.) (2018). The Handbook of Communication Skills. Routledge.London.
- Anderson, Peter & Guerrero, Laura. Handbook of Communication and Emotion. FirstEdition. Elsevier.
- Bordia Crossman, Bretag. Communication Skills. Tata Macgraw Hill.
- Tuhovsky, Ian. The Science of Effective Communication.
- Murphy, Herta, Thomas, Jane P. Effective Business Communication. Tata MacGrawHill

JOURNALS AND ARTI

CLES (Will be uploaded on LMS)

- Patterson, Kerry et.al. (2011) Crucial Conversations Tools for Talking When StakesAre High. MacMillan. Switzerland.
- A Theory of Goal Oriented Communication: https://www.researchgate.net/publication/220138297_A_Theory_of_Goal-Oriented_Communication.

WEB SOURCES

1) Effective Communication http://www.free-management-ebooks.com/dldebk/dlcm-effective.htm
2) Active Listening http://www.free-management-ebooks.com/dldebk/dlcm-active.htm
TED Talks:
https://www.ted.com/playlists/211/the_art_of_meaningful_conversa

Modes of Evaluation: Project + E-Portfolio + Mega Quiz

Examination Scheme:

Components	PROJECT	E-PORTFOLIO	MEGA QUIZ	Total
Weightage (%)	50%	30%	20%	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO7	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
Average	-	-	-	-	-	-	-	-	**3**	**3**	-	**3**	-	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
SSEN0102	Environment Sustainability and Climate Change (Living Lab)	2	0	0	2
Pre-requisites/Exposure	Fundamentals of basic Environment Sustainability and Climate Change				
Co-requisites					

Course Objectives (CO)

I. Understand the concept of Living Labs and their application in the environmental sustainability.
II. Develop a critical understanding of the nature, cause and impact of human activities on the environment.
III. Apply design thinking and innovative principles to develop sustainable solutions.
IV. Evaluate and address legal, policy and ethical consideration in environmental research.

Course Outcomes

CO-1: Gained practical skills in stakeholder engagement, environmental data collection and analysis.

CO-2: Develop expertise in designing and managing Living Lab for environmental sustainability and climate action.

CO-3: Acquired hands on experience with environmental monitoring tools and technologies.

CO-4: Enhance the ability to think critically and creatively in developing sustainable solutions.

Catalogue Description

This course offers a unique learning experience that blends theory and practice in the dynamic field of living labs. Students will engage with real-world challenges, collaborate with external stakeholders, and develop innovative solutions. Through hands-on projects and case studies, participants will gain the skills and knowledge needed to thrive in today's innovation-driven environments. This course is suitable for students interested in fields such as urban planning, technology development, social sciences, and business, as it provides a multidisciplinary perspective on the concept of living labs and their impact on communities and industries. The syllabus provide students with a storing foundation in using Living Lab to addressing pressing environmental challenges and contribute to sustainable solution in the context of climate change.

Course Content

1. A two-credit course in practicum or lab work, community engagement and services, and fieldwork in a semester means two-hour engagement per week. In a semester of 15 weeks duration, a one-credit practicum in a course is equivalent to 30 hours of engagement.
2. Case Studies and Field Work
   The students are expected to be engaged in some of the following or similar identified activities:

   Discussion on one national and one international case study related to the environment and sustainable development.

   Examples: Bhopal Gas Tragedy, Chipko Movement, Narmada Valley Projects, National Park, Sanctuaries, Biosphere Reserve, London Smog 1952, Air Pollution in Delhi, Case studies on Current Environmental Issues, Oil Spills – Deep Water Horizon Oil Spill, BP Oil Spill etc.
3. Field Visit
   Field visits to identify local/regional environmental issues make observations including data collection and prepare a brief report.
4. Campus Environmental Management.
   Campus environmental management activities such as solid waste disposal, water management, and sewage treatment.

   Group Project: Students are required to submit group projects on various topics related to environmental pollution, climate change, biodiversity, natural resource and sustainable development.

Broadly, Living Lab may fall in one of seven thrust areas:

1. **Indigenous technology and Traditional Ecological Knowledge (TEK)**

   The project aims to document, preserve, and revitalize Traditional Ecological Knowledge (TEK) held by indigenous communities. TEK encompasses the deep understanding of local ecosystems, sustainable solution resource management practices and cultural connection to environment. This project emphasizes a collaborative approach involving indigenous elders, community members and researcher. The project not only respects and preserves the rich cultural heritage of indigenous communities but also harnesses their valuable ecological knowledge to address contemporary environmental challenges and promote sustainable practices. It emphasizes the importance of community-driven conservation efforts and the recognition of TEK as a valuable source of ecological wisdom.

2. **Climate change and its impact on Bird Migration**

In recent years, climate change has been affecting the migration patterns of many bird species worldwide. This project aims to study and mitigate the impact of climate change on avian migration and contribute to conservation efforts. This project not only addresses the ecological impact of climate change but also contributes to the conservation of bird species that play vital roles in ecosystem health and biodiversity. It emphasizes the importance of interdisciplinary collaboration and community engagement in tackling climate-related ecological challenges. This project will focus on developing targeted conservation strategies to mitigate the impact of climate change on bird population and help in enhancing collaboration among scientists, conservationists, and local communities for bird conservation.

3. **Sustainable Communities**

How can co-production and social learning with stakeholder communities help us understand how climate action can be implemented 'on the ground'?

The 'living lab' offer for active engagement with a diverse student body and neighbourhood groups. It reflects the wider academic recognition that universities are significant economic, social, and environmental catalysts for cities and regions, offering the potential for change at a spatial scale that connects the local with the global. Project activities to empower the local community-based people to enhance their lifestyle by doing activities. For example, we can do a few projects like utilization of Himalayan biomass for various uses. Our students can give this training and awareness program to localities.

- We can work on the SMART village project by following the SDG goals given by United Nations.
- Identification and selection of such communities who have some native or ancestral knowledge. For example, one farmer in Kerala has huge seed bank from the very old time (more than 200 Years).
- Projects in this area will explore how meaningful policy change can be driven in expanding circles from the level of university communities to the cities, states and nations they are embedded in.

4. **Ecology, Conservation, and Climate Change**

Project within this domain will investigate the ecological characteristics of ecosystem undergoing degradation, examine the dynamics of shifts in parasite ecology and explore the enduring adaptation in hosts, parasites and explore the evolutionary adaptation in host, parasites and wildlife influenced by climate fluctuation and various environmental stressors.

UPES can work on the preservation of untouched Himalayan flora and fauna and propose one flora and fauna bank. This may be followed by the several awareness program for the locals by our staffs and students. The primary aim of projects in this area will be to establish and sustain long-term studies of how climate change impacts ecological aspects of our natural world.

5. **One Health**

This project is centred around the concept of "One Health," which is an approach that recognizes the interconnectedness of human health, animal health, and the health of the environment. It aims to address the broader context of ecological health, acknowledging that various factors such as climate change, habitat alterations, and biodiversity loss play a significant role in shaping the overall health of ecosystems and, consequently, human health. In essence, this project seeks to broaden our understanding of health by looking beyond the human dimension and recognizing the intricate web of relationships that connect human health to animal health and the environment.

One of the primary concerns is to examine the potential sources of new zoonotic diseases. Zoonotic diseases are those that can be transmitted from animals to humans, and understanding their origins is crucial for preventing future outbreaks.

6. **Climate and society**

Climate action will require disruptive transformations for society, but how can that 'transformational intent' be developed? The digital revolution and data science show how rapid transformation can happen, history offers perspectives on such transformations in the past while the business world illuminates how rapid change continues to occur in the commercial and financial sector.
This group of projects will study the interface between climate, sustainable living, and the forces that drive society and societal change.

7. **Communities Based Water Testing Kits and Soil Testing Kits and promotion of low-cost water purification technologies.**
    1. Identify water borne disease in surrounding villages by conducting field surveys and sensitize local communities about water borne diseases and suggest low-cost water treatment methods.
    2. Training local people for water and soil testing.
    3. Sampling and analysis of drinking water

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	Continuous Assessment	ESE
Weightage (%)	100	100

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	-	-	-	-	-	-	-	-	-		-
CO-2	2	1	-	-	-	-	-	-		-	-	-
CO-3	3	1	-	1	2	-	-	1	-	-	2	-
CO-4	2	2	-	1	1	-	-	1	-	-	1	-
Average	**2.25**	**1.3**	-	**1**	**1.3**	**-**	**-**	**1**	**-**	**-**	**1.5**	**-**

1=Weakly mapped **2= Moderately mapped** **3=Strongly mapped**

Course code	Course name	L	T	P	C
MATH1051	**Engineering Mathematics II**	**3**	**1**	**0**	**4**
Pre-Requisites/Exposure	**Math 1026**				
Co-Requisites	**--**				

Course Objectives

I. To help the students master the techniques to solve ordinary differential equation.
II. To help the students understand the basic theory of function of a complex variable.
III. To make the students apply the theory of contour integration using residue calculus.
IV. To enable the students, solve specific classes of partial differential equations.

Course Outcomes

On completion of this course the students will be able to

CO 1. Apply techniques to solve linear ordinary differential equations.

CO 2. Explain the concept of analyticity and integration of a complex function.

CO 3. Find the series representation of a complex function and to evaluate special integrals using calculus of residues.

CO 4. Solve homogeneous partial differential equations with constant coefficients and its applications in one-dimensional heat and wave equations.

Catalog Description

This course covers the ordinary differential equations, partial differential equations and complex analysis. In differential equations student equips with the fundamental tools to solve ordinary differential equations, glimpse of nonlinear ordinary differential equations of special forms and partial differential equations. Lagrange's method ensures the solution of first order nonlinear partial differential equations and separation of variables method useful to solve the one-dimensional wave and heat equations. In addition, this course introduces the calculus of complex functions of a complex variable. It turns out that complex differentiability is a very strong condition and differentiable functions behave very well. Integration is along paths in the complex plane. The central result of this spectacularly beautiful part of mathematics is Cauchy's Theorem guaranteeing that certain integrals along closed paths are zero. This striking result leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.

Course Content

Unit I: Ordinary Differential Equations (15 Lecture Hours)

Exact differential equation and equations reducible to exact, Linear Differential Equations with Constant Coefficients, Cauchy-Euler Differential Equations, Solution of Second Order Differential Equations (when a part of complementary function is known, by reduction to Normal Form, by changing the Independent Variable and by Variation of Parameters).

Unit II: Complex Variables-I (15 Lecture Hours)

Functions of a complex variable, Notion of limit, continuity and differentiability, Analytic function, Necessary & sufficient conditions for analyticity (Cauchy-Riemann equations), Harmonic function, harmonic conjugate and orthogonal families, construction of an analytic function, Milne Thomson method, Line integral and independence of path, Cauchy's theorem, Cauchy-Goursat theorem for simply and multiply connected domain, Cauchy's integral formula and its applications.

Unit III: Complex Variables-II (15 Lecture Hours)

Power series, Taylor's and Laurent's series, Zeros and singularities of a function, residues, Cauchy Residue Theorem, Evaluation of definite integral $\int_0^{2\pi} F(\cos\theta, \sin\theta)d\theta$, Evaluation of improper integrals $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}dx$ and $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}e^{iax}dx$; evaluation of $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}dx$ and $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}e^{iax}dx$ with poles on real axis (semicircular contour), Conformal mapping, Linear mapping, inversion, Bilinear transformation.

Unit IV: Partial Differential Equations (15 Lecture Hours)

Formation of partial differential equation (PDE) and classification of PDEs, Lagrange's Method, Solution of homogeneous linear PDE with constant coefficients, method of separation of variables, solution of one-dimensional heat and wave equation.

Text Books

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, ISBN: 9788184873221.

2. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications, ISBN: 9780470458365.
3. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publications.
   ISBN: 9789385676161.
4. M. D. Raisinghania, Advanced Differential Equations, S. Chand Publications. ISBN: 9788121908931.

Reference Books

1. D. G. Zill, Advanced Engineering Mathematics, Jones and Bartlett Learning, ISBN:
   9789384323271.
2. S. L. Ross, Differential Equations, Wiley Publications. ISBN: 9788126515370
3. D. G. Zill and P. D. Shanahan, A first course in Complex Analysis with Applications, Jones &
   Bartlett Learning, ISBN: 9789380108193.\
4. N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**IA**	**MID SEM**	**End Sem**	**Total**
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO3	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
Average	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
CHEM1013	**Chemistry**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**12th level Chemistry**				
Co-requisites	**--**				

Course Objectives

Objectives of the course are:

I. To make students familiar with the fundamental concepts of chemistry.
II. To make the students understand the various basic chemical reactions, related calculations and reasoning.
III. To prepare the students for studying advanced subjects with required knowledge of chemistry

Course Outcomes

On completion of this course, the students will be able to:

CO1. Choose and develop the appropriate fuel for commercial and domestic application with respect to socio-economic and environment concern.

CO2. Apply the concepts of reaction dynamics for the improvement of chemical reactions

involved in general chemical processes.

CO3. Explain the mechanism, theories and preventive measurements, of corrosion, with the help of electrochemical concepts.

CO4. Analysis and enhance the water quality

CO5. Explain preparation method, properties and application of polymeric and nanomaterials.

Catalogue Description

Chemistry is present everywhere around us. It exists in everything we see, feel or imagine. It is one of the very fundamental basics behind every structure, building, bridge, refinery and industry. In this course, focus will be on firming the basic knowledge of students about chemistry. Students will learn how to use the concepts correctly through prescribed syllabus. They will be taught various types of fuels.

Different processes used to improve the quality of fuels in refineries will be discussed. Combustion calculations related to oxygen or air required will help them to get an effective fuel: O_2 ratio to result in proper and complete combustion. Water chemistry will make the students understand various parameters of water quality and the treatments to improve it. Chemical dynamics will help them to understand the mechanism of reaction. This knowledge will make them able to control the factors to move the reaction in desired direction. Corrosion is based on electrochemical cells. For any engineer, it is quite mandatory to have an understanding to select the suitable metal and also the methods to protect it from decaying. They will also be discussed about various types of polymers and nanomaterials so that they can correlate their properties to their various application areas. Course delivery will be made by classroom teaching, Blackboard, presentations, videos and tutorial classes.

Course Content

Unit I: Fuels & Thermochemistry (10 Lecture Hours)

Prerequisite: Enthalpy of formation, Enthalpy of neutralization and Enthalpy of combustion, Hess's law of constant heat summation and its application, bond energy

Contents: Fuels - Introduction, Classification, Important properties of a good fuels, Calorific value, Determination of calorific value by Bomb calorimeter, Analysis of coal-proximate, Ultimate analysis, Combustion and its calculations, Distillation of crude oil, composition of petroleum, Important reactions for petroleum industries (isomerization, dimerization, aromatization, cracking), Octane number, cetane number, renewable energy sources: biodiesel, biogas, bioethanol. Hydrocarbons chemistry: Basic concepts for preparation strategy, chemical properties and reactivity of aliphatic (alkanes, alkenes, alkynes,cycloalkanes) and aromatic hydrocarbons.

Unit II: Reaction Dynamics (9 Lecture Hours)

Prerequisite: Rate of reaction and rate constant, factors affecting rate of a reaction, order and molecularity of a reaction, Rate expression for zero and first order

Contents: Pseudo first order reaction, Second (2A & A+B) and third (3A) order reaction, Methods of determining order of a reaction: Hit and trial method, half-life period method, graphical method, Von't Hoff method (ratio variation method), differential method and Ostwald isolation method. Concept of energy barrier and activation energy, Collision theory, Kinetics of complex reactions- reversible, parallel, consecutive and chain reaction, Steady state approximation, Lindemann theory. Equilibrium and equilibrium constant, Kp, Kc, Kx. Homogeneous and heterogeneous equilibrium, Le-chatelier principle.

Unit III: Electrochemistry And Corrosion (6 Lecture Hours)

Prerequisite: Galvanic cell, Single electrode potential

Contents: Nernst equation, Nernst Equation based concept and complex problem in electrochemistry, ECS and its applications. Conductance and its types, Variation of conductance with dilution, Kohlrausch law, conductometric titrations, application of electrochemistry in corrosion. Corrosion: Introduction, dry theory, Wet theory, acid theory, types, Factors, prevention.

Thermodynamic functions: Definitions of free energy and entropy. Derivation of Nernst equation for single electrode potential, Electrochemical energy systems: Reference electrodes: Introduction, construction, working and applications of Calomel electrode. Ion-selective electrode –Definition construction and principle of Glass electrode and determination of pH using glass electrode.

Energy storage systems: Introduction, classification -primary, secondary and reserve batteries. Construction, working and applications of Ni-MH and Li-ion batteries

Unit IV: Water Chemistry (6 Lecture Hours)

Contents: Introduction, hardness of water, measurement of hardness, alkalinity, water, softening- lime-soda process, zeolite process, ion exchange process.

Unit V: Polymers (6 Lecture Hours)

Contents: Classification, Types of polymerization techniques: Bulk, solution, suspension and, emulsion, mechanism of polymerization (cationic, anionic and free radical), vulcanization, average molecular weight of polymers, conducting polymers, plastic used in daily life, applications viz. making of tyres, ropes, electrical fittings, contact lenses, credit cards, air tight containers, cookwares, cold drink bottles.

Unit VI: Nanomaterials (3 Lecture Hours)

Contents: Introduction, Methods of preparation: precipitation, co-precipitation, sol-gel, hydrothermal, microemulsion. Introduction to various characterization techniques viz.

XRD, SEM, TEM, BET, UV-VIS for nanomaterials. Properties: optical and surface properties. Application of nanomaterials. Size dependent properties (Surface area, Electrical, Optical Catalytic and Thermal properties). Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes-properties and applications

Text Books

1. Bapna, Renu, Engineering Chemistry - New Delhi MacMillan 2010 – 431, ISBN:0230330762.
2. Text book of Engineering Chemistry, By: Chawla, Shashi, Book Publisher: Delhi: Dhanpat Rai, 2014. ISBN 13: 123456755036.
3. Engineering Chemistry, By: Krishnamoorty, P, Publisher: New Delhi: McGraw Hill, 2012, Edition: 1.ISBN: 9780071328753.

Reference Books

1. Encyclopedic dictionary of organic chemistry, By Milton, Jules K., Publisher: New Delhi Pentagon Press 2004 Description: 208p., ISBN: 818274167--X; 9788182741676.
2. Crude oil chemistry, By: Simanzhenkov, Vasily, BookPublisher: New York: Marcel Dekker, 2003 Description: 409 p. ISBN: 082474098.
3. Atkins' physical chemistry, By: Atkins, Peter, Paula, Julio De, BookPublisher: New Delhi Oxford University Press 2014, Edition: 10th. ISBN: 9780198728726; 0198728727.
4. Essentials of Physical Chemistry by Bahl & Tuli, Publisher: S. Chand & Co., ISBN 13: 978-8121929783.
5. Organic Chemistry for engineers, By: Mallick, Abhijit, Book Publisher: New Delhi: Viva Books, 2012, ISBN: 9788130920580.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship Between The Course Outcomes (Cos) And Program Outcomes (Pos)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.8**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1=Weakly mapped **2=Moderately mapped** **3=Strongly mapped**

Course code	Course name	L	T	P	C
MECH1008	**Basics of Mechanical Engineering**	**2**	**0**	**0**	**2**
Pre-requisites/Exposure	**Physics, Mathematics and Engineering Mechanics**				
Co-requisites	**--**				

Course Objectives

I. To Help The Students Learn How To Apply Their Analytical And Mathematical Skills ForSolving Problems Of Mechanical Engineering.

II. To Help Students Develop The Ability To Analyse And Model Real Life Problems OfMechanical Engineering.

III. To Enable Students Acquire Skills For Designing And Improving Various MechanicalSystems For Their Profession.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understand the basic principles of mechanical engineering.

CO2. Analyze engineering applications using basic principles of mechanical engineering.

CO3. Apply the principles of mechanical engineering in real life applications.

Course Content

Unit 1: Introduction to System of Forces (6 Lecture Hours)

Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Resultant of Force System, Equilibrium of System of Forces, Free body diagrams. Power transmission system: belt and pulley, chain, gear.

Unit 2: Beams and Trusses (6 Lecture Hours)

Beams and types. Types of beam supports, simply supported and over-hanging beams, cantilevers. Type of loads: point, uniformly distributed load, varying distributed load. Application of beams. Trusses and their applications for load bearing.

Unit 3: Manufacturing Processes (6 Lecture Hours)

Materials and its classification. Stress-strain diagram, mechanical properties of metal, Various metal forming processes: Casting and molding, Metal cutting: Single and multi-point cutting, Joining processes: Arc welding, brazing and soldering, Gas welding, Spot and seam welding.

Unit 4: Thermodynamics (6 Lecture Hours)

Thermodynamic System, Properties, Process, Cycle, Thermodynamic Equilibrium, Zeroth Law of thermodynamics, First Law of Thermodynamics, Second law of thermodynamics: Kelvin-Planck and Clausius statements, Working of refrigeration system.

Unit 5: Energy Conversion **(6 Lecture Hours)**

Basic working principle of heat exchangers, Turbines. Working of Diesel and Petrol engines: 2-stroke and 4-stroke IC engines, centrifugal pumps and hydraulic turbines.

Text Books:

1. Mechanics of Materials by Pytel.
2. Strength of Materials by Ryder.
3. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education.
4. Thermodynamics- An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship Between The Course Outcomes (Cos) And Program Outcomes (Pos)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	1	-	1	1	1	-	-	1	3	2	
CO2	3	3	3	2	1	-	1	1	1	-	-	1	3	2	
CO3	3	3	3	2	1	1	1	1	1	-	-	1	3	2	
Avg.	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**3**	**2**	

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course code	Course name	L	T	P	C
MECH1002	**Engineering Mechanics**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Basic Knowledge of physics.** **Basic Knowledge of Mathematics**				
Co-requisites	**--**				

Course Objectives

1. To enable student to develop in the engineering student the ability to analyze any problem in a simple and logical manner and to apply to its solution a few.
2. To enable student to analyze system of forces in statics.
3. To enable student to understand the effect of friction on various engineering applications.
4. To enable student to analyze the dynamics of a body under the action of various types of forces.
5. To enable student to compute the kinematics of connected bodies.

Course Outcomes

On completion of this course, the students will be able to

CO1. Apply basic engineering mechanics concepts.

CO2. Analyze static structures using good free-body diagrams and accurate equilibrium equations.

CO3. Analyze various types of loading and support conditions that act on structural systems.

CO4. Analyze the pin joint structure.

CO5. Understand the concepts of centroid and moments of Inertia.

CO6. Apply the concepts of friction in engineering problems.

CO7. Understand the laws of motion of particles.

Catalog Description

The course covers the fundamental knowledge in the statics and dynamics of rigid bodies, with a special emphasis on ***applications of laws of rigid body mechanics****,* as relevant to engineering sciences in general and automotive engineering in particular. The course begins with a description of basic laws of mechanics, equilibrium conditions of forces in single plane under collinear and non collinear conditions. This course will help to develop ability to analyze and solve various problems in a simple and logical manner by utilizing various principles of engineering mechanics. This course also helps to comprehend and analyze pinned joint structure and dynamics of bodies. Students will learn to understand the concepts of dealing problems with friction like belt, wedge and ladder friction. The understanding of centre of gravity and moment of inertia and its calculations are also explored in this course. Since, course is more oriented towards analytical problems solving skill pertaining to static and dynamic condition of various engineering systems and subsystems. The effective use of commercial software packages to answer engineering questions.

Course Content

UNIT I: Resultant And Equilibrium Of Coplanar Forces

(05 Lecture Hours)

Basic Concept and Principles of Mechanics, Types of force system, Composition and Resolution of Forces, Moments, Couple, Varignon's Theorem, Equivalent Force System ,Type of body constraints, structural loads & supports , Free body diagrams, Condition of Equilibrium, Resultant and Equilibrium of Co0planner forces. Support reaction of simple & compound beams, Principle of virtual work

UNIT II: Centroid & Moment Of Inertia (05 Lecture Hours)

Introduction, Centroid and Moment of Inertia of composite plane figures

UNIT III: Pin-Jointed Structure (05 Lecture Hours)

Introduction, perfect & imperfect frame, analysis of perfect frame by method of joint, method of section and graphical method

UNIT IV: Friction & Lifting Machine (05 Lecture Hours)

Introduction, Law of friction, simple contact friction on horizontal and inclined plane, Screw and Nut friction, Ladder, belt and wedge friction, Friction in journal collar bearings, Lifting Machines.

UNIT V: Kinematics (05 Lecture Hours)

Kinematics of Particle in Cartesian, polar and path co-ordinates, under uniform and non-uniform acceleration, Motion under gravity, Projectile Motion, Rotational motion Kinematics of rigid bodies in two- and three-dimension, Instantaneous center of rotation.

UNIT VI: Kinetics (05 Lecture Hours)

Kinetics of Particle, Motion under constant force, Momentum and Energy principles, D-Alembert's principle, Impulses and angular momentum, Motion under constant torque, Collision of Elastic bodies. Kinetics of general plane motion of body.

Text Books:

1. Tayal, A. K. *"Engineering Mechanics Statics and Dynamics"* 14th Edition, Umesh Publications

2. Bhavikatti, S. S. (2008) *"Engineering Mechanics"* New Age International (P) Limited, Publishers.

E. Reference Books:

1. Timoshenko, S., Young, D. H. and Rao, J. V. (2007) *"Engineering Mechanics"* Tata McGraw Hill Publishing Company Limited, New Delhi
2. Beer, F. P., Johnston, E. R., Mazurek, D. F., Cornwell, P. J., Eisenberg, E. R. and Sanghi, S. (2011) *"Vector Mechanics for Engineers: Statics and Dynamics"* 9th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Shames, I. H. and Rao, G. K. M. (2006) *"Engineering Mechanics: Statics and Dynamics"* 4th Edition, Pearson Education Inc.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**IA**	**MSE**	**ESE**
Weightage (%)	30	20	50

Relationship Between The Program Outcomes (Pos), Program Specific Outcomes (Psos) And Course Outcomes (Cos)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	3	-	-	-	-	-	2	-	-	-	1
CO2	3	3	2	-	3	-	-	-	-	-	2	-	-	-	1
CO3	3	3	2	-	3	-	-	-	-	-	2	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	2	3	-	-	-	2
CO5	3	3	2	-	3	-	-	-	-	2	2	-	-	-	2
CO6	3	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO7	3	3	2	-	3	-	-	-	-	-	-	-	-	-	1
Avg.	3	3	2.1	3	3	-	-	-	-	2	2.2	-	-	-	1.6

1=Weakly mapped   2=Moderately mapped   3=Strongly mapped

Course Code	Course Name	L	T	P	C
ECEG1004	**Basic Electrical & Electronics Engineering**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

I. To enable students, understand the fundamental semiconductor devices.
II. To enable students understands the logical operations and network theory.
III. To enable students, acquire knowledge about electrical machine and transformer.

Course Outcomes

On completion of this course, the students will be able to
CO 1. Employ electronic and electrical components and devices to solve the Engineering problems.

CO 2. Analyze and make simple circuits and Systems of Electrical and Electronics Engineering, Interpret the logics used in the Circuits and Systems.

CO 3. Design the electrical system with discrete components and to understand the specifications of industrial equipments.

CO4. Design the electronics system with discrete components and to understand the specifications of industrial equipment.

Catalog Description

Electrical & Electronics is the integral part of life. The basic circuits used in day to day life are studied in this course. In this course, the main focus will be on the designing of basic electrical and electronics circuits like AC to DC converter by using diode, half adder, full adder etc. in Electronics and three phase system circuits in electrical. Students will learn how to use diode, transistor, Integrated circuit, AC machine and DC Machine in real time and develop circuits buy using them. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as practical sessions, group discussions, and cooperative group solving problems. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all practical sessions to apply the devices and design the basic circuits.

Course Content

Unit I: Semiconductor Devices **(16 Lecture Hours)**

Diode: Fundamental Characteristics of diode: Formation of P-N junction, I-V characteristics, half-wave and full-wave rectifier circuits, Zener, and Avalanche breakdown; diode applications in clipper and clamper, Zener diode: voltage regulator.

Transistor: Construction and operation, Transistor amplifying action, Amplification factors; Limits of operation, Applications of transistor, DC-Biasing: Fixed bias, Emitter bias, Voltage divider bias.

Unit II: Boolean Algebra **(7 Lecture Hours)**

Number system and codes, Minimization techniques: Boolean logic operations, Basic laws of Boolean algebra, De Morgan's Theorems; Logic gates: AND, OR, NAND, NOR and realization. Implementation of Adder and subtractor, Two, three and four variables Karnaugh-map (K-map)

Unit III: Network Theory **(10 Lecture Hours)**

Voltage and current sources (conversion), Kirchoff current and voltage laws, Network theorems (DC/AC): Superposition, Thevenin's and Maximum Power Transfer theorem, star-delta transformations.

Unit IV: AC Circuits and Electrical Machines **(12 Lecture Hours)**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation. Elementary analysis of single-phase ac circuits R, L, C, series/parallel RLC circuits and Resonance conditions. DC machines: working Principle transformer, losses in transformers & efficiency; Classification of motors (AC & DC), characteristics & applications of DC Motors.

Text Books

1. Principle of Electronics by V.K. Mehta & Rohit Mehta 2018, S. Chand
2. Basic Electrical Engineering, V.K. Mehta, 2018, S. Chand.
3. Digital Circuits & Logic Design by Salivahanan: Vikas Publishing House.
4. Basic Electronics by Santiram Kal, 2013: PHI.

Reference Books

1. NPTEL Lectures –will be available - \\10.2.1.33 (intranet)

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	2	3	1	-	-	-	-	-	-	-	1	2	1
CO 2	2	2	2	1	1	-	-	-	-	-	-	1	1	2
CO 3	3	3	2	-	1	-	-	-	-	-	-	1	1	3
CO4	3	3	2	-	1	-	-	-	-	-	-	1	1	3
Average	2.5	2.5	2.25	1	1	0	0	0	0	0	0	1	1.25	2.25

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course name	L	T	P	C
CHEM1113	Chemistry lab	0	0	2	1
Pre-requisites/Exposure	Basic Knowledge of Physics and Chemistry				
Co-requisites	--				

Course Objectives

I. To help the students familiar with the fundamental concepts of practical chemistry
II. To make the students able to prepare standard solutions and few commercial materials
III. To make the students able to determine the strength of the solutions using basic instrumental and classical methods.

Course Outcomes

On completion of this course, the students will be able to:

CO1: Demonstrate the kinetics of chemical reaction and the synthesis of polymeric material like resins.
CO2: Analyse efficiency/quality of different fuels/water samples for commercial and domestic application.
CO3: Apply different types of titrations for various quantitative analysis.

Catalog Description

Chemistry is present everywhere around us. It is existing in everything we see, feel or imagine. It is one of the very fundamental basics behind every structure, building, bridge, refinery and industry. In this lab course, focus will be on firming the basic knowledge of students about chemistry. Students will learn how to use the concepts correctly through prescribed syllabus and will perform related experiments in the Chemistry lab. They will be taught to find the more effective fuel using proximate analysis and sulfur present in fuel through gravimetric analysis. fuels. Different processes used to improve the quality of fuels in refineries will be discussed. Water chemistry will make the students understand various parameters of water quality and the treatments to improve it. Kinetics experiments help them to find order of reaction in lab. They learn to prepare polymers also at lab scale. Lab activities include lab instructions, hands on experience, maintaining lab record and viva-voce.

List of Experiments

1. To determine the strength of given solution of NaOH by titrating it against standard oxalic acid solution using phenolphthalein.
2. To determine the percentage of moisture, volatile matter, ash content and fixed carbon in a given coal sample by proximate analysis.
3. To estimate sulfur content in a given sulfate solution of sodium sulphate gravimetrically.
4. To determine the rate constant and order of the reaction of the hydrolysis of an ester (ethyl acetate) at 25^{o}C in the presence of 0.5N hydrochloric acid.
5. To determine the strength of given solution conduct metrically.
6. To determine the strength of the given solution pH-metrically
7. To determine the total hardness of the given hard water sample by EDTA method
8. To determine the alkalinity of a given water sample.
9. To prepare Urea-Formaldehyde (UF) resin.
10. To determine the strength of a given solution of alkali by titrating it against various standard acid solutions using suitable indicator using virtual lab.
    Link: http://vlab.amrita.edu/?sub=2&brch=193&sim=352&cnt=4

Text Books / Reference Books

1. Practicals in Physical Chemistry: A Modern Approach by Sindhu, P.S., Publisher: Delhi Macmillan India, ISBN: 1403929165
2. Theory and Practicals of Engineering Chemistry by Chawla, Shashi, Publisher: New Delhi Dhanpat Rai & Co., ISBM: 9788177000405, 8177000403
3. Practical Physical Chemistry by B. Viswanathan, Publisher: Viva Books, ISBML 9788130920696

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Modes of Evaluation: Continuous Evaluation Pattern.

Components	Continuous evaluation
Weightage (%)	100

Relationship Between The Course Outcomes (Cos) And Program Outcomes (Pos)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	1	-	-	3	2	3	-	-	-	1	-
CO2	3	-	-	-	1	1	-	3	2	3	-	-	-	1	1
CO3	3	-	-	-	1	1	-	3	2	3	-	-	-	1	1
Average	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**1**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course name	L	T	P	C
ECEG1104	**Basic Electrical and Electronics Engg. Lab**	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

I. Understand the characteristics of the basic electronic components like diode and transistor and electric fuse.
II. Develop the application-based circuits using switch, Rectifier, Diode and transistor and logic gates also.
III. Design DC-Power supply by using Rectifiers and Adders & Subtractor by using Logic Gates.
IV. Apply laws to solve the DC & AC network Circuits using R, L, C circuits.
V. Study the Constructional features, operation and characteristics of Electrical Machines.

Course Outcomes

CO1: Understand the functionality of electronics and electrical components.

CO2: Analyze and interpret the data obtained during experiments of Electrical and Electronics circuits.

CO: Evaluate the results of the experiments based on different fundamental theorems/laws.

Catalog Description

Electrical & Electronics is the integral part of life. The basic circuits used in day to day life are studied in this course. In this course, the focus will be on the designing of basic electrical and electronics circuits like AC to DC converter by using diode, half adder, full adder etc. in Electronics and single phase system circuits analysis in electrical. Students will learn how to use semiconductor devices like diodes and transistors and apply their knowledge in finding the applications of all devices. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all practical sessions to apply the devices and design the basic circuits.

List of Experiments

Exp-1 To study various electronic components (diode, resistor, transistor, capacitors, ICs, etc) and measuring instruments.

Exp-2 To study the voltage and current measurement using voltmeter and ammeter connections in simple electrical circuit.

Exp-3 To plot V-I characteristics of PN junction diode.
Exp-4 To verify Thevenin's Theorem.
Exp-5 To study half-wave and full-wave rectifier circuit.
Exp-6 To verify Superposition Theorem
Exp-7 To study the characteristics of NPN transistor in CE configuration.
Exp-8 To verify the Maximum Power Transfer Theorem
Exp-9 To study the characteristics of NPN transistor in CB configuration.
Exp-10 To study the phenomenon of resonance in L-C-R series circuit
Exp-11 Implementation of Half and Full Adder digital circuits.
Exp-12 To study the phenomenon of resonance in LCR parallel circuits.

Text Books:

1. Electrical & Electronics Engineering by K R Niazi, Genius Publication.ISBN:9788188870137
2. Basic Electrical and Electronics Engineering, by J B Gupta S K Kataria and Sons.3rd Ed.

Reference Books:

1. William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGraw Hill Publication.
2. N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.
3. Basic Electronics By Santiram Kal,(2013): PHI

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	Continuous Evaluation
Weightage (%)	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	2	-	-	-	-	-	-	-	-	3	-
CO3	-	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	2	-	-	-	-	-	-	-	-	3	-
Average	**-**	**-**	**2.75**	**1.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

SEMESTER III

Course code	Course name	L	T	P	C
SLLS 0201	**Design Thinking**	**3**	**0**	**0**	**2**
Pre-requisites/Exposure	• Knowledge of analyzing society problems and product usage problems and a zeal to improve the current situation, in addition to knowing to using laptop/computers, internet, social media interaction, file sharing and uploading, email and communication etiquettes.				
Co-requisites	**Not Any**				

Course Objectives:

I. To enable students to acquire knowledge, imagination and be more assertive on opinions on problems in society.
II. To enable students to learn basics of research, data collection, analysis, brainstorming to find solutions to issues.
III. To make them understand Design Thinking methodologies to problems in field of study and other areas as well.
IV. To help students to understand future Engineering positions with scope of understanding dynamics of working between inter departments of a typical OEM.

Course Outcomes:

On completion of this course the students will be able to

CO1. Examine design thinking concepts and principles.

CO2. Practice the methods, processes, and tools of design thinking.

CO3. Apply the Design Thinking approach and model to real world scenarios.

CO4. Analyze the role of primary and secondary research in the discovery stage of design thinking.

Catalog Description:

Design thinking course is a completely online course offered to the first year B.Tech across all streams. The course is offered by Laureate Design University for UPES Students along with Domus Academy Milan and New School of Architecture & Design, San Diego. The Design Thinking Model introduced in this course helps us to understand the steps followed in the process of designing a solution to a problem. The online course has 8 modules to be completed in 8 weeks. Hence each module is allotted a week for understanding and assignment submissions.

Course Content

Unit I: What Is Design Thinking **03 lecture hours**

Designers seek to transform problems into opportunities. Through collaboration, teamwork, and creativity, they investigate user needs and desires on the way to developing human- centered products and/or services. This approach is at the very heart of design thinking.

Unit II: The Design Thinking Model **03 lecture hours**

A tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Unit III: Phase 1: Discover **04 lecture hours**

Begin the design thinking process with the Discover phase, where you will identify the specific problem your design is intended to solve, as well as important usability aspects from those who will use your design. Discovery can be performed through a variety of different research methods which you will learn in this module.

Unit IV: Phase 2: Define **03 lecture hours**

In the Define phase, you come to understand the problem. We often refer to this as framing the problem. You can do this by using a variety of tools, including storytelling, storyboarding, customer journey maps, personas, scenarios, and more.

Unit V: Phase 3: Develop **04 lecture hours**

Turn your attention to solving the problem. In this phase you brainstorm custom creative solutions to the problems previously identified and framed. To do this, you conceptualize in any way that helps, putting ideas on paper, on a computer, or anywhere whereby they can be considered and discussed.

Unit VI: Phase 4: Deliver **04 lecture hours**

This phase is all about testing and building concepts. Here you take all of the ideas that have been discussed to this point and bring them a little closer to reality by building a concept; something that makes it easier for a user to experience a design. This concept is referred to as a prototype.

Unit VII: Phase 5: Iterate **05 lecture hours**

You will test the prototype of your design solution, collecting and acting on feedback received. These actions may mean minor or major revisions to your design, and are repeated as often as necessary until a solution is reached. Tools such as focus groups and questionnaires are used to help you collect feedback that can help with your final design.

Unit VIII: Beyond Design Thinking **04 lecture hours**

The Design Thinking Model is a tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Textbooks / Reference Books

1. All the references are available to download in the online course.
2. Brown, Tim. "What We Can Learn from Barn Raisers." Design Thinking: Thoughts by Tim Brown. Design Thinking, 16 January 2015. Web. 9 July 2015.
3. Knapp, Jake. "The 8 Steps to Creating a Great Storyboard." Co.Design. Fast Company & Inc., 21 Dec. 2013. Web. 9 July 2015.
4. van der Lelie, Corrie. "The Value of Storyboards in the Product Design Process." Journal of Personal and Ubiquitous Computing 10.203 (2006): 159–162. Web. 9 July 2015. [PDF].
5. Millenson, Alisson. "Design Research 101: Prototyping Your Service with a Storyboard." Peer Insight. Peer Insight, 31 May 2013. Web. 9 July 2015.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Examination Scheme: Continuous evaluation

All evaluation on the online course is done based on continuous basis for each of the 8 units/modules through out the semester. The assignment submission formats are in the form of qualitative discussion boards and online submissions of research data and developed product lifecycle and originally designed/redesigned prototype images.

Components	IA	MID SEM	End Sem	Total
Weightage (%)	50	20	30	100

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

	Program Outcomes (POs)												PSO	
Cos	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	2	2	2	1	1	-	1	1	1	3	-	-
CO2	-	-	2	2	2	2	1	-	1	1	1	3	-	-
CO3	1	1	3	2	2	1	3	1	2	2	3	3	-	-
CO4	-	-	3	3	3	3	3	1	2	2	2	3	-	-
Average	1	1	2.5	2.25	2.25	1.75	2	1	1.5	1.5	1.75	3	-	-

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course name	L	T	P	C
CIVL2026	**Building Materials & Concrete Technology**	**3**	**1**	**0**	**4**
Pre-requisites/Exposure	**Basic knowledge of civil engineering materials and sustainability**				
Co-requisites	**--**				

Course Objectives

I. To provide scientific basis for understanding & development of construction materials

II. To give an overview of the fundamentals needed to understand material structure & behaviour.

III. To discuss the important materials used in construction today

IV. To teach students about the principles and methods to be followed in constructing various components of a building

V. To teach students about the deterioration and repair of buildings.

VI. To expose the students to the concepts of sustainability in the context of building and conventional engineered building materials.

Course Outcomes

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

CO1: Understand the physical and mechanical properties of building materials

CO2: Understand the construction to be followed in brick, stone and concreting

CO3: Explain innovative sustainable construction materials and their uses in construction.

CO4: Examine the green building rating systems and its contribution to sustainability.

Catalog Description

This course provides a comprehensive understanding of building materials and concrete technology, two fundamental aspects of the construction industry. Students will explore various types of construction materials, their properties, selection criteria, and sustainable practices. The course will also delve into the science and technology of concrete, including mix design, production, and quality control. Through theoretical learning and practical applications, students will gain the knowledge and skills necessary for a successful career in construction and civil engineering.

Course content

Unit I: Bricks (7 Lecture Hours)

Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick Earth, Different forms of bricks, Testing of bricks as per BIS. Defects of bricks. Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling

Unit II: Cement & Concrete (10 Lecture Hours)

OPC: Composition, PPC, Slag cement, Hydration, setting time, Concrete: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete, Mix design of concrete. Mortars: Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars, Other materials: Wood products, Paints etc.

Unit III: Masonry (10 Lecture Hours)

Principles of masonry construction, types of masonry, types of walls, types of partition walls such as brick partition, timber partition, glass partition etc., Stone masonry - Types of stone masonry & construction method, Dressing & Bonding Brick and block masonry, Brick & Block Masonry – Various types of bonds in brick masonry, reinforced brick masonry Formworks.

Unit IV: Steel Trusses (7 Lecture Hours)

Sections used for steel work, method of connections i.e. riveted, bolted & welded, types of trusses & theirs uses, roofs, covering materials & method of fixing tabular structures.
Building finishes, objectives & processes, pointing, plastering & painting, white-wash & colour wash, distempering etc, on old & new surfaces, repairs & maintenance.

Unit V: Sustainable Material (7 Lecture Hours)

Introduction to sustainable construction, Role of Material - Carbon from Cement, alternative cements and cementitious material, Role of quality - minimization of natural resource utilization, Sustainable material choices, Recycling and reuse of construction materials, Recycled aggregate concrete, geo-polymer concrete, high volume fly-ash concrete.

UNIT VI: Green Building (7 Lecture Hours)

Operational energy reduction and net zero building, Optimization for design of building for energy efficiency. Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. Energy codes ECBC requirement, Concepts of OTTV etc. Green Performance rating, requirements of LEED, GRIHA etc.

Text Books

1. Rangawala S. C. (2016). Building Construction, 33rd edition, Charotar Publishing House Pvt. Ltd.
2. Neville A.M. (2012). Properties of Concrete, 5th edition, Pearson Education India.
3. Charles J. K. (2008). Sustainable Construction - Green Building Design and Delivery, 2nd edition, John Wiley & Sons.

Reference Books

1. Punmia B.C., Jain A. K. and Jain A. K. (2016). Building Construction, 11th edition, Laxmi Publications.
2. Mehta P. K., and Monteiro P.J.M (2017). Concrete microstructure, properties and materials, 4th edition, McGraw Hill Education

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific outcomes (PSO) and Course Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO2	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO3	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO4	-	-	3	1	-	-	-	3	3	3	-	-	-	3
Averag e.	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**3**

1.Weakly Mapped 2. Moderately Mapped 3. Strongly Mapped

Course Code	Course Name	L	T	P	C
CIVL2131	**Surveying & Remote Sensing**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of mathematics and basic physics**				
Co-requisites	**Not Any**				

Course Objectives

I. To describe the function of surveying in civil engineering construction.

II. To work with survey observations and perform calculations.

III. To perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse.

IV. To calculate, design and layout horizontal and vertical curves, understand, interpret, and prepare plan, profile, and cross-section drawings, work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

V. To apply remote sensing techniques for calculations and mapping.

Course Outcomes (CO)

On completion of this course, the students will be able to

CO1. Understand levelling, contouring and basics of surveying.

CO2. Compute area and volumes using the various concepts of surveying.

CO3. Interpret photographs and analyze land geography.

CO4. Apply remote sensing to extensive civil engineering applications.

Catalog Description

Surveying is the basic and foremost requirement of any engineering project. The art of surveying has become an important profession. An introduction to the principles and practices of surveying is, therefore, desirable as an integral part of engineering education and training, irrespective of the branch of specialization. This subject helps in learning the concepts of traversing, levelling, tachometry and setting out of curves. It will help the student to calculate distances, angles (or bearings) and linear measurements at any type of terrain. Geomatics is the higher branch of surveying, and it covers areas like photogrammetry and remote sensing. It covers areas like triangulation. Trigonometry, Photogrammetry, and Remote Sensing.

Course Content

Unit 1: Introduction to Surveying (10 Lecture Hours)

Principles, Linear, angular and graphical methods, Survey stations, Survey lines-ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling-booking and reducing levels; differential, reciprocal leveling, profile levelling and cross-sectioning. Digital and Auto Level, Errors in levelling; contouring Characteristics, methods, uses; areas and volumes.

Unit 2: Angles and Curves (8 Lecture Hours)

Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control. Intervisibility of height and distances, Axis single corrections. Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Unit 3: Modern Field Survey Systems (8 Lecture Hours)

Principle of Electronic Distance Measurement, Modulation, and Types of EDM instruments, Distomat, Total Station: Parts of a Total Station, Accessories, Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, surveying with GPS, Co-ordinate transformation, accuracy considerations.

Unit 4: Photogrammetry Surveying (10 Lecture Hours)

Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo-plotting instruments, mosaics, map substitutes.

Unit 5: Remote Sensing (9 Lecture Hours)

Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Text Books

1. Arora, K.R., *Surveying*, Vol-I, II and III, Standard Book House, 2015.
2. Madhu, N, Sathikumar, R and Satheesh Gobi, *Advanced Surveying: Total Station, GIS and Remote Sensing*, Pearson India, 2006.
3. Arora, M. K.,and Badjatia, R.C., *Geomatics Engineering*, Nem Chand & Bros, 2011.

Reference Books

1. Chandra, A.M., *Higher Surveying*, Third Edition, New Age International (P) Limited, 2002.
2. Anji Reddy, M., *Remote sensing and Geographical Information System*, B.S. Publications, 2001.
3. Bhavikatti, S.S., *Surveying and Levelling*, Vol. I and II, I.K. International, 2010.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	Internal	Mid-term examination	End term examination	Total
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
Average	**3**	**1.5**	-	-	-	-	-	-	-	-	-	-	**2**	-

1- Weakly mapped   2- Moderately mapped   3-Strongly mapped

Course Code (Version)	Course Name	L	T	P	C
CIVL2028	**Elements of Fluid mechanics**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Basic knowledge of Mathematics**				
Co-requisites	**Not Any**				

Course Objectives

I. To present various concepts and impart proficiency in basic fluid mechanics concepts.

II. To Expose the students to various real-world applications of fluid mechanics.

III. To provide basic concepts about uniform & non-uniform flow

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understand the properties and applications of fluid mechanics.

CO2. Compute problems related to hydrostatics and kinematic forces.

CO3. Solve problems related to hydrodynamic forces.

CO4. Apply dimension analysis on prototype and models.

Catalog Description

Subject of Fluid Mechanics occupies an important position in many engineering disciplines. It deals with the flow of fluid, which is present all around. Fluid Mechanics also laid down the foundation for other subjects like water resources engineering, hydraulic structures, etc. This subject is also filled with advanced mathematics especially calculus. Students will be dealing with the topics like laminar and turbulent flow. Flow around Submerged bodies, Boundary layer flow, Non-uniform flow and the hydraulic machines. It requires mathematical aptitude and sharp mind as the analysis carried out is going to large implications on real life applications.

Course Content

Unit 1: Introduction (04 Lecture Hours)

Fluid properties: mass density, specific weight, specific volume and specific gravity, surface tension, capillarity, pressure inside a droplet and bubble due to surface tension, compressibility viscosity, Newtonian and Non-Newtonian fluids, real and ideal fluids.

Unit 2: Fluid Statics (07 Lecture Hours)

Pressure-density-height relationship, gauge and absolute pressure, simple differential and sensitive manometers, two liquid manometers, pressure on plane and curved surfaces, centre of pressure, Buoyancy, stability of immersed and floating bodies, determination of metacentric height, fluid masses subjected to uniform acceleration, free and forced vortex.

Unit 3: Kinematics of Fluid Flow (07 Lecture Hours)

Steady & unsteady, uniform and non-uniform, laminar & turbulent flows one, two & three dimensional flows, stream lines, streak lines and path lines, continuity equation in differential form, rotation and circulation, elementary explanation of stream function and velocity potential, rotational and irrotational flows, graphical and experimental methods of drawing flownets.

Unit 4: Dynamic of Fluid Flow (06 Lecture Hours)

Euler's equation of motion along a streamline and its integration, limitation of Bernoulli's equation, Pitot tubes, Venturimeter, Orificemeter, flow through orifices & mouth pieces, sharp crested weirs and notches, aeration of nappe.

Unit 5: Dimensional Analysis and Hydraulics Similitude (06 Lecture Hours)

Dimensional analysis, Buckingham theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies, physical modeling, similar and distorted models.

Unit 6: Boundary Layer Theory **(06 Lecture Hours)**

Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, von Karman integral equation, laminar sublayer, hydrodynamically smooth and rough boundaries, separation of flow and its control, cavitation.

Unit 7: Laminar and Turbulent Flow through Pipes **(09 Lecture Hours)**

Laminar flow through pipes, turbulent flow, Reynolds equations, Prandtl's mixing length theory, velocity distribution over a flat plate and in a pipe section, Darcy-Weisbach equation, friction factor, Moody diagram, minor losses, pipe networks, Venturimeter, orifice meter, water hammer, surge tanks.

Text Books

1. P.M. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, Standard Book House
2. K. Subramanya, *Theory and Applications of Fluid Mechanics*, Tata McGraw Hill.

Reference Books

1. Subramanya, K. (2009). *Flow in open channels*. Tata McGraw-Hill.
2. Ven Te Chow (1988), *Open Channel Hydraulics*, Tata McGraw Hill

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	-	3	-	-	-	-	-	-	1	-	-	-	3	-
CO 2	-	3	-	-	-	-	-	-	1	-	-	-	3	-
CO 3	-	3	-	-	-	-	-	-	1	-	-	-	3	-
CO 4	-	3	-	-	-	-	-	-	1	-	-	-	3	-
Avg.	-	3	-	-	-	-	-	-	1	-	-	-	3	-

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL2029	Engineering Geology and Hydrology	3	0	0	3
Pre-requisites/Exposure	Knowledge of Basic Geography				
Co-requisites	Not Any				

Course Objectives

I. To focus on core activities of engineering geologist's site characterization.
II. To couple geologic expertise with the engineering properties of rock and unconsolidated materials.
III. To understand the different layers of geological formation.
IV. To study the formation of rocks and rock cycle.
V. To provide knowledge about various components of hydrological cycles.

Course Outcomes (Cos)

On completion of this course, the students will be able to:

CO1. Learn Earth Science and Meteorology and their Components.

CO2. Explore the structural Geology Landform and earthquake.

CO3. Study earthquake causes and seismic Zoning and role of groundwater in Geology

CO4. Study Basics of Geology and Hydrology related to dam construction.

Catalog Description

Engineering geology is an applied geology discipline that involves collecting, analyzing, and interpreting geological data and information required for the safe development of civil works. Engineering geology also includes assessing and mitigating geologic hazards such earthquakes, landslides, and flooding; assessing timber harvesting impacts; and groundwater remediation and resource evaluation. Engineering geologists are applied geoscientists with an awareness of engineering principles and practices. Engineers can use geological exploration knowledge and data in various civil engineering applications.

Course Content

Unit 1: Physical Geology **(5 Lecture Hours)**

Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits. Description and classification of folds, faults, joints, unconformities, fault planes, geometrical destruction, etc. Geological Hazards - Rock Instability and Slope movement. Types of landslides and its protection.

Unit 2: Mineralogy, Petrology and Structural Geology **(5 Lecture Hours)**

Study of physical properties of minerals and study of common rock-forming minerals & way of formation of minerals, Study of three types of rocks with reference to their formation, identification, textural and structural features Rocks and natural materials as a construction material. Outcrop, stratification, dip and strike relation, Unconformity, joints their types and genesis Faults and folds with their types and causes, Engineering consideration of joints, folds and faults.

Unit 3: Engineering Geology and Earthquakes **(5 Lecture Hours)**

Engineering Geology Basics of Engineering Geology, Importance of geological studies to Engineers and significance of geological Investigations for civil engineering projects, Geology for Site selection of Dam, Tunnel, Reservoir and Highways. Earthquake: Magnitude and intensity of earthquake. Revelation from Seismic Records of the structure of Earth. Groundwater: Factors controlling water-bearing capacity of rock. Previous & impervious rocks and groundwater.

Unit 4: Site Selection **(5 Lecture Hours)**

Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Site and treatment given to such structures. Procedure for geological investigation for the various civil engineering structures. Data used for the geological investigation. Introduction to different tests and instruments used for the various geological investigations.

Unit : Introduction to hydrology and forms of precipitation (10 Lecture Hours)

Hydrologic cycle, water-budget equation, history of hydrology, world water balance, application in engineering, sources of data. Comparison of water budget of India and World. Water stress situation and factor responsible for the same. Water crises in India. Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Textbooks/Reference Books:

1. Kataria, S. K. (2010). Engineering and General Geology
2. N. Chenna Kesavulu (2009). Textbook of Engineering Geology, 2nd Edition Macmillan Publishers India.
3. Subramanya, K. (2008). Engineering hydrology. McGraw-Hill.

Reference Books:

1. Harvey, J. C. (1982). Geology for Geotechnical Engineers, Cambridge University Press.
2. Mays, L. W. (2010). *Water resources engineering*. John Wiley & Sons.
3. Tarbuck, E. J., Lutgens, F. K., Tasa, D., & Tasa, D. (2005). *Earth: an introduction to physical geology* (p. 744). Upper Saddle River: Pearson/Prentice Hall.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO 2	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	1	2	-	-	-	-	-	-	-	-	-	-	-
Average	**2.25**	**1.75**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.5**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL2130	**Building Materials and Concrete Technology Lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of mathematics, mechanics of solids and concrete technology theory**				
Co-requisites	**--**				

Course Objectives

I. To give detailed understanding of materials and their properties by conducting laboratory experiments
II. To provide knowledge about the structure-property-application relationships
III. To give exposure of various established material testing techniques.
IV. To prepare the students to effectively link theory with practice and application & to demonstrate the background of the theoretical aspects.
V. To prepare the students to generate and analyze data using experiments and to apply elements of data statistics.
VI. To prepare the students to solve problems including design elements and related to their course work.

Course Outcomes

On completion of this course, the students will be able to:

CO1: Determine hardness, tensile, shear and torsional strength of engineering materials

CO2: Design the mix proportioning of concrete and assess the quality of the concrete through laboratory tests

CO3: Assess the strength of concrete through destructive tests

CO4: Assess the strength & quality of concrete through non-destructive tests

Catalog Description

Building materials are the basics of any construction and knowledge about them and their mechanical properties is an essential aspect to be studied in civil engineering. In this laboratory course, students will perform number of tests to practically determine the various mechanical properties of materials and will also be able to develop better understanding about the materials from the point of view of mechanics. Out of all the building materials, concrete is the major/key one. Therefore, the lab aims primarily in testing the properties of various ingredients of concrete. Cement is tested for consistency; fine aggregates are tested for their fineness and coarse aggregates for their mechanical properties. Concrete is tested in both its fresh and hardened states. Fresh concrete is tested for its consistency and workability. Hardened concrete is tested for its compressive and tensile strength.

List of experiments

Experiment No: 01 Hardness Measurement

To determine the hardness of the given specimen using Rockwell Hardness Testing Machine and Brinell Hardness Testing Machine.

Experiment No: 02 Universal Testing Machine (UTM)

To conduct the tensile test on a UTM and determine the ultimate tensile strength and percentage elongation for a steel specimen.

Experiment No: 03 Torsion Testing Machine

To conduct Torsion test on Mild steel or cast-iron specimen to find out modulus of rigidity.

Experiment No: 04 Universal Testing Machine (UTM)

To analyze the performance of given specimen by shear test on UTM.

Experiment No: 05 Fineness test and Consistency test

Determination of fineness by specific surface by Blaine air permeability method as per IS: 4031 (Part 2). To determine the normal consistency as per IS: 4031 (Part 4)

Experiment No: 06 Soundness test & Initial and Final Setting time tests

To determine soundness of cement by Le-Chatelier method as per IS: 4031 (Part 3) – 1988 & initial setting & final setting time as per IS: 4031 (Part 5) of a given sample of cement

Experiment No: 07 Compressive strength test

To determine the compressive strength of 1:3 Cement sand mortar cubes after 3 days and 7 days curing as per IS: 4031 (Part 6, 7 & 8).

Experiment No: 08 Workability of concrete

To determine the workability of the cement concrete by slump test/ to measure the consistency of concrete by using slump cone as per IS: 1199

Experiment No: 09 Compressive strength test

Standard test method for compressive strength of concrete cube as per IS 516.

Experiment No: 10 Flexure test

Determining the flexural strength of moulded concrete flexure test specimens as per IS 516.

Experiment No: 11 Non-Destructive Test

To determine strength of hardened concrete by rebound hammer as per IS: 13311 (Part 2) To determine strength of hardened concrete by Ultrasonic Pulse Velocity as per IS: 13311

Text Books

1. Neville A.M. (2012). Properties of Concrete, 5th edition, Pearson Education India.

Reference Books

1. Gambhir M.L. (2004). Concrete Manual, Dhanpat Rai and Co

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Continuous Lab Evaluation is there to assess the students' performance in the lab

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) andCourse Outcomes (COs)

PO/CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	-	3	-	2	-	-	-	3	3	3	-	-	2	-
CO 2	-	-	3	2	-	-	-	3	3	3	-	-	2	-
CO 3	-	3	-	2	-	-	-	3	3	3	-	-	2	-
CO 4	-	2	-	2	-	-	-	3	3	3	-	-	2	-
Average	**-**	**2.67**	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**

1.Weakly Mapped **2. Moderately Mapped** **3. Strongly Mapped**

Course Code	Course Name	L	T	P	C
CIVL2131	**Surveying & Remote Sensing Lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of mathematics and basic physics**				
Co-requisites	**Not any**				

Course Objectives

I. To present the fundamentals of surveying in a simplified manner with its necessity and basics like levelling
II. To give knowledge of finding horizontal and vertical angles using various instruments.
III. To understand tachometry with respect field survey and its applicability.
IV. To create awareness about curve surveying and its setting methods
V. To apply remote sensing techniques for calculations and mapping.

Course Outcomes (COs)

On completion of this course, the students will be able to

CO1. Understand levelling, contouring and basics of surveying.

CO2. Compute area and volumes using the various concepts of surveying.

CO3. Interpret photographs and analyze land geography.

CO4. Apply remote sensing to extensive civil engineering applications.

Catalog Description

Surveying is one of the oldest arts practiced by man. It is one of the oldest and the most used disciplines of engineering. It is the basic and foremost requirement of any engineering project. The art of surveying has become an important profession. An introduction to the principles and practices of surveying is, therefore, desirable as an integral part of engineering education and training, irrespective of the branch of specialization. This lab helps in learning the concepts of traversing, levelling, tachometry and setting out of curves. It will help the student to calculate distances, angles (or bearings) and linear measurements at any type of terrain. Geomatics is the higher branch of surveying, and it covers areas like photogrammetry and remote sensing. In the time of digitization, various sorts of data are stored in digital formats. Digitized maps of the area are being made. Real time tracking is done with the help of

GPS. Geomatics covers all the areas like triangulation. Trigonometry, Photogrammetry, Remote Sensing and Astronomy. It is an emerging and exciting field of study. It also employs real-time modelling. Topics like astronomy make this subject more interesting and fun to learn. This subject serves as the repository of data to be used for construction work of any sort. Knowledge of surveying trains the ability of engineers to visualize, think logically and pursue the engineering approach. Geomatics will help the students to remain updated with modern trends in technology, which is applied in surveying.

List of experiments

Experiment No: 01 Map Study

To study different types of maps published by Survey of India and Conventional Symbol Charts.

Experiment No: 02 Chain Surveying

To study instruments used in conventional chain and compass surveying and to measure distance between two points by ranging.

Experiment No: 03 Traversing

To measure the bearing of sides and length of a given traverse by prismatic compass and tape, and plotting of the traverse after adjustment.

Experiment No: 04 Theodolite Survey

To conduct temporary adjustments of a Vernier Theodolite and measure Horizontal and Vertical angles by Reiteration method.

Experiment No: 05 Repetition Method

To measure Horizontal angle by repetition method.

Experiment No: 06 Dumpy/IOP level Surveying

To find out the reduced levels of given points using Dumpy/IOP level (Reduction by height of Collimation method and Rise and Fall method) and transfer of bench mark

Experiment No: 07 Tacheometric Survey

To determine the Tacheometric constants of a given tacheometric instrument and measurement of distance between two points by Tacheometry.

Experiment No: 08 Plane Table Survey

To plot details using radiation and intersection methods in plane tabling.

Experiment No: 09 Plane Table Traverse Survey

To solve two point/ three point problem in plane table traverse survey.

Experiment No: 10 Profile and Cross-section

To determine and draw the longitudinal profile and cross-section along a given route.

Text/Reference Books

1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., *Surveying I & II*, Laxmi Publications, 2005.
2. Chandra A. M., *Higher Surveying*, New Age International Publishers, 2007.
3. Chandra A. M., *Plane Surveying*, New Age International Publishers, 2007.
4. Charles D Ghilani, Paul R Wolf., *Elementary Surveying*, Prentice Hall, 2012.
5. Arora, K.R., *Surveying*, Vol-I, II and III, Standard Book House, 2015.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Continuous Lab Evaluation is there to assess the students' performance in the lab

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Each experiment evaluation:

Components	**Continuous evaluation**
Viva	30%
Practical Work	30%
Practical File Work	40%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO-1	3	3	-	-	-	-	-	3	3	3	-	-	2	-
CO-2	3	-	-	-	-	-	-	3	3	3	-	-	2	-
CO-3	3	-	-	-	-	-	-	3	3	3	-	-	2	-
CO-4	3	-	-	-	-	-	-	3	3	3	-	-	2	-
Average	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**

1- Weakly mapped 2- Moderately mapped 3-Strongly mapped

Course Code	Course Name	L	T	P	C
MECH2123	**FLUID MECHANICS LAB**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of Fluid Mechanics**				
Co-requisites	**--**				

Course Objectives

I. To provide practical knowledge in verification of principles of fluid flow and its characterization.

II. To impart knowledge in measuring pressure, discharge and velocity of fluid flow

III. To understand Major and Minor Losses in pipe flow

Course Outcomes

On completion of this course, the students will be able to;

CO1. Calibrate flow measuring devices used in pipes, channels and tanks.

CO2. Determine fluid and flow properties

CO3. Classify laminar and turbulent flows

CO4. Compute the various losses in pipe flow

Catalog Description

This course will provide the student with a fundamental background in the statics and dynamics of fluids. The basic conservation laws of mass, momentum and energy are analysed in control volume and differential form. It is expected that student will be able to correctly apply practical concepts so as to evaluate potential industrial applications. Interpretation of results from experiments and numerical simulation of fluid flows will be greatly emphasized.

List of Experiments

Experiment No. 01: Law of Conservation of Energy: To verify the Bernoulli's equation using Venturimeter.

Experiment No. 02: Coefficient of Discharge: To determine the Coefficient of discharge Cd, Velocity Cv and Contraction Cc of various types of orifices and mmouthpieces.

Experiment No. 04: Discharge Coefficients: To determine the discharge coefficients of V-notch and Rectangular Notch (U).

Experiment No. 05: Darcy's Law: To verify Darcy's law and find out the coefficient of permeability of the given medium.

Experiment No. 06: Variation of Friction Factor: To study the variation of friction factor, 'f' for turbulent flow in smooth and rough commercia l pipes

Experiment No. 03: Reynolds Number: To study the Reynolds number in different flow conditions.

Experiment No. 07: Head Loss Coefficient: To determine the minor head loss coefficient for different pipe fittings.

Experiment No. 08: Variation of Coefficient of Discharge: To calibrate an Orifice meter and study the variation of coefficient of discharge with Reynolds number.

Experiment No 09: Calibration of Venturimeter: To calibrate a Venturimeter and to study the variation of coefficient of discharge with the Reynolds Number.

Text Books

1. P.N. Modi and S.M. Seth, *Hydraulics and Fluid Mechanics*, 18th Edition, Standard Book House, Delhi, 2011.
2. Cengel, Y., & Cimbala, J. (2013). *Ebook: Fluid mechanics fundamentals and applications (si units)*. McGraw Hill.

Reference Books

1. Subramanya, K. (2009). *Flow in open channels*. Tata McGraw-Hill.
2. Ven Te Chow (1988), *Open Channel Hydraulics*, Tata McGraw Hill

Modes of Evaluation:

Continuous Lab Evaluation is there to assess the students' performance in the lab:

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	3	-	2	-	-	-	3	3	3	-	-	2	-
CO 2	-	3	-	2	-	-	-		3	3	-	-	2	-
CO 3	-	3	-	2	-	-	-	3	3	3	-	-	2	-
CO 4	-	3	-	2	-	-	-		3	3	-	-	2	-
Avg.	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**

1=weakly mapped 2= moderately mapped 3=strongly mapped

SEMESTER IV

Course code	Course name	L	T	P	C
SLLS0202	Working with Data	2	0	0	2
Pre-requisites/Exposure	Not Any				
Co-requisites	Not Any				

Course Objectives:

The objectives of this course are:

- To perform basic operations such as reading data into excel using various data formats, organizing, and manipulating data, to some of the more advanced functionality of Excel.
- To collate data, analyse that data, and present the decision-making process for their chosen organizational problem.
- To collaborate with team members and execute group projects in a timely manner.

Course Outcomes (COs):

Knowledge & Understanding:

On completion of this course, the students should be able to:

CO1. Understand the use and importance of data in our daily lives and business decisions.

CO2. Apply mathematical and statistical operations on collected datasets using MS Excel.

CO3. Analyse data collected from open-source platforms to find hidden patterns.

CO4. Develop a small project using analytical and visualization techniques on a real dataset using data analytical tool like MS Excel.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs):

	Program Outcomes (POs)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	1	1	1	-	-	1	1	1	1	-	-
CO2	1	2	1	1	1	1	-	-	1	1	1	1	-	-
CO3	1	1	1	1	1	1	-	-	1	1	2	1	-	-
CO4	1	1	2	1	1	1	-	-	2	1	2	1	-	-
Average	1	1.25	1.25	1	1	1	0	0	1.25	1	1.5	1	-	-

1 = Weakly Mapped, 2 = Moderately Mapped, 3 = Strongly Mapped

Skills and Attributes:

- **Use a range of basic operations** to draw appropriate conclusions in the development of a decision to a problem that the team decided to solve.
- Work **Collaboratively**.

Catalogue Description:

This course provides an understanding of the essential spreadsheet functions to organize data in our day-to-day life, particularly at our workplace, and also to analyse data for decision-making. It focuses on enabling the students to consciously apply the acquired knowledge to grow to be an expert data-driven decision-maker.

SYLLABUS CONTENT

1. **Decision Making and Risks**: (**2 lecture Hour)**
   Informed decisions and Intuition
2. **Sources of Data: (4 lecture Hours)**
   Data collection methods, Referencing, deriving interpretations, Decision-making process.
3. **Introduction to Spreadsheets**: (**6 lecture Hours)**
   Reading data into Excel using various formats, Basic functions in Excel, arithmetic as well as various logical functions, Formatting rows and columns, using formulas in Excel and their copy and paste using absolute and relative referencing.

4. **Spreadsheet Functions to Organize Data: (4 lecture Hours)**
   IF and the nested IF functions VLOOKUP and HLOOKUP, The RANDBETWEEN function

5. **Introduction to Filtering, Pivot Tables, and Charts: (6 lecture Hours)**
   VLOOKUP across worksheets, Data filtering in Excel, Use of Pivot tables with categorical as well as numerical data, Introduction to the charting capability of Excel

6. **Advanced Graphing and Charting: (2 Lecture Hours)**
   Line, Bar and Pie charts, Pivot charts, Scatter plots, Histograms.

7. **Capstone Project Submission & Presentation (6 Lecture Hours)**

Textbooks

- **Hector Guerrero,18 Jan 2019**: Excel Data Analysis Modelling and Simulation, Springer International Publishing ISBN: 9783030012786
- **Ash Narayan Shah**, Data Analysis Using Microsoft Excel ISBN: 9788174467164, 8174467165

E-book Link:

https://www.google.co.in/books/edition/Excel_Data_Analysis/V3B_DwAAQBAJ?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

https://www.google.co.in/books/edition/Data_Analysis_Using_Microsoft_Excel/lekT1py5WPUC?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

Reference Books:

- **Denise Etheridge, 2007:** Microsoft Office Excel 2007 Data Analysis Publishing, Wiley ISBN: 9780470132296, 0470132299

E-book Link:

https://www.google.co.in/books/edition/Microsoft_Office_Excel_2007_Data_Analysi/04sQhDOpDiAC?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

Web Sources

- https://excelwithbusiness.com/
- https://www.excel-easy.com/

Modes of Evaluation: (Capstone Project **{50%}** + Excel Quiz-1 **{30%}** + Excel Quiz-2 **{20%}**)

- **EXAMINATION SCHEME**

Components	Quiz (Based on Weekly Exercises & Coursera)	Capstone Project	Coursera Course
Weightage (%)	50% (Quiz-1 {30%} {Week-1 to Week-4 + Coursera} + Quiz-2 {20%} {Week-6 to Week-9 + Coursera})	50% (30% Data Analysis + 20% Data Visualization)	Audit Mode

Course Code	Course Name	L	T	P	C
CIVL2032	**WATER SUPPLY AND SANITATION**	**2**	**0**	**0**	**2**
Pre-requisites/Exposure	**Knowledge of Mathematics and Chemistry**				
Co-requisites	**--**				

Course Objectives

I. To present various concepts involved in water supply scheme designing for a city.
II. To provide knowledge about the qualitative analysis of water.
III. To teach students about the treatment processes involved in purification of water supplies.
IV. To expose students to the concepts of sanitation system and its importance in real world.

Course Outcomes

On completion of this course, the students will be able to;

CO1. Understand the various components of water supply system

CO2. Comprehend the various components/units of water treatment plant

CO3. Analyze the various quality parameters of raw water and their importance

CO4. Design the components of water supply scheme and water treatment plant

Catalog Description

Water Supply and Sanitation in civil engineering deals with the major infrastructure component i.e., water supply system for a city. It also covers the study of processes adopted in water treatment plants for purification of water. The course explains the impact of various water quality parameters on human health and ecosystem. Treatment choices and working of technologies for various water quality parameters are discussed. In this course, the focus will be on developing the understanding of the students regarding concepts of environmental engineering systems.

Course Content

Unit 1: Water Sources and Importance (06 Lecture Hours)

Sources of water and quality issues, Water quality requirement for different beneficial uses, Water quality standards, Water quality indices, Water safety plans.

Unit 2: Water Demands and Water Supply System **(08 Lecture Hours)**

Water supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, S ervice reservoirs and design.

Unit 3: Water Quality Parameters **(06 Lecture Hours)**

Importance of Water Quality Parameters, Physical parameters, Chemical parameters, Bacteriological parameters, Determination procedure.

Unit 4: Water Treatment **(10 Lecture Hours)**

Methods for removal of dissolved gases, Taste and odour, Turbidity, Fluoride, Salinity, Hardness, Iron and Manganese, and Pathogens. Design principles of flash mixer, Sedimentation tank, Clari-flocculator, Sand filtration units and Working of adsorption; ion-exchange; electro-dialysis; and other distillation techniques.

Water Treatment: Aeration, Sedimentation, Coagulation-flocculation, Filtration, Disinfect ion, Advanced treatments like adsorption, ion exchange, membrane processes.

Textbooks

1. Garg, S.K. *Water Supply Engineering*, Volume I, Khanna Publishers.
2. Punmia, B.C., Jain, A.K. & Jain, A.K. *Water Supply Engineering*. Laxmi Publications Limited.

Reference books

1. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
2. Garg, S.K. *Sewage Disposal and Air Pollution Engineering*, Volume II, Khanna Publishers.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) andCourse Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	2	-	-	-	1	2	-	-	-	-	-	2	-
CO2	2	-	-	-	-	1	2	-	-	-	-	-	2	-
CO3	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO4	-	-	3	-	-	1	2	2	-	-	-	-	-	3
Average	**2**	**2**	**3**	-	-	**1.25**	**2**	**2**	-	-	-	-	**2**	**3**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
MECH2065	**Elements of Hydraulic Engineering**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	• **Knowledge of Mathematics,** • **Knowledge of Introduction toFluid Mechanics**				
Co-requisites	**Not any**				

Course Objectives

I. To present various concepts and impart proficiency in basic fluid mechanics concepts.
II. To Expose the students to various real-world applications of fluid mechanics.
III. To provide basic concepts about uniform & non-uniform flow.
IV. To design the various shapes of irrigation canals.

Course Outcomes (COs)

On completion of this course, the students will be able to;

CO1. Interpret the concept of boundary layer theory.

CO2. Apply the concepts of laminar and turbulent flow.

CO3. Analyze the concepts of uniform & non-uniform flow in open channel hydraulics.

CO4. Design the various shapes of lined canals.

Catalog Description

The subject of Fluid Mechanics occupies an important position in many engineering disciplines, such as civil, mechanical, chemical, and aeronautical engineering. It deals with the flow of fluid, which is present all around. This fluid is mostly in the form of water, air & oil, and most of the analyses are based on them. It is essential to have a good understanding of the mechanics of fluids. Fluid Mechanics also laid down the foundation for other subjects like water resources engineering, hydraulic structures, etc. This subject is also filled with advanced mathematics, especially calculus. Students will be dealing with topics like laminar and turbulent flow. Flow around Submerged bodies, Boundary layer flow, Non-uniform flow, and the hydraulic machines. It requires mathematical aptitude and a sharp mind, as the analysis carried out will have large implications for real-life applications.

Course content

Unit 1: **Laminar Flow and Turbulent Flow** (**08 Lecture Hours)**

Concept of Laminar flows through circular pipes, annulus, and parallel plates, Stoke's law, Measurement of `viscosity. Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses semi-empirical theories of turbulence, Prandtl's mixing length theory, and universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

Unit 2: **Boundary Layer Analysis** **(04 Lecture Hours)**

Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Unit 3: Dimensional Analysis and Hydraulic Similitude **(05 Lecture Hours)**

Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Unit 4: Introduction to Open Channel Flow **(08 Lecture Hours)**

Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n." *Most economical section of the ch*annel. Computation of Uniform flow, Normal depth. Design of lined canals systems. Use of MATLAB in design of canal system. Introduction to SewerGEMs/SewerCAD and other packages.

Unit 5: Gradually varied flow (non-uniform flow) (08 Lecture Hours

Concept of Specific energy, Specific energy curve, critical flow, discharge curve Specific force, Specific depth, and Critical depth. Channel Transitions. (Covered in lab) Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and direct integration method. Application MATLAB in computation of water surface profile.

Unit 6: Rapidly varied flow (non-uniform flow) (06 Lecture Hours)

Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. (Covered in the lab or fluid mechanics under the impact of jet topic). Hydraulic jump in the non-rectangular sections.

Unit 7: Flow through Pipes (08 Lecture Hours)

Loss of head through pipes, Darcy-Weisbach equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead-end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problems. Introduction of pipe network analysis software like EPANET, WaterCAD, WaterGEMS etc, and application of EPANET in real life network design. Introduction to optimization of pipe network design.

Text Books

1. Modi P.M. and Seth S.M. (2017). Hydraulics and Fluid Mechanics, Standard Book House
2. Subramanya K. (2010). Theory and Applications of Fluid Mechanics, Tata McGraw Hill.
3. Subramanya, K. (2009). Flow in open channels. Tata McGraw-Hill.
4. Ven Te Chow (2010). Open Channel Hydraulics, Tata McGraw Hill.

Reference Books

1. Prasuhn, A. L. (1987). Fundamentals of hydraulic engineering.
2. Roberson, J. A., Cassidy, J. J., & Chaudhry, M. H. (1998). *Hydraulic engineering*. John Wiley & Sons.
3. Warring, R. H. (1983). Hydraulic handbook.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) andCourse Outcomes (COs)

PO/CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	-	3	3	2	-	-	-	-	-	-	-	-	2	-
CO 2	-	3	3	2	-	-	-	-	-	-	-	-	-	2
CO 3	-	3	3	2	-	-	-	-	-	-	-	-	-	2
CO 4	-	3	3	2	-	-	-	-	-	-	-	-	-	2
Avg.	**-**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
MECH2018	**Strength Of Materials**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Engineering Mechanics**				
Co-requisites	**Mathematics and Physics up till B. Tech Semester 3**				

Course Objectives

I. To learn about the strength parameters of materials, concept of stress, strain anddeformation of solid and state of stress

II. To know the concepts of strain energy, principal stress, principal planes, principal strainand failure theories

III. To learn the bending moment, shear force and the corresponding stress distribution fordifferent types of beams

IV. To understand the theory of torsion and stresses in springs

V. To learn the concept of thin pressure vessels (thin cylinders and shells) and shear center

VI. To determine the deflection in determinate beams & deflection in curved beams

Course Outcomes

On completion of this course, the students will be able to;

CO1. Understand the different types of material behavior to predict the strength of materials.

CO2. Analyze problems of torsion, axially loaded columns, combined loading & pressure vessel

CO3.Analyze bending stresses and shear stresses, and draw the SFD and BMD for various members.

CO4. Determine the deflection in determinate beams & curved beams

Catalog Description

Solid Mechanics is a branch of mechanics that studies the effect of external loading has on a body. This is important to be studied by a civil engineer, as it helps determine the material to be used for construction, and also exploring new materials for construction. The behavior of the material and members under various loading is to be understood and member sizes defined for any structure, for safe, functional structures at optimal costs and resources. Today's continually changing global scenario dictates that a civil engineer considers sustainable construction, and minimal carbon footprint of construction sector. To achieve this goal, it is important that the student should learn and be able to ascertain the behavior of various materials and members under varying loading conditions.

Course Content

Unit1: Strength Properties of material & complex stress & strain (09 Lecture Hours)

Brief about the course, Definition of stress and strain, True stress and strain, Engineering stress and strain, Ductile and brittle materials, Elasticity, proof stress, types of stress strain curve, resilience, toughness and their modulus, Creep, Fatigue, S N Curve, Types of failure in tension and compression test, Types of stresses, Elastic constants- Young's modulus, poisons ratio, Types of modulus for stress strain curve, Stress and strain, complementary stress, differential strain, stress matrix and strain matrix, Application of hooks law,

Unit 2: Compound Stresses and Strains (06 Lecture Hours)

3D stress effect, Hydrostatic loading, Compatibility equations, Deflection in linear systems - stepped bar, circular tapered, rectangular tapered, composite bar, self-weight in prismatic bar, stepped bar, FOS, Reaction in indeterminate bars system, Temperature stress, Principle stresses, Finding stress matrix at inclined plane, Finding principle stresses, pure shear, Problems, Mohr Circle, Analysis of strains, strain energy stored per unit volume, Transformation of strain and principle strain and its Mohr's circle.

Unit 3: Bending moment and Shear Force Diagrams (09 Lecture Hours)

Different types of support system, finding reactions, sign convention, stability. Relation between Shear force, Bending moment & Loading and guidelines to draw SFD and BMD with elastic curve, SFD and BMD for compound beams, Overhanging Beams, Cantilever beams, simply supported beams, curved beams and determinate frames. Assumption in simple bending theory and derivation of bending equation, bending capacity of a cross section, Bending Stress Distribution across a Section, Shear Stresses in Beams.

Unit 4: Theory of Torsion **(06 Lecture Hours)**

Concept of pure torsion. Torsion equation, Torsion capacity, Shafts in series and parallel arrangements. Determination of shear stress and angle of twist of shafts of circular section, hollow shafts, indeterminate shafts.

Unit 5: Deflection of Beams **(07 Lecture Hours)**

Double integration method, Macaulay's Method, Moment Area method and problems. Strain energy calculations and deflection in curved beams

Unit 6: Pressure vessels, Combined loading & Columns **(08 Lecture Hours)**

Thin-walled cylinders and spheres. Stress due to internal pressure, state of stress due to combined loading. Introduction to buckling effect, Euler's theory & Rankine's formula for axial y loaded columns with different end conditions. Concept of equivalent length.

Text Books

1. Timoshenko, S. (2021). Strength of Materials, 3rd edition, CBS Publishers and Distributors Pvt. Ltd.
2. Hibbeler, R. C. (2004). Mechanics of Materials. 6th edition, Pearson Prentice Hall.
3. Ratan S.S. (2017). Strength of materials, 3rd edition, McGraw Hill education

Reference Books

1. Crandall, S. H., Dahl, N. C. and Lardner T. J. (1979) An Introduction to the Mechanics of Solids. 2nd edition, McGraw Hill
2. Ramamrutham S. and Narayanan R. (2020). Strength of materials, 20th edition, Dhanpat Rai Publishing Company (P) Ltd.
3. Bansal R.K. (2011). Strength of materilas, Laxmi Publications Pvt Ltd.

Modes Of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written ExaminationExamination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship Between The Course Outcomes (Cos) And Program Outcomes (Pos) &Program Specific Outcomes (Psos)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	3	-
Average	3	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL2125	**Solid Mechanics Lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Basic Knowledge of Engineering Mechanics, Ability to find** **support reactions and Mathematics**				
Co-requisites	**--**				

Course Objectives

I. To provide understanding of the strength parameters of materials

II. To provide understanding of the engineering properties of beams by conducting laboratory Experiments

III. To provide knowledge about the structure-property-application relationships

IV. To provide comprehensive understanding of shear, stress & stain in structure, experimentally.

V. To determine deflection in beams experimentally

Course Outcomes

On completion of this course, the students will be able to;

CO1. Determine engineering properties of given specimens

CO2. Determine shear forces, stress & Strain of given specimen

CO3. Assess deflection in determinate beam

CO4. Find the behaviour of steel bar under bending

Catalog Description

A structure refers to a system of connected parts used to support a load. Before designing, the Structure must be analyzed to ensure that it has its required stiffness and strength. This lab helps in understanding and visualizing the principles of various engineering properties on engineering under various application of load like stress, shear, strain, etc. Experimental evaluation of the various engineering properties of structure will develop better understanding about the materials. Through the experiments, students will develop essential skills in material testing, data acquisition, analysis, and interpretation. They will also learn to assess the strength, stiffness, and ductility of materials, which are critical for designing and analyzing structures.

List of experiments

Experiment No: 01 Bending Test

Bending tests on simply supported beam and Cantilever beam.

Experiment No: 02 Hooke's Law

Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation.

Experiment No: 03 Tension test

Perform the tension test on nominal concrete mix

Experiment No: 04 Compression test on concrete

Perform the compression test on nominal concrete mix

Experiment No: 05 Shear Forces in Beam

Determine the force for shear failure in concrete mix.

Experiment No: 06 Yield/tensile strength of steel bar

Measure the yield / tensile strength of steel bar

Experiment No: 07 Measurement of deflections in statically determinate beam

To measurement, the deflections in statically determinate beam for applied load

Experiment No: 08 Strain in a Bar

Measurement of strain in a bar

Experiment No: 09 Bend Test on steel bar

Measurement of Bend of steel bar on application of load

Text Books

1. Timoshenko, S. (2021). Strength of Materials, 3rd edition, CBS Publishers and Distributors Pvt. Ltd.
2. Hibbeler, R. C. (2004). Mechanics of Materials. 6th edition, Pearson Prentice Hall.
3. Ratan S.S. (2017). Strength of materials, 3rd edition, McGraw Hill education

Reference Books

1. Crandall, S. H., Dahl, N. C. and Lardner T. J. (1979) An Introduction to the Mechanics of Solids. 2nd edition, McGraw Hill
2. Ramamrutham S. and Narayanan R. (2020). Strength of materials, 20th edition, Dhanpat Rai Publishing Company (P) Ltd.
3. Bansal R.K. (2011). Strength of materilas, Laxmi Publications Pvt Ltd

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) andCourse Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	2	3	-	-	-	2	-
CO2	3	-	-	-	-	-	-	2	3	-	-	-	2	-
CO3	3	-	-	-	-	-	-	2	3	-	-	-	2	-
CO4	3	-	-	-	-	-	-	2	3	-	-	-	2	-
AveraGe	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**2**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL2033	COMPUTER AIDED CIVIL ENGINEERING DESIGN LAB	0	0	2	1
Pre-requisites/Exposure	Engineering Drawings				
Co-requisites	--				

Course Objectives

I. To be able to visualize different views of an object and to be able to construct the object provided with the views of the object

II. To give knowledge of Auto CAD software for making drawing for Civil Engineering structural and non-structural elements.

III. To be able to read design drawing.

IV. To be able to implement the reinforcement detailing in the field.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understanding the basic commands, principles and features behind AutoCAD

CO2. Implementing CAD software for scaled drawing

CO3. Preparing building drawings using CAD software

CO4. Preparing Structural drawings using CAD software

CatLog Description

CAD (Computer Aided Design) provides a convenient mean to create designs for almost every engineering discipline. It can be used for architectural design, landscape design, interior design, civil and surveying etc. This subject will include introduction to AutoCAD software, drawing civil engineering structure elements like foundation, brickwork, masonry, doors, and staircase. Drawings of sections for these elements and structural drawings with the detailing of reinforcement.

List of experiments for lab

Unit 1: Introduction to AutoCAD

AUTOCAD screen, Setting the options, Menu commands, Opening a drawing, Drawing tools, Editing tools, Creating drawings using wizards, Dimensioning, Text in AUTOCAD, Layers concept, Blocks, Hatching, Working with Multiple drawings, Drawing 2D objects using above tools.

Unit 2: Drawing components of building

Symbols used in Civil Engineering drawing, Masonry Bonds (Brick and Stone masonry), pointing Types, masonry Columns and wall Junctions. Drawing following components of building using AUTOCAD tools - Masonry foundations, Doors and Windows, Staircases

Unit 3: Building drawings

Drawing plans of buildings using drawing tools, creating openings in plans using modify tools, creating and inserting blocks of doors and windows, Inserting text and dimensions, Drawing elevation and sections, Creating sanction drawing. Preparation of working drawings of single story and double storey residential buildings.

Unit 4: Structural drawings

Preparation of column lay out and excavation drawings, footing, lintel and chejja, beams and slabs of framed structures

Text Book

1. Pandey S.K. (2010), Learn AutoCAD, S.K. Kataria & Sons

Reference Book

1. Wahab A. (2020), A hand book on AutoCAD tools practice, Notion Press

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Continuous Lab Evaluation is there to assess the students' performance in the lab

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	-	-	-	-	-	-	-	-	3	-	-	2	-
CO 2	-	-	-	-	3	-	-	-	-	3	-	-	2	-
CO 3	-	-	-	-	3	-	-	-	-	3	-	-	2	-
CO 4	-	-	-	-	3	-	-	-	-	3	-	-	2	-
Avg.	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL2134	Survey Camp	0	0	0	1
Pre-requisites/Exposure	Knowledge of surveying				
Co-requisites	Not Any				

Course Objectives

I. To provide the students with practical training in engineering survey in the field. Conditions.
II. To enable the students to solve a real-life surveying problem in groups.
III. To facilitate students with knowledge and experience to map and contour the area.
IV. To give exposure on recording original field observations, calculations, and plots.

Course Outcomes (COs)

On completion of this course, the students will be able to

1. Apply the concepts of surveying in the field to solve a real-life problem.
2. Use of surveying instruments to record field observations and do calculations.
3. Understand the challenges of surveying in the field.
4. Design and plot survey area maps by contouring the region.

Catalog Description

Knowledge of surveying trains the ability of engineers to visualize, think logically and pursue the engineering approach. It is one of the oldest and the most used disciplines of engineering. It is the basic and foremost requirement of any engineering project. The art of surveying has become an important profession. An introduction to the principles and practices of surveying is, therefore, desirable as an integral part of engineering education and training, irrespective of the branch of specialization. The survey camp will enable the students to solve a real-life surveying problem in the field and gives a first-hand experience of being a civil engineer. The concepts of surveying taught in the class will be put to use here when the students would be subjected to apply surveying techniques to record measurements in the field and plot the survey map in the end by contouring the region

Survey camp Activities

Two weeks Survey Camp will be conducted with the following activities:

1. Traversing the survey region using Total station
2. Contouring
3. Offset of Buildings and Plotting the Location
4. Use of GPS to determine latitude and longitude and locate the survey camp location.
5. Traversing using GPS.
6. Curve setting by deflection angle.

Apart from the above, students may be given survey exercises in other areas also based on site conditions to give good exposure on survey.

Text/Reference Books

1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2005.
2. Chandra A. M., Higher Surveying, New Age International Publishers, 2007.
3. Chandra A. M., Plane Surveying, New Age International Publishers, 2007.
4. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012.
5. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Continuous Lab Evaluation is there to assess the students' performance in the lab

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Performance during survey camp, viva

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO-1	3	3	-	-	-	-	-	3	3	3	-	-	2	-
CO-2	3	-	-	-	-	-	-	3	3	3	-	-	2	-
CO-3	3	-	-	-	-	-	-	3	3	3	-	-	2	-
CO-4	3	-	-	-	-	-	-	3	3	3	-	-	2	-
Averag e	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code (Version)	Course Name	L	T	P	C
CSEG2049	Programming in Python	0	0	2	1
Pre-requisites/Exposure	Basic knowledge of computer system and elementary mathematics				
Co-requisites	Not Any				

Course Objectives

I. To understand the fundamental of python programming language.
II. To write python scripting elements such as variables and flow control structures.
III. To use python library packages for solving domain problems.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understand the basic python programming concepts, and data structures.

CO2. Execute file handling operations and OOPS concepts using python.

CO3. Create modules and implement web development framework.

CO4. Apply python in solving real world data analytics.

Catalog Description

This course introduces the basic concepts of procedural and object-oriented programming using python programming language. This course also provides practical knowledge and hands-on experience in designing and implementing data structures. Activities covered include introduction to python programming language, datatypes, operators, loop structures, decision-making statements, fundamental data structures, functions, Classes and Objects, Constructor, File Handling, Exception Handling and NumPy module. This course will also enable the students to perform basic data analytics required for scientific writing and report making.

List of Experiments

Lab Exercise	Contents
Experiment No 1	To introduce the python interface and basic libraries.
Experiment No 2	To introduction to basic data types and strings in python
Experiment No 3	To implement the strings in python
Experiment No 4	To implement functions in python
Experiment No 5	To explore the file handling capabilities of python
Experiment No 6	To introduce Object Oriented Programming (OOPS) using python
Experiment No 7	To implement GUI using tkinter library
Experiment No 8	To implement the basic commands of NumPy in python
Experiment No 9	To perform basic data analytics in pandas

TEXT BOOKS

1. Lutz, M. (2001). *Programming python*. " O'Reilly Media, Inc.". Python Programming by “Reema Thareja”.
2. Kuhlman, D. (2009). *A python book: Beginning python, advanced python, and python exercises* (pp. 1-227). Lutz: Dave Kuhlman.

REFERENCE BOOKS

1. Lutz, M. (2013). *Learning python: Powerful object-oriented programming*. " O'Reilly Media, Inc.".

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	-	-	-	3	-	1	3	3	3	-	-	2	2
CO 2	3	-	-	-	3	-	1	3	3	3	-	-	2	2
CO 3	3	-	-	-	3	-	1	3	3	3	-	-	2	2
CO 4	2	-	-	-	3	-	1	3	3	3	-	-	1	1
Avg.	**2.5**	**-**	**-**	**-**	**3**	**-**	**1**	**3**	**3**	**3**	**-**	**-**	**1.75**	**1.75**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

SEMESTER V

Course code	Course name	L	T	P	C
SLLS 0103	**Leadership And Teamwork**	2	0	0	2
Pre-requisites/Exposure	Not any				
Co-requisites	Not any				

Course Objectives:

- To formulate and articulate a personal point of view about the meaning of leadership and teamwork, and why they are important.
- To explore and appreciate the scope of leadership and teamwork in one's day to day life.
- To understand the concepts of effective leadership and teamwork in organizations.
- To identify and assess the skills and motivations associated with effective leadership and teamwork.
- To improve effective communications in groups and manage team conflict to resolve issues.
- To learn how to perform in teams to achieve results on personal and professional levels.

Course Outcomes:

On completion of this course the students will be able to Knowledge & Understanding:

CO1. Understand the importance of being an empathetic leader and a collaborative team member.

CO2. Understand the skills of leadership and teamwork – including analysis of leadership and teamwork theory, as well as how they are assessed in the professional and social process.

CO3. Build collaborative relationships that emphasize team building and problem solving.

Skills and Attributes:

CO4: Use a range of basic reflective practice techniques, to evaluate their own teamwork and leadership skills.

CO5: Use leadership and teamwork skills to create more effective and productive professional and personal relationships.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	-	-	-	3	-	1	3	3	3	-	-	2	2
CO2	3	-	-	-	3	-	1	3	3	3	-	-	2	2
CO3	3	-	-	-	3	-	1	3	3	3	-	-	2	2
CO4	2	-	-	-	2	-	1	3	3	3	-	-	1	1
CO5	**2.5**	**-**	**-**	**-**	**2.75**	**-**	**1**	**3**	**3**	**3**	**-**	**-**	**1.75**	**1.75**
Average														

1. WEAK 2. MODERATE 3. STRONG

Course Content

Unit I: Leadership: Introduction, Self-Awareness & Leadership (5 lecture hours)

Introduction to the Course, Importance and Its Application in Life, Self-Awareness and Leadership Examples from Different Walks of Life, Personality Assessment through (i) BIG 5, (ii) MBTI.

Unit II: Defining Leaders and Leadership (3 lecture hours)

Defining Leaders and Leadership, Historical Perspective, Contemporary Perspective, Types of Leaders and Leadership Styles.

Unit III: Leadership Toolkit (6 lecture hours)

Leadership Tools - Locus of Control, Goal Setting, Time Management, Interpersonal Relationship, Role of Perception, Powerful First Impression, Body Language, Elevator Pitch, Small Talk, Constructive Criticism, Assertiveness Skills, Dealing with Difficult People.

Unit IV: What is a Team? (6 lecture hours)

What is a Team? Why is a Team needed? 4 Phase Model of Team Formation, What to Do as a Leader and What to Do as a Team Member in Each Phase? Effective Teams and Solving Problems as a Team – Brief Introduction to the Six Thinking Hats

Unit V: Positive Leadership & Team Building Activity (6 lecture hours)

Positive Leadership - Communication, Appreciation, Empathy, Feedback, Leaders and Teams: Working Effectively towards Common Goals, Team Building Activity.

Unit VI: 20. PROJECT and E- portfolio Submission (4 lecture hours)

Text Books

1. Carroll, John, and Sachi Hatakenaka. "Driving Organizational Change in the Midst of Crisis." MIT Sloan Management Review 42, no. 3 (Spring 2001): 70-79.
2. Senge, Peter M., Art Kleiner, Charlotte Roberts, Rick Ross, and Bryan Smith. "The Ladder of Inference." In The Fifth Discipline Fieldbook. New York, NY: Currency Publishers, pp. 242-250. ISBN: 0385472560.
3. Organizational Behavior, Stephen P. Robbins, Timothi A. Judge and Seema Sanghi, 12th ed, Prentice Hall India.
4. Organizational behavior-Human behavior at work by John W Newstrom, 12th edition, McGrawHill

Additional Reading/Viewing:

1. Stephen R. Covey, The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change
2. Katie Shonk (2018, June 19). 3 Types of Conflict and How to Address Them. Harvard Law School.
3. Climerconsulting.com/episode-23-how-conflict-impacts-team-creativity Charas, S. (2013, February 27).
4. Boardroom conflict: Productive or not? Business Insider. businessinsider.com/boardroom-conflict-productive-or-not-2013-3?r=AU&IR=T
5. Mitchell, R. (2014, January 21). Team innovation and success: Why we should fight at work. The Conversation
6. theconversation.com/team-innovation-and-success-why-we-should-fight-at-work-20651

WEB SOURCES:

1. NACE Job Outlook Report, 2020
2. https://www.stjohns.edu/sites/default/files/2020-05/nace_job_outlook_0.pdf
3. Ten Leadership Theories in Five Minutes

4. https://courses.lumenlearning.com/wmopen-organizationalbehavior/chapter/the- history-of-leadership-theories/
5. https://toughnickel.com/business/The-History-of-Leadership-Studies-and-Evolution-of-Leadership-Theories
6. https://courses.lumenlearning.com/principlesmanagement/chapter/10-5- contemporary-approaches-to-leadership/
7. https://www.bumc.bu.edu/facdev-medicine/files/2010/10/Leadership-Matrix-Self-Assessment-Questionnaire.pdf
8. https://www.tuw.edu/business/what-kind-of-leader-are-you/
9. https://www.thebalancesmb.com/smart-goal-examples-2951827
10. https://examples.yourdictionary.com/examples-of-measurable-goals-and-objectives.html
11. https://www.youtube.com/watch?v=0Mi9_XEXQqc
12. https://www.youtube.com/watch?v=zc8zCSQxBhM
13. https://www.youtube.com/watch?v=vlpKyLklDDY&t=296s

Modes of Evaluation: Project + E-Portfolio + Mega Quiz

Components	PROJECT	E-PORTFOLIO	MEGA QUIZ	Total
Weightage (%)	50%	30%	20%	100

Course Code	Course Name	L	T	P	C
CIVL3020	**GEOTECHNICAL ENGINEERING**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Mechanics and Mathematics**				
Co-requisites					

Course Objectives

I. To establish and understand the fundamental concepts of mechanics of soil particles, including the behaviour of soil in multiphase and constitutive behaviour of soil.
II. To provide students the exposure to the systematic methods for solving engineering problems in geotechnical engineering using basic mechanical principles
III. To analyse and predict soil behaviour under various loading conditions

Course Outcomes

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

CO1. Identify and classify soil required for design purposes using various soil parameters.
CO2. Apply the concept of effective stresses, vertical stress due to external load, and permeability to predict soil behavior under stress and seepage.
CO3. Utilize the mechanism of compaction to solve problems related to compaction in the field or lab.
CO4. Assess the magnitude and time-rate of settlement due to consolidation.
CO5. Estimate soil shear strength parameters with respect to the drainage conditions in the field or lab and analyze soil failure.

Catalog Description

Loads of any civil engineering structure will need to be transferred to and carried by earth through a foundation system. Foundation engineering requires knowledge of soil and its behavior, i.e. geotechnical engineering. The objective of this course is to introduce the basics of geotechnical engineering to the students. Some of the topics that students will learn are soil structure, compaction, consolidation, permeability, seepage through soil and fundamental behavior of soil under stress. After successful completion of this course students will be able to apply fundamentals of geotechnical engineering in the analysis and design of civil engineering projects.

Course Content

Unit 1: Soil Formation and Composition **(05 Lecture Hours)**

Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, interparticle forces, soil structure, principal clay minerals.

Unit 2: Soil properties and classification **(08 Lecture Hours)**

Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, relative density, consistency limits and their determination, activity of clays, Soil classification - classification based on grain size, classification on the basis of plasticity, plasticity chart, Indian Standard Classification System.

Unit 3: Permeability of Soil **(06 Lecture Hours)**

Soil-water systems – capillarity, Darcy's law, permeability, estimation of permeability in the laboratory and field, permeability of stratified soils, factors affecting permeability of soil.

Unit 4: Effective Stress Principle **(08 Lecture Hours)**

Principle of effective stress, effective stress under hydrostatic conditions, effective stress in the zone of capillary rise, effective stress under steady state hydro-dynamic conditions, seepage force, quick condition, critical hydraulic gradient, two-dimensional flow, Laplace's equation, properties and utilities of flow net, graphical method of construction of flownets, piping, protective filter.

Unit 5: Vertical stresses in soils **(05 Lecture Hours)**

Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart, contact pressure under rigid and flexible area, computation of displacements from elastic theory.

Unit 6: Compaction of Soil **(05 Lecture Hours)**

Introduction, role of moisture and compactive effect in compaction, laboratory determination of optimum moisture content, moisture density relationship, compaction in field, compaction specifications and field control of compaction.

Unit 7: Consolidation of Soil **(09 Lecture Hours)**

Introduction, components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande's graphical method of estimating pre-consolidation pressure, Terzaghi's theory of one-dimensional primary consolidation, determination of coefficients of consolidation, computation of consolidation settlement, secondary consolidation.

Unit 8: Shear Strength **(09 Lecture Hours)**

Introduction, Mohr stress circle, Mohr-Coulomb failure-criterion, relationship between principal stresses at failure, shear tests, direct shear test, unconfined compression test, triaxial compression tests, drainage conditions and strength parameters, Vane shear test, shear strength characteristics of sands, normally consolidated clays, over-consolidated clays and partially saturated soils, sensitivity and thixotropy.

Textbooks

1. Ranjan, G. & Rao, A. S. R. (2016). *Basic and Applied Soil Mechanics (Theory & Practice)*, Third Edition, New Age International Publishers.
2. V.N.S. Murthy, *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*, CRC Press.
3. Holtz, R. D. and Kovacs, W. D. *An Introduction to Geotechnical Engineering*, Prentice Hall, NJ.

Reference books

1. Das, B. M. Principles of Geotechnical Engineering, Cengage Learning.
2. Terzaghi, K., Peck, R. B. and Mesri, G. *Soil Mechanics in Engineering Practice*, John Wiley & Sons Inc.
3. Taylor, J. *Fundamentals of Soil Engineering*, Wiley & Sons.
4. Craig, R. F. *Soil Mechanics*, Chapman & Hall.
5. McCarthy, D. F. (2006) *Essentials of Soil Mechanics and Foundations: Basic Geotechnics*, Pearson.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3018	**STRUCTURAL ENGINEERING**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Mechanics of Solids, Structural Analysis I**				
Co-requisites	**--**				

Course Objectives

I. To determine the static degree of indeterminacy, kinematic degree of indeterminacy, to understand concept of force method and displacement method

II. To be able to perform analysis of indeterminate beams, frames using slope deflectio n method, energy method and to perform approximate analysis for beams, frames, and trusses by approximate method

III. To be able to create stiffness matrix and flexibility matrix and perform the analysis by the matrix methods

IV. To perform the plastic analysis and its application in real life situations

Course Outcomes

On completion of this course, the students will be able to;

CO1. Determine the Degree of Static and Degree of Kinematic Indeterminacy for any structureand ability to select suitable method for analysis.

CO2. Perform analysis of indeterminate beams, frames by slope deflection method, momentdistribution method, Kani's Method and approximate analysis for frames.

CO3. Analyze the structure by flexibility and stiffness methods.

CO4. Determine plastic strength of a section, plastic mechanisms, plastic analysis and its application

Catalog Description

A structure refers to a system of connected parts used to support a load. Before designing, the structure must be analyzed to ensure that it has its required stiffness and strength. The results of the analysis are used for redesign the structure, accounting for a more accurate determination of the weight of the members and their size and simultaneous optimization. This course includes determination of degree of static and kinematic indeterminacy, understanding displacement and force method of analysis. Analysis of indeterminate beams, frames by slope deflection method, moment distribution method and approximate methods. Analysis by stiffness and flexibility matrix method and plastic analysis.

Course Content

Unit 1: Basic Concepts of Structural Analysis (06 Lecture Hours)

Types of skeletal structures, static and kinematics indeterminacy, equilibrium and compatibility conditions, stress-strain relations, force-displacement relations. Concept of linear /non-linear behavior of structures. Energy theorem, concept of complementary energy, Fundamental concept of Force and the Displacement method of analysis.

Unit 2: Slope Deflection Method and Approximate Methods (15 Lecture Hours)

Slope deflection method, applied to continuous and rigid jointed frames, transverse and rotational yielding of supports. (up to three unknown). Moment distribution & Kani's method applied to continuous beams and rigid jointed rectangular frames, transnational and rotational yielding of supports. Approximate analysis of trusses and multistory frames for vertical and cantilever method.lateral loads, substitute frame, portal frame

Unit 3: Fundamental Concept of Flexibility (06 Lecture Hours)

Method for structural analysis, flexibility coefficient, matrix formulation for flexibility methods, degree of freedom. Choice of redundant forces, compatibility equations, effect of settlement and rotation of supports, hand solution of simple problems on beams and rigid jointed frames (involving not more than three unknown)

Unit 4: Fundamental Concept of Stiffness (09 Lecture Hours)

Method of stiffness analysis, stiffness coefficient, matrix formulation for stiffness methods, degree of freedom. Stiffness matrix for frames with inclined member, physical significance of stiffness, effect of settlement and rotation on rigid jointed plane frames (involving not more than three unknown)

Unit 5: Plastic Analysis of Steel Structures (09 Lecture Hours)

Introduction, Shape factor, plastic hinge, collapse mechanism, upper bound and lower bound theories, application to continuous, fixed and single bay single storey rectangular frames.

Text Books

1. Hibbeler R.C. (2022), Structural Analysis, 10th edition, Pearson Education
2. Ramamrutham S. and Narayanan R. (2020), Theory of structures, 11th edition, Dhanpat Rai Publishing Company Ltd.

Reference Books

1. Bhavikatti S.S. (2021), Structural Analysis Vol-2, 5th edition, Vikas Publishing
2. Menon D (2010), Structural Analysis, Narosa

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written ExaminationScheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) andCourse Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Average	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3055	**ENVIRONMENTAL ENGINEERING**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Knowledge of Mathematics and Chemistry** • **Water Supply and Sanitation**				
Co-requisites	**--**				

Course Objectives

I. To present various concepts and impart proficiency in designing of sewerage system and its various components.
II. To provide knowledge about the qualitative analysis of sewage and their standard permissible limits before disposal.
III. To teach students in detail about the processes involved in treatment of sewage.
IV. To provide knowledge in detail about the air and noise quality, its control and monitoring practices.
V. To provide knowledge about the solid waste generation, its impact and managementstrategies.

Course Outcomes

On completion of this course, the students will be able to;
CO1. Comprehend the relevant physical and chemical characteristics of sewage

CO2. Analyse the sewage disposal and sludge digestion processes

CO3. Apply the air and noise quality concepts along with their monitoring and control

Methods

CO4. Analyse the various solid waste management practices

CO5. Design the various components of sewerage system

Catalog Description

Environmental Engineering in civil engineering deals with one of the major infrastructure components i.e., sewerage system for a city. It also covers qualitative analysis study of sewage and processes adopted in sewage treatment plant for treatment of sewage. In this course, the focus will be on developing the understanding of the students regarding sewerage system and detailed study of its various components. It also provides knowledge to the students regarding air and noise quality concepts along with their monitoring and control procedures. Additionally, knowledge about solid waste and management strategies will also be provided to the students under the course.

Course Content

Unit 1: Design of Sewerage System (08 Lecture Hours)

Sewerage schemes and their importance, collection & conveyance of sewage, storm water quantity, fluctuation in sewage flow, flow through sewer, design of sewer, construction & maintenance of sewer, sewer appurtenances, pumps & pumping stations.

Unit 2: Quality and Characteristics of Sewage (10 Lecture Hours)

Characteristics and analysis of wastewater, cycles of decomposition, physical, chemical & biological parameters. oxygen demand i.e., BOD, COD, TOC, TOD, relative stability, population equivalent, instrumentation involved in analysis, natural methods of wastewater disposal i.e., by land treatment & by dilution, self-purification capacity of stream, oxygen sag analysis.

Unit 3: Treatment of Sewage (12 Lecture Hours)

Unit operations for wastewater treatment, preliminary treatment such as screens, grit chamber, floatation tank, sedimentation and chemical clarification, role of micro-organism in biological treatment, sewage filtration-theory & design. Methods of biological treatment (Theory & Design) - activated sludge process, oxidation ditch, stabilization ponds, aerated lagoon, anaerobic lagoons, septic tank & imhoff tank, sources & treatment of sludge, sludge thickening and digestion sludge drying beds, sludge disposal.

Unit 4: Air and Noise Pollution Engineering (09 Lecture Hours)

Composition and properties of air, quantification of air pollutants, monitoring of air pollutants, air pollution- occupational hazards, urban air pollution, automobile pollution, chemistry of combustion, automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, control measures for air pollution, construction and limitations. Noise-basic concept, measurement and various control methods.

Unit 5: Solid Waste Management (06 Lecture Hours)

Municipal solid waste (MSW), composition and various chemical and physical parameters of MSW, MSW management: collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, effects of solid waste on environment: effects on air, soil, water surface and ground health hazards.

Textbooks

1. Garg, S.K. *Sewage Disposal and Air Pollution Engineering*, Volume II, Khanna Publishers.
2. Metcalf and Eddy. *Wastewater Engineering: Treatment & Reuse*. McGraw Hill Education.

Reference books

1. Punmia, B.C., Jain, A.K. *Wastewater Engineering (Including Air Pollution).* Laxmi Publications Limited.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	3	-	-	-	3	1	2	-	-	-	-	3	-
CO2	-	3	-	-	-	3	1	3	-	-	-	-	3	-
CO3	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO4	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO5	-	-	3	-	-	3	1	-	-	-	-	-	2	3
Average	**2**	**3**	**3**	**-**	**-**	**2.6**	**1.4**	**2.5**	**-**	**-**	**-**	**-**	**2.4**	**3**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3120	GEOTECHNICAL ENGINEERING LAB	0	0	2	1
Pre-requisites/Exposure	Knowledge of Mechanics				
Co-requisites	--				

Course Objectives

I. To comprehend structure, composition, and hydraulic properties of soil.
II. To obtain soil stresses, and compaction characteristics of soils.
III. To assess settlement and shear strength parameters of soils

Course Outcomes

On completion of this course, the students will be able to:

CO1. Identify and classify soil based on standard geotechnical engineering practices.
CO2. Determine *in-situ* density, permeability, and compaction characteristics of soil.
CO3. Evaluate shear strength parameters of soil by various standard tests.

Catalog Description

The material in this course will provide the students with the fundamental background of soil mechanics. Students will acquire the basic knowledge to carry out field investigations and to identify different types of soils. It is expected that after completion of this course, student will have the knowledge and ability to perform laboratory test needed to determine soil design parameters. Students will also be able to conduct experiments as well as analyze and interpret data.

List of experiments
Experiments No: 01 Moisture Content

To determine the moisture content of a given soil sample by oven drying method

Experiment No: 02 Specific Gravity

To determine the specific gravity of a given soil sample by Pycnometer method

Experiment No: 03 Permeability

To determine the permeability of a given soil sample

Experiment No: 04 Unit Weight by Core cutter

To find the field unit weight of soil mass by core cutter method

Experiment No: 05 Unit Weight by Sand Replacement

To find the field unit weight of soil mass by sand replacement method

Experiment No: 06 Sieve Analysis

To determine the particle size distribution by sieve analysis (wet and dry both)

Experiment No: 07 Sedimentation Analysis

To determine the particle size distribution by sedimentation analysis

Experiment No: 08 Atterberg Limits

To determine the Atterberg's limits (plastic limit, liquid limit, shrinkage limit) of a given soil sample

Experiment No: 09 Compaction Test

To perform the standard compaction test on a given soil sample

Experiment No: 10 Direct Shear Test

To determine the direct shear strength of soil on a given soil sample

Experiment No: 11 Triaxial Shear Test

To determine the triaxial shear strength of soil on a given soil sample

Reference Books

1. Gopal Ranjan, and A. S. R. Rao, *Basic and Applied Soil Mechanics*.
2. Alam Singh, *Soil Engineering Theory and Practice*, Vol .I, Fundamentals and General Principles.
3. Ralph B. Peck, Walter E. Henson, and Thomas H. Thornburn, *Foundation Engineering*
4. V. N. S. Murthy, Geotechnical Engineering.
5. Shamsher Prakash and Hari D. Sharma, *Pile Foundation in Engineering Practice*
6. Braja M. Das, *Principles of Geotechnical Engineering*.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:Continuous Lab Evaluation is there to assess the student's performance in the lab

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Each experiment evaluation:

Components	Continuous evaluation
Viva	30%
Practical Work	30%
Practical File Work	40%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	1	1	1	1	1	3	3	3	1	1	3	1
CO2	3	3	1	1	1	1	1	3	3	3	1	1	3	1
CO3	3	3	1	1	1	1	1	3	3	3	1	1	3	1
Average	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**3**	**1**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3155	**ENVIRONMENTAL ENGINEERING LAB**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	• **Knowledge of Mathematics and Chemistry** • **Water Supply and Sanitation**				
Co-requisites	**Environmental Engineering**				

Course Objectives

I. To give detailed understanding of quality analysis study of water and wastewater.

II. To make students aware about the common environmental experiments related to waterand wastewater quality.

III. To impart practical knowledge and understanding about the various environmental qualityparameters determining techniques/instruments.

Course Outcomes

On completion of this course, the students will be able to

CO1. Estimate the pollutant concentration in water and wastewater

CO2. Evaluate different physical parameters of water and correlate with the BIS standards

CO3. Evaluate different chemical parameters of water and correlate with the BIS standards

CO4. Conduct the sound level measurement process

Catalog Description

Qualitative analysis of water and wastewater is an essential aspect of water supply and wastewater engineering domain. In this laboratory course, students will perform number of tests to practically determine the various parameters (such as turbidity, pH etc.) of water and wastewater and will also be able to develop better understanding about the techniques and instruments required for the determination purpose.

List of Experiments

Experiment No: 01 Alkalinity Measurement

To determine the alkalinity of water sample by titrating with standard sulphuric acid.

Experiment No: 02 Chloride Concentration

To determine the chloride content of water sample by titrating with standard silver nitrate solution.

Experiment No: 03 Conductivity Measurement

To determine the conductivity of the given water sample.

Experiment No: 04 pH and Colour Determination

To determine the pH and colour of the given water sample.

Experiment No: 05 Total Hardness

To determine total hardness of the given water sample.

Experiment No: 06 Turbidity Measurement

To determine the turbidity of the given water sample.

Experiment No: 07 Total Dissolved Solids and Total Suspended Solids

To determine total dissolved and suspended solids in the given water sample.

Experiment No: 08 Chemical Oxygen Demand

To determine Chemical Oxygen Demand (COD) in the given water sample.

Experiment No: 09 Biochemical Oxygen Demand

To determine Biochemical Oxygen Demand (BOD) in the given water sample.

Experiment No: 10 Dissolved Oxygen

To determine Dissolved oxygen (DO) in the given water sample.

Experiment No: 11 Sound Level Measurement

To measure the sound level of a location with sound level meter.

Reference Books

1. APHA (2012). *Standard Methods for the Examination of Water and Wastewater*. 22nd Edition, American Public Health Association, American Water Works Association, Water Environment Federation.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Continuous Lab Evaluation is there to assess the student’s performance in the lab.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Course Outcomes (COs), Program Outcomes (POs), and Program Specific Outcomes

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	-	-	2	-	3	1	3	3	3	-	-	2	-
CO 2	3	-	-	3	-	3	1	3	3	3	-	-	2	-
CO 3	3	-	-	3	-	3	1	3	3	3	-	-	2	-
CO 4	2	-	-	2	-	2	1	3	3	3	-	-	1	-
Avg.	**2.5**	**-**	**-**	**2.5**	**-**	**2.75**	**1**	**3**	**3**	**3**	**-**	**-**	**1.75**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code (Version)	Course Name	L	T	P	C
CIVL3083	**Problem solving using MATLAB**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Basic knowledge of computer system and elementary mathematics**				
Co-requisites	**Not Any**				

Course Objectives

I. To understand the basics of MATLAB programming in engineering.
II. To use MATLAB for numerical computation, data analysis, and visualization in engineering.
III. To create and use variables, data structures, and functions in MATLAB for engineering problems.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Write basic MATLAB programs to perform numerical computations and data analysis.

CO2. Create visualizations of data and mathematical functions.

CO3. Apply numerical methods to solve engineering and scientific problems using MATLAB.

CO4. Design and implement MATLAB programs to solve complex problems

Catalog Description

This course is high-level programming language and development environment commonly used in engineering, science, and mathematics fields. It is developed by MathWorks and is widely used for numerical computation, data analysis, and visualization. MATLAB provides a flexible and interactive environment for programming, allowing users to write and run their own algorithms, create visualizations, and perform simulations.

Experiment no. 1	• Introduction to MATLAB interface and basic commands • Variables and data types • Simple calculations and mathematical operations
Experiment no. 2	• Basic plotting commands • Plotting functions and data • Adding titles, labels, and legends
Experiment no. 3	• Logical operators and conditional statements • Loops and iterations • Writing basic programs in MATLAB
Experiment no. 4	• Vectors and matrices in MATLAB • Indexing and slicing matrices • Matrix operations: addition, subtraction, multiplication, and division
Experiment no. 5	• File input/output in MATLAB • Reading and writing data to files • Importing data from spreadsheets
Experiment no. 6	• User-defined functions in MATLAB • Writing functions with inputs and outputs • Calling functions within programs
Experiment no. 7	• Advanced plotting commands: histograms, scatter plots, and subplots • Customizing plot properties • Saving figures in various formats
Experiment no. 8	• Symbolic mathematics in MATLAB • Solving algebraic equations and systems of equations • Differentiation and integration
Experiment no. 9	• Advanced matrix operations: eigenvalues, eigenvectors, and determinants • Solving linear equations and systems of equations • Matrix factorization: LU, QR, and Cholesky decomposition
Experiment no. 10	• Curve fitting and interpolation in MATLAB • Linear and nonlinear regression analysis

	• Interpolating data using splines and polynomials
Experiment no. 11	• Signal processing in MATLAB • Fourier analysis and transforms • Filtering and smoothing time-series data
Experiment no. 12	• Optimization in MATLAB • Linear and nonlinear optimization problems • Using built-in solvers and optimization algorithms

Text Books

1. MATLAB: An Introduction with Applications, 6e. Amos Gilat, Ohio State University. John Wiley & Sons, Inc., 2017.

Reference Books

1. Applied Numerical Methods with MATLAB for Engineers and Scientists, 5th edition. Steven C. Chapra, Tufts University. McGraw-Hill, 2022
2. Moler, C. B. (2004). *Numerical computing with MATLAB*. Society for Industrial and Applied Mathematics.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs):

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	3	-	-	3	-	1	3	3	3	-	-	2	2
CO 2	3	3	-	-	3	-	1	3	3	3	-	-	2	2
CO 3	3	3	-	-	3	-	1	3	3	3	-	-	2	2
CO 4	3	3	-	-	3	-	1	3	3	3	-	-	1	1
Avg.	**3**	**3**	**-**	**-**	**3**	**-**	**1**	**3**	**3**	**3**	**-**	**-**	**1.75**	**1.75**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

UNIVERSITY OF TOMORROW

SEMESTER VI

Course Code	Course Name	L	T	P	C
CIVL3022	**Transportation Engineering**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Surveying, Basic Knowledge of dynamics,** **Knowledge of construction materials**				
Co-requisites	**Not Any**				

Course Objectives

I. To educate the students on the fundamentals of transportation engineering along with the diverse aspects of highway development, planning and materials.

II. To provide knowledge of highway geometric design, road alignment, and traffic systems.

III. To make students familiar with various pavement materials, pavement design and testing methodologies.

IV. To give them detailed insight on the road construction practices and maintenance.

Course Outcomes (CO)

On completion of this course, the students will be able to:

CO1. Understand the concepts of highway development, planning and materials

CO2. Implement geometric design of roads and traffic engineering

CO3. Evaluate highway construction and maintenance

CO4. Design flexible and rigid pavements according to IRC codes

Catalog Description

Transportation Engineering is the application of scientific processes like observation, analysis and deduction to the planning, design, operation, and management of transportation facilities. It is also multidisciplinary and requires knowledge from specialized filed such as psychology, economics, ecology and environment, sociology, management, optimization, graph theory, probability theory, statistics, computer simulation and other areas of civil engineering such as structural and geotechnical engineering.

Course Content

Unit 1: Highway Development and Planning (06 Lecture Hours)

Historical Development, road patterns, master plans, road development plans, PMGSY, engineering surveys, highway projects. Highway Materials and Testing: Subgrade soil, sub base and base course materials, bituminous materials, testing of soil, stone aggregates and bitumen.

Unit 2: Highway Geometric Design (06 Lecture Hours)

Cross section elements, sight distances, horizontal and vertical alignment.

Unit 3: Traffic Engineering (10 Lecture Hours)

Traffic characteristics, road user & vehicular characteristics, traffic studies, accident studies, traffic operations, traffic control devices, intelligent transport systems, pollution due to traffic.

Unit 4: Design of Highway Pavements (09 Lecture Hours)

Flexible pavements and their design, review of old methods, CBR method, IRC: 37-2001, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method (IRC: 58-2002).

Unit 5: Highway Construction (07 Lecture Hours)

Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements.

Unit 6: Highway Maintenance (07 Lecture Hours)

Various type of pavement failures, evaluation and remedial measures.

Text Books:

1. Khanna, S.K. and Justo, C.E.G., "*Highway Engineering*", Nem Chand & Bros.
2. Khanna, S.K. and Justo, C.E.G., "*Highway Material Testing Manual*", Nem Chand & Bros.
3. Kadiyali, L.R., "*Traffic Engineering and Transportation Planning*", Khanna Publishers.

Reference Books:

1. Sharma, S.K., "*Principles and Design of Highway Engineering*", S. Chand & Co.
2. Papacostas, C.S. and Prevedouros, P.D., "*Transportation Engineering and Planning*", Prentice Hall.
3. Jotin Khisty, C. and Kent Lall, B., "*Transportation Engineering – An Introduction*", Prentice Hall.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid-term examination**	**End term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO-1	3	-	-	-	-	3	-	3	-	-	-	-	3	-
CO-2	-	-	3	-	-	-	-	3	3	3	-	-	-	3
CO-3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO-4	-	-	3	-	-	-	-	3	3	3	-	-	-	3
Averag e	**3**		**3**			**3**		**3**	**3**	**3**			**3**	**3**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
CIVL3062	**DESIGN OF CONCRETE STRUCTURE**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Structural Analysis, Concrete Technology, Mechanics of Solids, Mathematics**				
Co-requisites	**--**				

Course Objectives:

I. To study the stress strain behaviour of steel and concrete.

II. To understand the concept of limit state methods.

III. To gain the knowledge of limit state design for flexure, shear, torsion, bond andanchorage.

IV. To understand the behaviour of columns subjected to eccentric load and use ofinteraction diagrams.

V. To study the design of various foundations

Course Outcomes:

On completion of this course, the students will be able to;

CO1. Acquire knowledge of concepts of limit state method.

CO2. Develop knowledge for the design of concrete elements like beams, slabs and columnsusing IS codes 456, SP-16, & SP-34.

CO3. Design the reinforced concrete structures like staircase & footings

CO4. Design RCC structural elements.

Catalog Description:

The purpose of this course is to develop an in-depth knowledge in the area of design of concrete structure with the latest code of practice as per the Indian Standard. On completion of this course student gain good confidence in designing major components of concrete structures like beam, column, foundation, slab; buildings structures, support structures, high rise structures and pre- engineered structures. Design of structural elements will be done as per IS Code 456: 2000 and SP 16 and detailing as per SP 34. Limit state method will be discussed for all the structural elements,

Course Content

Unit 1: Introduction (10 Lecture Hours)

Introduction to various design philosophies of R.C. structures: working stress method, ultimate load method, limit state method, Study of structural properties of concrete.

Unit 2: Design of Beam (8 Lecture Hours)

Design of simply supported and cantilever beams for flexure, shear and bond

Unit 3: Design of Slabs (8 Lecture Hours)

Design of one way and two-way simply supported, cantilever & continuous slabs, Design of stair case

Unit 4: Design of Columns (10 Lecture Hours)

Introduction, strain and stress variation diagrams, axially loaded column withminimum eccentricity requirements, Design of column for axial load, Design of column for axial load, uniaxial & biaxial bending.

Unit 5: Design Footing for Isolated Columns (10 Lecture Hours)

Design of isolated footing

Unit 6: Introduction to Prestressed Concrete (5 Lecture Hours)

Concept of prestressing, types of prestressing, types of losses, analysis of prestressed members

NOTE: All designs in units II, III & IV shall be performed according to limit state designphilosophy.

Text Books

1. Menon D. and Pillai S. (2017), Reinforced concrete design, 3rd edition, McGraw Hill Education
2. Varghese P.C. (2008), Limit state design of concrete, 2nd edition, Prentice Hall India Learning Private Limited.

Reference Books

1. Punmia B. C., Jain A.K. and Jain A.K. (2016). Limit State Design of Reinforced Concrete, Laxmi Publications
2. IS 456:2000, ‘Plain and Reinforced Concrete’ BIS, New Delhi.
3. SP-16(S&T)-1980, 'Design Aids for Reinforced Concrete to IS:456, BIS, New Delhi.

4. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing', BIS, New Delhi.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	-	3	-	1	-	-	-	-	-	-	-	-	-	2
CO 2	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 3	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 4	-	-	3	1	-	-	-	3	-	3	-	-	-	3
Average	**-**	**3**	**3**	**1**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**2.75**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3084	Water Resources Engineering	2	1	0	3
Pre-requisites/Exposure	• Knowledge of Mathematics, • Knowledge of Introduction to Fluid Mechanics				
Co-requisites	Not Any				

Course Objectives (COs)

I. To know the general elements of rainfall and its characteristics from India's point of view.
II. To study precipitation, infiltration, and evapotranspiration.
III. To discuss various parameters of runoff and hydrographs.
IV. To design a canal outlet and associated hydraulic structures.

Course Outcomes

On completion of this course, the students will be able to;

CO1. Implement the concepts of infiltration, runoff, hydrograph, and design flood.

CO2. Analyze the various irrigation systems and soil-water relationships.

CO3. Estimate precipitation and various losses in the hydrological system.

CO4. Design irrigation canal system and modeling of rainfall-runoff system

Catalog Description

Water Resources in one of the most important aspects for a nation. Its study becomes more important for a monsoon-dependent nation like ours. The processes affecting rainfall and runoff and their quantification is one of the most challenging tasks for a water resources engineer. As rainfall is a stochastic process, its prediction is a very complex process indeed. All these challenges are reflected in this course. This course also deals with Evapotranspiration, infiltration, flood forecasting, hydrographs, and irrigation engineering with topics like canal irrigation and river training. Each of the aforementioned components is indispensable for a nation and its careful study and analysis thus should be the duty of a water resource engineer.

Course Content

Unit 1: Hydrological Cycle and Precipitation (10 Lecture Hours)

Hydrologic cycle, water-budget equation, history of hydrology, world water balance, application in engineering, sources of data. Comparison of water budget of India and World. Water stress situation and factor responsible for the same. Water crises in India. Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India. Collection of rainfall, temperature, humidity and other data from various sources and their real time application in predication modeling. Errors and corrections in data sets. Consistency checks for data.

Unit 2: Abstractions from precipitation (08 Lecture Hours)

Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration , interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices. Application of MATLAB in quantification of potential evapotranspiration, development of code and plotting of time series plots.

Unit 3: Runoff and It's estimation (10 Lecture Hours)

Runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows. Introduction to hydrological modelling software like HEC-HMS, HEC-RAS, MIKE-SHE etc. Project based on the any hydrological modelling software and their used in design of hydraulic structure.

Unit 4: Water Withdrawals and Uses (10 Lecture Hours)

Water for energy production, water for agriculture, water for hydroelectric generation;

flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation. Ask students to prepare a water budget of any state of India, so that they can aware about the water resources in local regions. Policies, acts, and laws related to water use in India.

Unit 5: Distribution Systems (10 Lecture Hours) Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods. Application of various soft computing techniques in design and optimization of distribution systems.

Textbooks

1. Subramanya, K. (2008). Engineering hydrology. McGraw-Hill.
2. Subramanya, K. (2010). Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill.
3. Asawa, G. L. (2011). Irrigation Engineering, Wiley Eastern

Reference Books

1. Mays, L. W. (2010). Water resources engineering. John Wiley & Sons.
2. Zimmerman J. D. (2013) Irrigation. John Wiley & Sons.
3. Ojha, C. S. P., Berndtsson, R., & Bhunya, P. (2008). Engineering hydrology.
4. Marriott, M. (2009). *Civil engineering hydraulics*. John Wiley & Sons.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Course Code	Course Name	L	T	P	C
AE	**ADVANCED GEOTECHNICAL ENGINEERING**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Basic knowledge of Engineering Mechanics and Engineering Mathematics**				
Co-requisites	**--**				

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs):

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	3	-	3	-	3	-	-	-	-	-	-	-	2
CO 2	-	3	-	3	-	3	-	-	-	-	-	-	-	2
CO 3	-	3	-	2	-	3	-	-	-	-	-	-	-	2
CO 4	-	-	3	3	-	3	-	3	3	3	-	-	-	2
Avg.	**-**	**3**	**3**	**2.75**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**2**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Objectives

I. To provide students the knowledge of the stability of slopes under different drainage conditions.
II. To enable students to assess the bearing capacity of shallow and deep foundation.
III. To make students familiar with the design principles of retaining structures and coffer dams.
IV. To provide students with the fundamental concept of soil stabilization.
V. To make students comprehend the lateral earth pressure theories.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the importance of soil investigation and mechanism of soil stabilization for any civil engineering construction.

CO2. Estimate bearing capacity and select a suitable shallow foundation for various foundation systems.

CO3. Estimate pile group capacity and select a suitable pile foundation under various soil conditions.

CO4. Comprehend and apply the concept of stability of slope and modes of failure.

CO5. Analyze the response of soil under lateral earth pressure for the design of earthen dam and retaining structures.

Catalog Description

Advanced geotechnical engineering will demonstrate the understanding of the principles and theories behind ground engineering, from soil mechanics to site investigation, and from advanced soil testing to foundation design. This course explores and attempts to address technological challenges in the geotechnical engineering sector including shallow and deep foundations, slope stability, earthen dam and retaining structure and soil stabilization. It aims at enabling students to consciously acquire, analyze and critically evaluate data, then draw valid conclusions from it to graduate as a confident and capable geotechnical engineer. After successful completion of this course students will be able to apply advanced geotechnical engineering concepts in the analysis and design of civil engineering projects.

Course Content

Unit 1: Sub-Surface Exploration (5 Lecture Hours)

Purpose, stages in soil exploration, depth and lateral extent of exploration, guidelines for various types of structures, ground water observations, excavation and boring methods, soil sampling and disturbance, major types of samplers, sounding methods.

Unit 2: Shallow Foundations (7 Lecture Hours)

Ultimate bearing capacity, modes of shear failure, Rankine's analysis Tergazi's theory, Skempton's formula, effect of fluctuation of G.W.T. , effect of eccentricity on bearing capacity, inclined load, I.S Code recommendations, factors affecting bearing capacity. Various causes of settlement of foundation, allowable bearing pressure based on settlement, settlement calculation, allowable settlement according to I.S. Code. Plate load test and its interpretation, bearing capacity from penetration tests, design bearing capacity.

Unit 3: Deep foundation **(7 Lecture Hours)**

Introduction, necessity of pile foundations, classification of piles, load capacity, static analysis, analysis of pile capacity in sands and clays, dynamic analysis, pile load tests, negative skin friction, batter piles, lateral load capacity, uplift capacity of single pile, under-reamed pile, Group action in piles, pile spacing, pile group capacity, stress on lower strata, settlement analysis, design of pile caps, negative skin friction of pile group, uplift resistance of pile group, lateral resistance, batter pile group.

Unit 4: Earth Pressure **(7 Lecture Hours)**

Earth pressure at rest, Rankine's earth pressure theory, Rankine's active & passive states of plastic equilibrium for cohesionless and cohesive soil, Depth of unsupported vertical cut, Coulomb's active & passive earth pressure theory, Culmann's graphical construction, Rebhann's construction.

Unit 5: Stability of slopes **(7 Lecture Hours)**

Causes of failure, factors of safety, stability analysis of slopes-total stress analysis, effective stress analysis, stability of infinite slope, types of failures of finite slopes, analysis of finite slopes-mass procedure, method of slices, effect of pore pressure, Fellinius method to locate center of most critical slip circle, friction circle method, Tayler's stability number.

Unit 6: Earthen dan and retaining structures **(7 Lecture Hours)**

Earth dam foundations, causes of failure and criteria for safe design, control of seepage through the embankment and foundation, sheeting and bracing for deep excavation, movements associated with sheeting and bracing, modes of failure of braced cuts, pressure distribution behind sheeting, Purpose of sheet piles, cantilever sheet piles, depth of embedment in granular soils-rigorous method, simplified procedure, Methods of design, free earth support method in cohesionless and cohesive soils, fixed earth support method in cohesionless soils, Introduction, types of cofferdams.

Unit 7: Soil Stabilization **(5 Lecture Hours)**

Soil improvement, mechanical treatment – dynamic compaction, deep dynamic compaction, vibroflotation, accelerating consolidation – preloading, vertical drains, PVD, use of admixtures, lime stabilization, cement stabilization, lime fly ash stabilization, Bituminous stabilization, chemical stabilization, stone column, grouting, methods of grouting.

Textbooks

1. Ranjan, G. & Rao, A. S. R. (2016). *Basic and Applied Soil Mechanics (Theory & Practice)*, Third Edition, New Age International Publishers.
2. V.N.S. Murthy, *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*, CRC Press.
3. Bowles, J. E. (1998). *Foundation Analysis and Design*, McGRAW-Hill.

Reference books

1. Das, B. M. Principles of Foundation Engineering, Thomson Asia Pvt. Ltd.
2. Kurian, N. P. (2011) Design of foundation Systems Principles and Practices, Narosa.
3. Terzaghi, K., Peck, R. B. and Mesri, G. *Soil Mechanics in Engineering Practice*, John Wiley & Sons Inc.
4. Taylor, J. *Fundamentals of Soil Engineering*, Wiley & Sons.
5. McCarthy, D. F. (2006) *Essentials of Soil Mechanics and Foundations: Basic Geotechnics*, Pearson.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3122	**Transportation Engineering Lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of road construction materials**				
Co-requisites	**--**				

Course Objectives

I. To study the physical and mechanical properties of highway materials viz. aggregates, soil and bitumen.
II. To be able to identify suitability of given highway materials based on the outcomes of the various experiments.
III. To observe the direct association between lab experiments and field applications.
IV. To understand and analyze the pavement characteristics and associated problems.

Course Outcomes

On completion of this course, the students will be able to

CO1. Execute shape tests on aggregates.

CO2. Execute mechanical property tests on aggregates.

CO3. Execute property tests on bitumen.

CO4. Execute CBR test on a given soil sample.

Catalog Description

The material in this course will provide the students with the fundamental background of transportation engineering. Students will acquire the basic knowledge to carry out field investigations and to identify different types of materials used in road construction. It is expected that after completion of this course students will have the knowledge and ability to perform laboratory tests needed to determine the quality of road materials. Students will also be able to conduct experiments as well as analyze and interpret data.

List of Experiments

Experiment No: 01 Aggregate Impact Value

To determine the aggregate impact value of given aggregate as per IS 2386 (Part IV): 1963

Experiment No: 02 Aggregate Crushing Strength

To determine crushing strength of a given aggregate as per IS: 2386 (part – IV): 1963

Experiment No: 03 Los Angeles Abrasion Test

To determine the abrasion value of given aggregate sample by conducting Los Angeles Abrasion Test as per I.S.-2386 (part-IV): 1963

Experiment No: 04 Flakiness, Elongation and Angularity for Aggregate

A. To determine the flakiness Index of a given aggregates sample as per IS 2386 (PART- I): 1963
B. To determine the Elongation Index of the given aggregate sample as per IS 2386 (PART- I): 1963
C. To determine the Angularity Number of the given aggregate sample as per IS 2386 (PART- I): 1963

Experiment No: 05 CBR Value

To determine California Baring Ratio (C.B.R.) value of a given soil sample as per IS 2720 (part XVI): 1987

Experiment No: 06 Specific Gravity of Bitumen

To determine the Specific gravity of given Bituminous material as per IS 1202: 1978

Experiment No: 07 Bitumen Grade

To determine the grade of a given binder as per IS 1203: 1978

Experiment No: 08 Softening Point

To determine the softening point of given paving bitumen as per IS 1205: 1978

Experiment No: 09 Property of Bitumen

To determine the property of a given bituminous material as per IS 1206: 1978

Experiment No: 10 Ductility of Bitumen

To conduct ductility test on given bitumen sample as per IS 1208: 1978

Experiment No: 11 Flash and Fire Point of Bitumen

To determine the flash and fire point of a given bituminous material as per IS 1209: 1978

Experiment No: 12 Optimal Binder Content

To determine optimum binder content of given bituminous mix by Marshall Method of Mix Design

Experiment No: 13 Roughness of Road

To determine the Roughness of road by Merlin Apparatus

Experiment No: 14 Deflection of Road

To determine the deflection of road by Benkelman Beam Apparatus

Text Books

1. Khanna, S.K. and Justo, C.E.G., "*Highway Engineering*", Nem Chand & Bros.
2. Khanna, S.K. and Justo, C.E.G., "*Highway Material Testing Manual*", Nem Chand & Bros.
3. Kadiyali, L.R., "*Traffic Engineering and Transportation Planning*", Khanna Publishers.

Reference Books

1. Sharma, S.K., "*Principles and Design of Highway Engineering*", S. Chand & Co.
2. Papacostas, C.S. and Prevedouros, P.D., "*Transportation Engineering and Planning*", Prentice Hall.
3. Jotin Khisty, C. and Kent Lall, B., "*Transportation Engineering – An Introduction*", Prentice Hall.

Modes of Evaluation: Continuous evaluation during laboratory sessions

Continuous Lab Evaluation is there to assess the students' performance in the lab

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO-1	3	-	-	2	-	-	-	3	3	3	-	-	2	-
CO-2	3	-	-	2	-	-	-	3	3	3	-	-	2	-
CO-3	3	-	-	2	-	-	-	3	3	3	-	-	2	-
CO-4	3	-	-	2	-	-	-	3	3	3	-	-	2	-
Average	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**2**	**-**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3169	**STRUCTURAL DESIGN LAB**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of Structural Analysis, Design of Concrete Structure**				
Co-requisites	**--**				

Course Objectives:

I. To study the staad pro software for design
II. To gain the knowledge of design of beam, column in staad pro.
III. To understand the behaviour of singly storey and multi storey frame analysis.
IV. To study the wind load analysis on bridge truss.
V. To study the design of various foundations.

Course Outcomes:

On completion of this course, the students will be able to;

CO1. Acquire knowledge of design software like staad pro.

CO2. Analyze and design beam and frame components of buildings

CO3. Wind load analysis and design truss & bridge

CO4. Design the reinforced concrete footings using staad pro

Catalog Description:

The Structural Design Laboratory is an essential component of our engineering curriculum, offering students a hands-on experience in the art and science of designing and analyzing structures. The purpose of this course is to develop an in-depth knowledge in the area of design of concrete structure with the latest code of practice as per the Indian Standard. On completion of this course students will be confident enough in designing major components of concrete structures like beam, column, foundation, slab; buildings structures, support structures, high rise structures and pre- engineered structures. Students will also gain proficiency in using industry-standard software for structural analysis and design.

Course Content

Experiment No 1: Introduction to staad pro

Experiment No 2: Analysis of continuous beam

Experiment No 3: Analysis of single storey frame

Experiment No 4: Analysis of multi-storey frame

Experiment No 5: Design of multi-storey frame

Experiment No 6: Analysis of multi-storeyed building

Experiment No 7: Design of multi-storeyed building

Experiment No 8: Wind load analysis on rcc building

Experiment No 9: Analysis and design of steel truss

Experiment No 10: Analysis and design of isolated footing

Experiment No 11: Analysis and design of combined footing

Experiment No 12: Analysis of bridge deck

Text Books

1. Menon D. and Pillai S. (2017), Reinforced concrete design, 3rd edition, McGraw Hill Education
2. Varghese P.C. (2008), Limit state design of concrete, 2nd edition, Prentice Hall India Learning Private Limited.

Reference Books

1. Punmia B. C., Jain A.K. and Jain A.K. (2016). Limit State Design of Reinforced Concrete, Laxmi Publications
2. IS 456:2000, 'Plain and Reinforced Concrete' BIS, New Delhi.
3. SP-16(S&T)-1980, 'Design Aids for Reinforced Concrete to IS:456, BIS, New Delhi.
4. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing', BIS, New Delhi.
5.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	-	-	-	2	3	-	-	-	-	-	-	-	-	3
CO 2	-	-	-	2	3	-	-	-	-	-	-	-	-	3
CO 3	-	-	-	2	3	-	-	-	-	-	-	-	-	3
CO 4	-	-	-	2	3	-	-	-	-	-	-	-	-	3
Average	-	-	-	2	3	-	-	-	-	-	-	-	-	3

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
INDT3105	**INDUSTRIAL VISIT**	**0**	**0**	**0**	**0**
Pre-requisites/Exposure	**Major subjects of Civil engineering**				
Co-requisites	**--**				

Course Objectives

I. To provide students with the exposure of practical application of the theory learnt.

II. To make students bridge the gap between theoretical training and practical learning.

III. To enable students to broaden their outlook with exposure to different workforces of industries.

Course Outcomes

On completion of this course, the students will be able to

CO1. Comprehend the project details of the site being visited.

CO2. Understand the correlation between theory and practical conditions.

CO3. Observe and understand the various on-going construction activities.

CO4. Understand the use of modern equipment and techniques at site.

Catalog Description

There is a lot of difference between the information gets through books /classroom and what one earns by seeing. Industrial visits play a vital role in bridging this gap. Through industrial visit students are opened to the real world, where they also get to know what engineering is and what is their future profession. Also, one of the important objectives of engineering is to prepare graduates to quickly become productive upon entering the workforce. This industrial visit makes students understand the subject to its core and its deeper practical experience in real field situation. Industrial visits give students an opportunity to learn things practically in a real time functional environment through interaction, witnessing the working methods and clarifying the doubts from experienced person.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Evaluation through report, presentation by students & assessment provided by industry.

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	2
CO2	1	-	-	-	-	-	-	-	-	-	-	-	1	2
CO3	1	-	-	-	-	-	-	-	-	-	-	-	1	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	1	2
Average	1	-	-	-	-	-	-	-	-	-	-	-	1	**2**

1=weakly mapped 2= moderately mapped 3=strongly mapped

SEMESTER VII

Course Code	Course Name	L	T	P	C
CIVL4034	**Design of steel structures**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Structural Analysis, Mechanics of Solids, Mathematics**				
Co-requisites	**--**				

Couse Objectives

I. To understand the provisions of IS800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections.
II. To study the behavior and design of compression and tension members using simple and built-up sections.
III. To understand behavior of flexural members and the design laterally restrained and unrestrained beams.
IV. To study the design of bolted and welded connections.

Course Outcomes

On completion of this course, the students will be able to.

CO1. Design of bolt and weld connections by using IS code.

CO2. Design of tension and compression members by using IS code.

CO3. Design of beams and beam columns by using IS code.

CO4. Design of built-up members and roof truss by using IS code.

Catalog Description

Topics covered in this course include behaviour of steel structure and techniques of steel structures, and industrial buildings. The concepts of structure stability and buckling of columns, the stability concepts for beam-columns, buckling analysis of frames using IS code methods, lateral torsional buckling of steel beams, design of crane-supporting steel girders, plate girders, and steel connections. In this course, limit state method is used by using revised code of steel.

Course Content

Unit 1: Introduction **(07 Lecture Hours)**

Steel structures and IS800-2007- Material specifications - Rolled sections – Section classifications - Permissible stresses in tension, compression, bending and shear.

Unit 2: Bolted Connection **(07 Lecture Hours)**

Types of bolts - Resistance of bolted connections under various failure modes – design of beam splice, seated shear connections at the supports.

Unit 3: Welded Connection **(06 Lecture Hours)**

Types - strength of welds - design of fillet and butt welds - shear and moment resistant joints - design and detailing of connections.

Unit 4: Tension Members **(06 Lecture Hours)**

Types- strength of tension members-Design of Tension Members-Angle Section, Channel Section Design-Block Shear Analysis.

Unit 5: Compression Members **(08 Lecture Hours)**

Compression members - Slenderness ratio – Design - Simple and built- up sections - lacings and battens.

Unit 6: Flexural Members **(06 Lecture Hours)**

Rolled sections - built-up beams - Design for strength and serviceability, web crippling, web yielding, bearing stiffeners.

Unit 7: Roof Truss **(08 Lecture Hours)**

Components - Loads - Design of purlins using channel and angle sections, and truss members - End connections at the supports.

Text Books

1. Subramanian N. (2008), Design of Steel Structures, Oxford University Press
2. Duggal S.K. (2019), Limit state design of steel structures, 3rd edition, McGraw-Hill

Reference Books

1. Dayaratnam P. (2003), Design of Steel Structures, S. Chand & Co.
2. Bhavikatti S. S. (2017), Design of Steel Structures: By Limit State Method as Per IS: 800 – 2007, 5th edition, I K International Publishing House Pvt. Ltd
3. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO2	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO3	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO4	-	-	3	1	-	-	-	3	3	3	-	-	-	3
Average.	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**3**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
CIVL4086	**ENGINEERING ECONOMICS, ESTIMATION & COSTING**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic knowledge of Mathematics** • **Basic knowledge of Civil engineering materials & processes**				
Co-requisites	**--**				

Course Objectives

I. To provide knowledge of basic principles of economics and managerial economics and their application in civil engineering.

II. To provide knowledge on methods of estimation of quantities for different civil structures.

III. To impart exposure to the students regarding rate analysis of different civil structures/components and tender preparation for the planned projects.

IV. To provide knowledge on various cost estimates for civil engineering projects.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the concepts of basic economics and its applications in civil engineering.

CO2. Analyze cost estimation and bill of quantities for civil engineering projects.

CO3. Estimate civil quantities for buildings, and other civil engineering works like roadwork, canal, etc.

CO4. Evaluate rate analysis and schedule of rates and apply in civil engineering projects.

Catalog Description

During construction project planning and implementation, there is a need to know the quantities and costs of various items required to determine the direct cost of project which can be utilized for planning & execution. During the life cycle of a project, different parties for various reasons require an estimate. Management decisions are based on these estimates & costing. Sometime methods of construction also need to be reviewed/revised to make project economical. This course will provide concepts of basic economics and its applications in civil engineering. The details of the project cost estimate with quantity and rate analysis, and schedule of rates will be thoroughly explained through this course.

Course Content

Unit 1: Basic Principles and Methodology of Economics (06 Lecture Hours)

Demand/Supply – elasticity – Government Policies and Application, Theory of Firm and Market Structure, Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies, Aggregate demand and Supply (IS/LM), Price Indices (WPI/CPI), Interest rates, Direct and Indirect taxes.

Unit 2: Elements of Business/Managerial Economics and forms of organizations (06 Lecture Hours)

Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows), Business Forecasting – Elementary techniques. Statements – Cash flow, Financial, Case Study Method.

Unit 3: Estimation of Quantities (12 Lecture Hours)

Introduction to the process of estimation; Use of relevant IS specifications for the same, Taking out quantities from the given requirements of the work, Comparison of different alternatives, Bar bending schedules, Estimation of civil quantities in single room building and two roomed building with different sections of walls, foundation, floors and roofs, R.B. and R.C.C. works, building finishes, Estimates of canals, roads etc., Estimating earthwork and foundations, etc.

Unit 4: Specifications and Rate Analysis (13 Lecture Hours)

Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. Purpose, importance, and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity, Rate analysis for various civil works - Earthwork, concrete works, R.C.C. works, reinforced brick work, plastering, painting, finishing (white-washing, distempering).

Unit 5: Cost Estimates (08 Lecture Hours)

Cost estimate for projects of civil engineering – to estimate total cost of building on basis of estimate of quantities and DSR/ schedule of rate. Introduction to Acts pertaining to minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Textbooks

1. Dutta, B.N. (2021). *Estimating and Costing in Civil Engineering (Theory & Practice)*, Twenty Eighth Edition, CBS Publishers.
2. Patil, B.S. & Wool house, S.P. *Building & Engineering Contracts,* Seventh Edition, CRC Press.

Reference books

1. Chakraborty, M. *Estimating, Costing, Specification & Valuation in Civil Engineering.*
2. Steiner, H.M. *Engineering Economic Principles*, McGraw-Hill Inc., US.
3. Typical PWD Rate Analysis documents.
4. Joy, P.K (2000). *Handbook of Construction Management*, Macmillan Publishers India.
5. Relevant *Indian Standard Specifications*.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	-	3	-	-	-	-	-	2	-	-	2	-	1	1
CO2	-	3	-	-	-	-	-	2	-	-	2	-	2	2
CO3	-	3	-	-	-	-	-	2	-	-	2	-	2	3
CO4	-	3	-	-	-	-	-	2	-	-	2	-	2	3
Average	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**1.75**	**2.25**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
CIVL4174	**Engineering economics, estimation & costing lab**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	• **Basic knowledge of Mathematics** • **Building materials and construction**				
Co-requisites	**Engineering economics, estimation and costing theory**				

Course Objectives

I. To make student familiar with advance excel and its application in project management.

II. To expose student with tools of project management.

III. To provide exposure to project planning software and its applications in civil engineering.

IV. To provide hands-on experience to the project management tools used in construction projects.

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop construction project schedule by activities creation & inter relationship in project planning software

CO2. Execute construction project schedule by resource assignment & levelling in project management software

CO3. Analyze construction project updated schedule through project management software

CO4. Evaluate schedule page setup & various reports through project management software

Catalog Description

It has been said knowledge is power. But, unless it is applied, all knowledge is in vain. So, phrase could be read as “Applied knowledge is power”. In today’s modern era, application of theoretical knowledge in field or making it practically use is very important. So, practice at lab is integrated part of academy. In Engineering Economics, Estimation and Costing lab, practice on the usage of tools of project management shall be emphasized. In this lab, theoretical and practical knowledge on project management tools, relevant practical challenges and case studies shall be covered.

List of Experiments

Experiment No. 01-04: Use of Advance Excel in Project Management

1. Introduction to advance excel commands/formulas to use in project planning & management.
2. Draw bar chart for construction of single storey building work or road work.
3. Updation for construction of single storey building work or road work project using bar chart.

Experiment No 05-08: Project Scheduling by Primavera for Construction Project

1. Introduction of primavera & its features, EPS, project creation.
2. Work breakdown structure, activity creation, assign predecessor/successor, duration assignment,
   Find critical path, etc. for construction of single storey building project or road project.
3. Resource assignment & resource levelling for project.
4. Updating the project & generate reports.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Continuous Lab Evaluation is there to assess the students' performance in the lab.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Lab experiment performance, quiz.

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSO)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	2	-	2	2	2	2	2	3	3	3	-	1	2
CO2	-	2	-	2	2	-	-	2	3	3	3	-	2	2
CO3	-	2	-	2	2	-	-	2	3	3	3	-	2	3
CO4	-	2	-	2	2	-	-	2	3	3	3	-	2	3
Average	**-**	**2**	**-**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**-**	**1.75**	**2.5**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
INDT4104	**Industrial internship**	**0**	**0**	**0**	**1**
Pre-requisites/Exposure	**Major subjects of Civil engineering**				
Co-requisites	**--**				

Course Objectives

I. To enhance technical skills of students in real time environment
II. To gain in-depth technical knowledge & analytical skill by real time work and workshop
III. To acquire basics of how to work as a team member to complete given tasks in industrial environment and its work culture.

Course Outcomes

On completion of this course, the students will be able to

CO1. Interpret plans and execute works.

CO2. Estimate quantities at site.

CO3. Design structural elements using software.

CO4. Examine finished works.

Catalog Description

Industries are looking for graduates who are technically sound, creative, and analytical and hire graduates who require zero or minimal training, to meet the organizational / project goal. But, in general, theoretical knowledge of students do not only make them capable to cope up to industrial environment. A quality solution for this gap is industrial exposure and gain practical knowledge through internship. An internship enables students to gain first-hand exposure of working in the real world & allows students to harness the skill, knowledge, and theoretical practice they learnt in university.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Sceme:

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Presentation and Technical Report.

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	3	3	3	-	-	-	2
CO2	-	3	-	-	-	-	-	-	3	3	-	-	2	-
CO3	-	-	3	-	-	-	-	3	3	3	-	-	-	3
CO4	-	3	-	-	-	-	-	2	3	3	-	-	-	2
Average	**2**	**3**	**3**	-	-	-	-	**2.67**	**3**	**3**	-	-	**2**	**2.33**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
PROJ4135	**RESEARCH PROJECT I**	**0**	**0**	**4**	**2**
Pre-requisites/Exposure	Knowledge of civil engineering				
Co-requisites	--				

Course Objectives

I. To allow students to develop better understanding about the literature search and identify a problem statement for the project work.

II. To enable students to develop the ability to apply principles, tools, and techniques to address the problem statement.

III. To make students aware with the practical work-environment related to civil engineering domain.

IV. To make students familiar with the experience of working in a team, prepare project reports and presentation related to the project work.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the real-life / practical problems and the literature review.

CO2. Develop better understanding about research approach and project report preparation.

CO3. Work effectively and efficiently as a team member.

CO4. Address the problem statement and work towards the solution for the same by using the Principles, tools, and techniques.

Catalog Description

Research project I aims at providing students with practical knowledge of the civil engineering domain. In the research project I students will identify through literature search or from industry and address the real-life problem related to civil engineering and will attempt to find the solution for it. In this course students will be divided into groups, and they will collectively work to find the solution to the problem applying appropriate principles, tools, and techniques.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Evaluation will be assessed through detailed report of the project work, presentation, and viva of the students regarding their project work.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Performance and Technical Report

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO2	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO3	-	-	-	3	3	-	-	-	-	3	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**2**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
PROJ4137	**Capstone I**	**0**	**0**	**4**	**2**
Pre-requisites/Exposure	**Knowledge of civil engineering courses**				
Co-requisites	**--**				

Course Objectives

I. To allow students to develop better understanding about the literature search and identify a problem statement for the project work.

II. To enable students to develop the ability to apply principles, tools, and techniques to address the problem statement.

III. To make students aware with the practical work-environment related to civil engineering domain.

IV. To make students familiar with the experience of working in a team, prepare project reports and presentation related to the project work.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the real-life / practical problems and the literature review.

CO2. Develop better understanding about research approach and project report preparation.

CO3. Work effectively and efficiently as a team member.

CO4. Address the problem statement and work towards the solution for the same by using, Principles, tools, and techniques.

Catalog Description

The “Capstone Project I” provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the profession. The course teaches the research and development (R&D) cycle, beginning with the conceptual planning and review phases of an engineering project. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students. The overall objective of this course is to give students a simulated design experience that is as close to real life as is practicable in a university setting.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination

Examination Scheme:

Evaluation will be assessed through detailed report of the project work, presentation, and viva of the students regarding their project work.

Components	Continuous evaluation	Format
Weightage (%)	100%	Viva, Performance and Technical Report

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO2	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO3	-	-	-	3	3	-	-	-	-	3	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**2**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

SEMESTER VIII

Course Code	Course Name	L	T	P	C
CIVL4087	**Building Information Modelling**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Building materials, Engineering principle, Construction technology**				
Co-requisites					

Course Objectives

I. To introduce students to the core principles and concepts of Building Information Modelling

II. To develop students' proficiency in using BIM software tools for creating and managing digital building models

III. To train students in using BIM for design coordination and clash detection

IV. To introduce the use of BIM in construction-related tasks, such as quantity take off and cost estimation.

V. To integrate BIM into project management processes

VI. To explore the role of BIM in sustainable building practices

Course Outcomes

On completion of this course, the students will be able to;

CO 1. Students will be able to define and explain fundamental BIM concepts and terminologies.

CO 2. Students will be able to use BIM software to create, edit, and manipulate 3D models and identify and resolve conflicts in BIM models during the design phase.

CO 3. Students will be able to perform quantity take off and estimate costs using BIM.

CO 4. Students will be able to use BIM for project planning, communication, and documentation and also will be able to perform energy analysis and simulation using BIM tools to support sustainable design decisions.

Catalog Description

This course introduces students to the revolutionary field of Building Information Modelling (BIM), a transformative technology and methodology in the architecture, engineering, and construction (AEC) industry. BIM is more than just software; it's a collaborative approach to designing, constructing, and managing buildings and infrastructure projects. In this course, students will delve into the core principles, concepts, and practical applications of BIM, equipping them with the skills and knowledge necessary to excel in the modern AEC landscape.

Course Content

Unit1: Introduction to Building Information Modelling (06 Lecture Hours)

Definition and history of BIM, BIM concepts and terminology, Benefits and challenges of BIM in the AEC industry

Unit 2: BIM Software Tools (10 Lecture Hours)

Overview of popular BIM software (e.g., Revit, Archi CAD, AutoCAD), Hands-on exercises with BIM software, Creating and editing BIM models, BIM file formats (IFC, Cobie).

Unit 3: BIM for design and construction (13 Lecture Hours)

BIM in architectural design, Building components and families, Parametric modeling, Design coordination and clash detection, Quantity takeoff and cost estimation, 4D BIM (time scheduling), Construction sequencing and logistics, Quality control and safety in construction

Unit 4: BIM for project management and sustainability (13 Lecture Hours)

BIM in project planning, Collaboration and information sharing, Risk management with BIM, Project documentation and reporting, Sustainable design and BIM, Energy analysis and simulation, BIM and green building certifications, Case studies in sustainable BIM projects

Unit 5: Ethical and Legal Aspects of BIM (05 Lecture Hours)

Intellectual property and data ownership, BIM standards and regulations, Ethical considerations in BIM usage, Industry best practices and professional responsibility.

Text book

1. Dana K.S. (2009) Building Information Modeling: A Strategic Implementation Guide", 1st edition, Wiley.
2. Kymmell W. (2008). Building information modelling. McGraw-Hill Professional CAD Bhatt A. (2020) AutoCAD 2020 Beginners Guide, CADFOLKS.

Reference Book

1. Sacks R., Eastman C., Lee G. and Teicholz P. (2018). BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, 3rd edition, Wiley
2. Sanchez A. Hampson K. and Vaux S. (2017). Delivering Value with BIM: A whole-of-life approach, 1st edition, Routledge
3. Sagar L (2022) Autocad 2022 Training Guide: CAD Language, BPB Publication

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Scheme

Relationship between the Course Outcomes (COs) and Program Outcomes (POs) &Program Specific Outcomes (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Average	-	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
PROJ4136	**Research project ii**	**0**	**0**	**16**	**8**
Pre-requisites/Exposure	**Knowledge of civil engineering**				
Co-requisites	**--**				

Course Objectives

I. To allow students to develop better understanding about the literature search and identify a problem statement for the project work.

II. To enable students to develop the ability to apply principles, tools, and techniques to solve the problem identified.

III. To make students aware with the practical work-environment related to civil engineering domain.

IV. To make students familiar with the experience of working in a team, prepare project reports and presentation related to the project work.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the real-life / practical problems and the literature review.

CO2. Develop better understanding about research approach and project report preparation.

CO3. Work effectively and efficiently as a team member.

CO4. Solve the problem statement by investigating it experimentally and/or analytically and analysing the results using various principles, tools, and techniques.

Catalog Description

Research project I aims at providing students with practical knowledge of the civil engineering domain. In the research project I students will identify through literature search or from industry and address the real-life problem related to civil engineering and will attempt to find the solution for it. In this course students will be divided into groups, and they will collectively work to find the solution to the problem applying appropriate principles, tools, and techniques.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Evaluation will be assessed through detailed report of the project work, presentation, and viva of the students regarding their project work.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Performance and Technical Report

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO2	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO3	-	-	-	3	3	-	-	-	-	3	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**2**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
PROJ4138	**Capstone project ii**	**0**	**0**	**4**	**2**
Pre-requisites/Exposure	**Knowledge of civil engineering couses**				
Co-requisites	**--**				

Course Objectives

I. To allow students to develop better understanding about the literature search and identify a problem statement for the project work.

II. To enable students to develop the ability to apply principles, tools, and techniques to address the problem statement.

III. To make students aware with the practical work-environment related to civil engineering domain.

IV. To make students familiar with the experience of working in a team, prepare project reports and presentation related to the project work.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the real-life / practical problems and the literature review.

CO2. Develop better understanding about research approach and project report preparation.

CO3. Work effectively and efficiently as a team member.

CO4. Address the problem statement and work towards the solution for the same by using the
Principles, tools, and techniques.

Catalog Description

The "Capstone Project II" provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the profession. The course teaches the research and development (R&D) cycle, beginning with the conceptual planning and review phases of an engineering project. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students. The overall objective of this course is to give students a simulated design experience that is as close to real life as is practicable in a university setting. The "Capstone Project II" is the continuation of the previous semester course "Capstone Project I". So, in this semester, students will execute the detailed plan prepared in the preceding semester.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Evaluation will be assessed through detailed report of the project work, presentation, and viva of the students regarding their project work.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Performance and Technical Report

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO2	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO3	-	-	-	3	3	-	-	-	-	3	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**2**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Specialization in Tansporatation Engineering

Course Code	Course Name	L	T	P	C
CIVL3080P	**Traffic Engineering and Transportation Planning**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic understanding of transportation engineering** • **Basic knowledge of mathematics**				
Co-requisites	**None**				

Course Objectives:

I. To provide an overall knowledge of the traffic components and assess the traffic characteristics and related problems.

II. To introduce transportation systems analysis of a multimodal integrated urban and regional transport system.

III. To give knowledge of traffic flow components and explain their interaction with road infrastructure.

IV. To familiarize the students with the current urban transport problems and policies in India.

Course Outcomes (CO):

On completion of this course, the students will be able to:

CO1. Understand the traffic characteristics and urban planning approaches.

CO2. Identify the influence of traffic stream components on traffic flow.

CO3. Design traffic and road facilities, and intersection control measures for smooth traffic movement.

CO4. Estimate travel demand generation at aggregate and disaggregate levels.

Catalog Description

Traffic Engineering and planning is the application of scientific processes including observation, analysis and deduction to the planning, design, operation, and management of transportation facilities. It is a multidisciplinary course which requires knowledge from specialized filed such as psychology, economics, ecology and environment, sociology, management, optimization, graph theory, probability theory, statistics, computer simulation and other areas of civil engineering such as structural and geotechnical engineering.

Course Content

Unit I: Traffic Engineering (08 Lecture Hours)

Fundamental of traffic flow, basic components of traffic flow, road user, vehicle, environment and their characteristics, speed –volume –density relationship, homogenous and heterogonous
traffic flow, PCU concept, vehicle operating cost.

Unit II: Traffic Management and Control (18 Lecture Hours)

Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies. Traffic regulation and control - Signs and markings - Traffic System Management - Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram – Signal co-ordination. Grade separated intersections - Geometric elements for divided and access-controlled highways and expressways – Road furniture - Street lighting. Traffic Safety – Principles and Practices – Road Safety Audit.

Unit III: Urban Transport Planning Process (13 Lecture Hours)

Status of transportation in India. Objectives and scope of transport planning. Urban, regional and national transport planning. Transport planning process, various stages. Land use and traffic. Transportation Survey: Definition of study area. Zoning. Types of surveys. O-D surveys, socio-economic surveys, Inventories of existing transport facilities, land use and economic activities.

Unit IV: Metropolitan and Regional Transport Planning (06 Lecture Hours)

Problems of Urban and Rural Transport; Introduction to Regional Planning & Transportation: Significance of Garmin-Seva, M/B-RTS, Regional Setting; Location & Connectivity: Intra & Inter-Connectivity.

Text Books:

1. L. R. Kadiyali, Traffic Engineering And Transport Planning, Khanna Publishers, Delhi.
2. S. K. Khanna & C.E.G. Justo, Highway Engineering, Nem Chand Bros., Roorkee.
3. Bruton, M. J., Introduction to Transport Planning, Hutchinson Technical Education, London.

Reference Books:

1. Chandra, S. and Agarwal, M. M., "Railway Engineering", Oxford.
2. Arora, S. P. and Saxena, S. C., "A Text Book of Railway Engineering", Dhanpat Rai.
3. Mundrey, J. S., "Railway Track Engineering", Tata Mcgraw Hill.
4. Saxena, S.C., "Airport Engineering – Planning and Design", CBS Publishers.
5. Rangwala, Airport Engineering, Charotar Publications
6. Khanna, S.K., Arora, M.G. and Jain, S. S., "Airport Planning & Design", Nem Chand and Bros.
7. Horonjeff, Robert and McKelvey, Francis X., "Planning & Design of Airports', 4th Ed.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO-1	2	-	-	-	-	3	-	-	-	-	-	-	-	1
CO-2	-	2	-	-	-	3	-	-	-	-	-	-	-	2
CO-3	2	-	-	-	-	3	-	-	-	-	-	-	-	1
CO-4	2	-	-	-	-	-	-	-	-	-	-	-	-	2
Average	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

1=weakly mapped **2= moderately mapped** **3=strongly mapped**

Course Code	Course Name	L	T	P	C
SPL	**Pavement Design and Performance**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic understanding of transportation engineering** • **Basic knowledge of mathematics**				
Co-requisites	**None**				

Course Objectives:

I. To explain the structural and functional design of pavement structures with an emphasis on highways.
II. To familiarize students with pavement design considerations, include climatic conditions, traffic loadings, life cycle design economics, and rehabilitation.
III. To inculcate knowledge on the detailed design procedures for rigid and flexible pavements.
IV. To give exposure on various pavement performance management system approaches.

Course Outcomes (CO):

On completion of this course the students will be able to:

CO 1. Understand the various components influencing design and performance of pavements.

CO 2. Understand the design procedures involved in the flexible pavement design.

CO 3. Understand the design procedures involved in the rigid pavement design.

CO 4. Assess the various approaches used in pavement performance management.

Catalog Description

This course will enable students to learn about all aspects of pavement system design, including the testing of soil/base substructure, pavement material mix design, and pavement thickness design for both flexible and rigid pavements. Through detailed examples, students will understand how certain materials can optimize the thickness selected for pavement layers based on the most commonly used analysis and design procedures, ultimately giving you the ability to predict their performance.

Course Content

Unit I: Introduction to pavement design (8 Lecture Hours)
Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements, functions of pavement components.

Unit II: Components of pavement design (8 Lecture Hours)
Pavement Design Factors: Design wheel load, strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and equivalent wheel loads, aircraft loading, gear configuration and tyre pressure. Drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures.

Unit III: Design of flexible pavements (10 Lecture Hours)
Flexible Pavement Design: Empirical, semi-empirical and theoretical approaches, design of highway and airport pavements by IRC, AASHTO Methods, applications of pavement design software.

Unit IV: Design of rigid pavements (10 Lecture Hours)
Rigid Pavement Design: Types of joints and their functions, joint spacing; design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints. Design of continuously reinforced concrete pavements. Reliability; Use of software for rigid pavement design.

Unit V: Pavement performance management (9 Lecture Hours)
Pavement Management: Pavement failures, maintenance of highways, structural and functional condition evaluation of pavements, pavement management system.

Text Books:

1. Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons.

2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.

3. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group).

Reference Books:

1. W. Ronald Hudson, Ralph Haas and Zeniswki, Modern Pavement Management, Mc Graw Hill and Co.

2. Highway Engineering- S.K. Khanna & C.E.G. Justo. Nem Chand & Bros.

3. IRC: 37-2012 "Guidelines for Design of Flexible Pavements

4. IRC: 58-2011 "Guidelines for Design of Rigid Pavements

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme;

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO-1	2	-	-	-	-	2	-	-	-	-	-	-	2	2
CO-2	2	2	-	-	-	2	-	-	-	-	-	-	2	2
CO-3	2	3	-	-	-	2	-	-	-	-	-	-	2	2
CO-4	2	-	-	-	-	2	-	-	-	-	-	-	2	2
Averag e	**2**	**2.5**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1=weakly mapped 2= moderately mapped 3= strongly mapped

Course Code	Course Name	L	T	P	C
CIVL3086P	**Railway and Tunnel Engineering**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic understanding of transportation engineering** • **Basic knowledge of mathematics**				
Co-requisites	**None**				

Course Objectives:

I. To introduce the fundamentals and advances in the field of railway engineering.
II. To familiarize students with the track geometry and functional requirements in railway operations.
III. To inculcate knowledge on various tunnelling and excavation approaches.
IV. To give exposure on safety control devices and applications in railway engineering.

Course Outcomes (CO):

On completion of this course the students will be able to:

CO 1. Understand the railway engineering components and functional operations.

CO 2. Interpret and analyse the track alignment and geometry.

CO 3. Understand track operations and controls related to railway safety.

CO 4. Assess the various tunnelling approaches used in railway tunnel excavations.

Catalog Description

Railway is important mode of surface transportation. Railways are economic for the long-distance transportation of passengers and freight on the land. India has the second largest Railway network in the world. Tunnels are essential to provide safe and economic passage over/through obstructions to railway or road corridor. This subject provides necessary knowledge of railway track, its component parts, geometric design, points and crossings, stations, and yards, signalling and control system, maintenance, modern development and safety in railways. It also provides knowledge on tunnel engineering, tunnel alignment, tunnel construction in different types of grounds, tunnel - ventilation, lining, safety, and lighting.

Course Contant

Unit I: Railway Engineering Components (10 Lecture Hours)

Historical development and set-up of Indian Railways; Rail Gauges; Permanent way – functions, requirements, sections; Electrified tracks; Locomotives, Wheel and Axle arrangement; Coning of wheels; Components – Rail, Sleeper and Ballast, and their functional requirements.

Unit II: Joints and Fastenings (6 Lecture Hours)

Types of joints; Welded rails – short and long, continuous; Rail to Rail and Rail to Sleeper fastenings, Elastic fastenings; Induced effects – Creep, wear.

Unit III: Track Geometry Turnouts and Crossings (10 Lecture Hours)

Track alignment, Horizontal alignment – curves, superelevation, cant, safe speed, transition curves, widening of gauge, track clearances; Vertical alignment – gradients; Points and Crossings – terminologies, types, turnouts, design of turnouts and crossings.

Unit IV: Railway Safety (6 Lecture Hours)

Signals – Classification, functions; Train operation control systems – Absolute, Automatic Block system, Centralized control system, ATS; Interlocking of tracks – Principle, types; Railway Certification process.

Unit V: Tunneling and excavation (13 Lecture Hours)

Types and purpose of tunnels; factors affecting choice of excavation technique; Methods: soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Text Books

1. Chandra, Satish and Agarwal, M. M., “Railway Engineering”, Oxford University Press, New Delhi, 2nd edition, 2013.
2. Arora, S. P. and Saxena, S. C, “A Textbook on Railway Engineering”, Dhanpat Rai Publications (P) Ltd., New Delhi, 7th edition, 2006.
3. Harbour dock and tunnel engineering – R Srinivasan, 28^{th} edition, 2016.

Reference Books

1. Mundrey, J. S., "Railway Track Engineering", Tata McGraw-Hill Publishing Company, New Delhi, 2017.
2. M M Agarwal, "Railway Works Engineering", Prabha & Co. Delhi, 2007.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Internal assessment	Mid-Semester Examination (MSE)	End-Semester Examination (ESE)	Total
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO-1	2	-	-	-	-	2	-	-	-	-	-	-	1	2
CO-2	2	3	-	-	-	2	-	-	-	-	-	-	2	2
CO-3	2	3	-	-	-	2	-	-	-	-	-	-	2	2
CO-4	2	-	-	-	-	-	-	-	-	-	-	-	1	2
Average	**2**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**	**2**

1=weakly mapped **2= moderately mapped** **3= strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4075P	**Metro Rail Transportation Design & Construction**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic understanding of transportation engineering** • **Basic knowledge of mathematics**				
Co-requisites	**None**				

Course Objectives:

I. To introduce the fundamentals and advances in metro rail planning around the world.

II. To familiarize students with metro rail design, financial planning, and implementation of metro rail projects.

III. To inculcate knowledge on the construction technologies implemented in Metro rail projects.

IV. To give exposure on the operations, maintenance, and control systems of metro rails.

Course Outcomes (CO):

On completion of this course the students will be able to:

CO1. Understand the requirement of metro for a city.

CO2. Assess the planning, routing, and financing involved in a metro project.

CO3. Remember the implementation of construction technologies used in metro rail projects.

CO4. Analyze the metro rail operations, maintenance, and control systems.

Catalog Description

The growing cities in a densely populated urban region, in any developing nation, require safe and efficient public transportation. Elevated light rails have been a popular choice in India since past two decades. The Metro Projects of all major cities in India are a hallmark of growing economy. It is imperative to teach civil engineers the basics involved for planning and financing a metro project. The various construction methodologies available and how to analyse and select a suitable one. The various inter-disciplinary components involved in a metro project and the basic concepts of their working. The student shall be able to grasp these concepts and apply them in conjunction with their knowledge of civil engineering to have a better understanding of a metro project.

Course Content

Unit 1: Introduction to metro rail projects (6 Lecture Hours)

Need of metro rail projects, Overview of different metro rail projects implemented in India, proposed and ongoing metro rail projects in India, global aspects of metro rail construction, factors influencing the need of metro rail construction.

Unit 2: Planning, routing, and financial aspects of metro rail projects

(8 Lecture Hours)

Different steps/approaches in metro rail planning, routing parameters, sustainability aspects in planning and routing, management aspects in planning and routing, financing of metro rail projects, field implementation.

Unit 3: Tunnelling and excavation (12 Lecture Hours)

Types and purpose of tunnels; factors affecting choice of excavation technique; Methods: soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Unit 4: Construction technologies implemented in Metro projects.

(12 Lecture Hours)

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers, and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management.

Unit 5: Operations and control (7 Lecture Hours)

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors. Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators. OHE, Traction Power; Substations-TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Text Books:

1. Chandra, S. and Agarwal, M. M. “Railway Engineering”, Oxford Publishers, 2013.
2. Venkataramaiah, C. “Transportation Engineering: Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels”, Orient Blackswan Private Limited, 2018.
3. Saxena, S. C., and Arora, S. P. “A Text Book Of Railway Engineering” Dhanpat Rai Publications, 2010.

Reference Books:

1. Srinivasan, R. “Harbour Dock and Tunnel Engineering”, Charotar Publications, 2016.
2. Ramachandran, M. “Metro Rail Projects in India”, Oxford Publishers, 2011.
3. Agarwal, M. M., Chandra, S. and Miglani, K. K. “Metro rail in India for urban mobility”, 2021.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	Internal	Mid-term examination	End term examination	Total
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	2	1	-	-	-	1	2	-	-	-	2	-	2	1
CO 2	1	2	-	-	-	1	1	-	-	-	1	-	1	1
CO 3	2	2	-	-	-	1	2	-	-	-	2	-	2	2
CO 4	2	2	-	-	-	1	2	-	-	-	2	-	3	2
Avg.	**1.7**	**1.7**	-	-	-	**1**	**1.7**	-	-	-	**1.7**	-	**2**	**1.5**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3087P	**Computer Simulation in Transportation Engineering**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic understanding of transportation engineering** • **Basic knowledge of mathematics** • **Basic analytical and programming skills**				
Co-requisites	**None**				

Course Objectives

I. To provide understanding on the functioning and operation of Intelligent Transportation Systems (ITS).
II. To inculcate knowledge on various simulation approaches used in ITS.
III. To give exposure on automated highway systems and traffic simulators used in transportation management.
IV. To enable students to apply simulation techniques on field data.

Course Outcomes (CO)

On completion of this course the students will be able to:

CO1. Understand and apply the basic principles of simulation used in Intelligent Transportation Systems (ITS).

CO2. Interpret and analyse the telecommunication-based stochastic approaches used in ITS.

CO3. Collect and use field data to calibrate and validate transport simulators.

CO4. Deploy simulations for scenario analysis, prediction, and optimization.

Catalog Description

This course focuses on the fundamentals behind some of the most popular computer simulation approaches used in the planning, design, operations, and management of transportation systems. Topics include signal optimization and evaluation at various levels of spatiotemporal scales, forecasting of traffic flows and passenger volumes for both long-term and short-term planning, simulation of traffic and transit systems, design and evaluation of Intelligent Transportation Systems.

Course Content

Unit I: Intelligent Transportation Systems (10 Lecture Hours)

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

Unit II: Telecommunication and ITS operations (11 Lecture Hours)

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Roadside communication – Vehicle Positioning System. ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

Unit III: Automated Highway Systems (12 Lecture Hours)

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries. ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

Unit IV: Advanced modelling and simulation techniques (12 Lecture Hours)

Introduction to systems approach - Typical transportation systems - Mathematical models. Fundamentals of simulation - Monte Carlo method - Analog and digital simulation - Continuous and discrete models - Simulation languages. Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions, Queue discipline – Manual simulation of simple queuing system Creating and moving transactions - Queues and facilities - Event scheduling - Internal logic of GPSS processor - Program control statements.

Text Books

1. Gordon, G., System Simulation, Prentice-Hall of India, 1992.
2. Rajaraman, V., Computer Oriented Numerical Methods, Prentice – Hall of India, 1995.
3. Traffic Engineering and Transport Planning, L.R. Kadiyali, Khanna Publisher, 2019.
4. Papacostas, C.S., Fundamentals of Transportation System Analysis, Prentice-Hall of India Private Limited, New Delhi. 2010.

Reference Books

1. ITS Handbook 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
2. GPSS/PC, User Manual, Minuteman Software, USA, 1985.
3. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	-	-	-	-	3	-	-	-	-	-	-	-	2
CO2	2	2	-	-	-	3	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	3	-	-	-	-	-	-	1	2
CO4	2	-	-	-	-	-	-	-	-	-	-	-	1	2
Average	**2**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4076P	Intelligent Transportation Systems	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• Basic understanding of transportation engineering • Basic knowledge of mathematics				
Co-requisites	None				

Course Objectives:

i. To provide an overall knowledge of the advanced intelligence/computational approaches in transportation systems.
ii. To describe the role of ITS and its benefits and challenges in improving the transportation experiences of users and system managers.
iii. To give knowledge of cutting-edge ITS applications and visualize the evolution of transportation soon.
iv. Understand the systems engineering application in ITS and ITS architecture.

Course Outcomes (CO):

On completion of this course, the students will be able to:

CO1. Understand the historical background and evolution of intelligent transportation systems (ITS).
CO2. Identify the benefits and challenges in improving the transportation experiences of users and system managers.
CO3. Assess technological requirements for ITS and its applications in various transportation modes to improve their safety and efficiency.
CO4. Develop intelligent solutions to transportation issues and highway management.

Catalog Description

This course presents the fundamental concepts of Intelligent Transportation Systems (ITS) to students with interest in engineering, transportation systems, communication systems, vehicle technologies, transportation planning, transportation policy, and urban planning. ITS refers to information and communication technologies, as applied to transportation infrastructure and vehicles, that improve transportation safety, productivity, environment, and travel reliability. With accessibility of mobile devices, ITS applications, such as trip planners, help travellers make informed travel choices. ITS is an international program intended to improve the effectiveness and efficiency of surface transportation systems through advanced technologies in information systems, communications, and sensors. In addition to technology discussions, this course will include topics related to policy, economics, security, as well as urban and rural planning.

Course Content

Unit I: Introduction to ITS **08 lecture hours**

Introduction to ITS, including where ITS fits; roles and responsibilities, Advanced Traveller Information Systems (ATIS), including functionality; business models; field trip to Smart Route Systems.

Unit II: Network operations **10 lecture hours**

Advanced Transportation Management Systems (ATMS), including network operations; incident detection; congestion pricing, tolling, HOT lanes, example deployments.

Unit III: Transport management applications **12 lecture hours**

Fleet-oriented ITS services, including Advanced Public Transportation Systems (APTS); BRT; Commercial Vehicle Operations (CVO); Intermodal Freight, including International Operations and Supply Chains; ITS and Technology, including automated highway systems (AHS); sensors, electronic toll collection (ETC); dedicated short range communication, and standards.

Unit IV: Deployment and challenges **08 lecture hours**

Regionally-scaled ITS deployment, including regional architecture; organizational and institutional issues; standards; developed vs. developing countries; ITS and strategic regional transportation planning; Integrating infrastructure and operations planning.

Unit V: ITS-based safety and emerging issues **07 lecture hours**

Critical ITS Issues, including (as time permits) ITS and security; safety; human factors; privacy; sustainability; funding (as contrasted with conventional infrastructure); technology deployment/R &D/policy; other institutional issues. Regional ITS planning and architecture presentation; the future of ITS; International ITS Programs Case Studies: applications in bus transport, metro and highways; Emerging Issues.

Text Books

1. Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principles and Architectures, CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004.

Reference Books

1. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO-1	2	-	-	-	-	3	-	-	-	-	-	-	-	1
CO-2	-	2	-	-	-	3	-	-	-	-	-	-	-	2
CO-3	2	-	-	-	-	2	-	-	-	-	-	-	-	1
CO-4	2	2	-	-	-	2	-	-	-	-	-	-	-	2
Average	**2**	**2**	**-**	**-**	**-**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

1=weakly mapped 2= moderately mapped 3= strongly mapped

Course Code	Course Name	L	T	P	C
CIVL XXXX	Optimization techniques for transportation engineering	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• Basic understanding of transportation engineering • Basic knowledge of mathematics and programming				
Co-requisites	None				

Course Objectives:

i. To provide an in-depth knowledge of the classical optimization techniques implemented in transportation engineering.
ii. To describe the role of optimization and its benefits in solving real-world transportation problems.
iii. To give knowledge of advanced optimization techniques and their applications in the field of transportation engineering.
iv. To apply optimization models and solve transportation problems faced in real traffic.

Course Outcomes (CO):

On completion of this course, the students will be able to:

CO1. Understand the historical background and evolution of optimization techniques.
CO2. Understand the working of classical and advanced optimization models implemented to solve transportation engineering problems.
CO3. Assess the real-world transportation problems and apply the optimization techniques to solve them.
CO4. Develop intelligent solutions involving optimization models to transportation issues and traffic management.

Catalog Description

This course will expose you to the basic concepts of formulating and solving optimization problems, particularly in transportation engineering. Transit and roadway network design, vehicle routing and logistics, and resource allocation rely heavily on optimization theories and methods. By the end of this course, you will have the knowledge to address these questions and many others which arise in civil engineering. You will be able to formulate a variety of engineering problems as optimization models, and have the practical knowledge needed to solve them. Furthermore, you will have a conceptual understanding of optimization models which allows you to understand and critically evaluate model results which others may present to you. This course will require you to both understand the basic and advanced concepts of optimization, and to apply them in solving real-world transportation problems.

Course Content

Unit I: Introduction to Optimization 08 lecture hours

Concept of optimization, classification of optimization, problems and challenges.

Unit II: Linear Programming 12 lecture hours

Examples of linear programming problems, formulation simplex methods variable with upper bounds, principle of duality, dual simplex method, sensitivity analysis, revised simplex procedure, solution of the transportation problems, network minimization, shortest route problem, maximal two problem, L.P. representationn of networks

Unit III: Queuing Theory 10 lecture hours

Queuing Model, poison and exponential distributions, queues with combined arrivals and departures-random and series queues.

Unit IV: Unconstrained Optimization 08 lecture hours

Maximization and minimization of convex functions, necessary and sufficient conditions for local minima, speed and order of convergence, univariate search, steepest and descent methods- metcher reeves method, conjugate gradient method.

Unit V: Constrained Optimization 07 lecture hours

Necessary and sufficient condition, equality constraints, inequality constraints, kuhu – tucker conditions, gradient projection method, penalty function methods, cutting plane methods of sibel directions.

Text Books

1. Bertsimas, D. and J. N. Tsitsiklis. (1997) Introduction to Linear Optimization. Athena Scientific, Cambridge, MA.
2. Ahuja, R., T. Magnanti, and J. Orlin. (1993) Network Flows. Prentice-Hall, Englewood, NJ.
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004.

Reference Books

1. S.S. Rao, Engineering Optimization: Theory and Practice, New Age International Ltd., New Delhi, 2000.
2. H.A. Taha, Operations Research: An Introduction, 5th Edition, Macmillan, New York, 1992.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO-1	3	-	2	-	-	2	-	-	-	-	-	-	-	1
CO-2	-	2	-	-	-	2	-	-	-	-	-	-	-	2
CO-3	3	-	2	-	-	2	-	-	-	-	-	-	-	1
CO-4	3	2	-	-	-	2	-	-	-	-	-	-	-	2
Average	**3**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

1=weakly mapped 2= moderately mapped 3= strongly mapped

Specialization in Environmental Engineering

Course code	Course Name	L	T	P	C
SPL	**Green Building and Energy Efficiency**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Environmental Science, Environmental Economics, Construction Technology, Engineering Principle**				
Co-requisites	**--**				

Course Objectives

I. To understand sustainable construction principles

II. To evaluate building materials for sustainability.

III. To design energy-efficient building systems

IV. To enhance indoor environmental quality.

V. To analyse economic aspects of sustainable construction

VI. To evaluate case studies and real-world applications

Course Outcomes

On completion of this course, the students will be able to.

CO1. Explain the fundamental principles and concepts of sustainable construction, including Environmental, social, and economic considerations.

CO2. Assess the environmental impact of various building materials and construction methods using life Cycle analysis.

CO3. Develop energy-efficient building designs that incorporate passive and active strategies to reduce Energy consumption.

CO4. Conduct cost-benefit analyses to evaluate the financial viability and long-term benefits of Sustainable building practices.

Catalog Description

The course offers a comprehensive exploration of sustainable building practices, focusing on reducing environmental impact and enhancing energy efficiency in construction. Students will delve into the principles of green building design, sustainable materials, renewable energy systems, and energy-efficient technologies. Through case studies and hands-on projects, they will learn to evaluate and implement sustainable building strategies, including LEED (Leadership in Energy and Environmental Design) principles. Through this course the students will be equipped with the knowledge and skills to create eco-friendly and energy-efficient buildings that align with modern environmental standards.

Course Content

Unit 1: Introduction to green building (06 Lecture Hours)

Definition and principles of green building, Historical context and evolution, Environmental and social benefits, green building rating systems (e.g., LEED, BREEAM)

Unit 2: Sustainable Materials and Resources (10 Lecture Hours)

Sustainable building materials and products, Life cycle assessment (LCA), Sustainable sourcing and procurement, Recycling, and waste reduction in construction

Unit 3: Energy Efficiency in Building Design (10 Lecture Hours)

Building envelope design for energy efficiency, Efficient lighting and HVAC systems, Renewable energy Integration, Passive design strategies, Indoor air quality (IAQ) considerations, Thermal comfort and daylighting, Acoustics and noise control, Health and well-being in green buildings

Unit 4: Indoor Environmental Quality (06 Lecture Hours)

Cost-benefit analysis of green building, Government policies and incentives for sustainability, Legal and regulatory frameworks, Global and local perspectives on green building

Unit 5: Economics and Policy (06 Lecture Hours)

Cost-benefit analysis of green building, Government policies and incentives for sustainability, Legal and regulatory frameworks, Global and local perspectives on green building

Unit 6: Green Building Certification **(07 Lecture Hours)**

Overview of green building certification programs, Case studies of certified green buildings, The role of sustainable design in certification, Peer evaluation and feedback

Text Books

1. Schmidt M. (2016). Green Building and Energy Efficiency, Syrawood Publishing House
2. Kibert C. J. (2012). Sustainable Construction: Green Building Design and Delivery, 3rd edition, John Wiley & Sons.
3. "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert.
4. "Energy-Efficient Building Systems" by Lilburn, F., & Liu, Y.

Reference Books:

1. Kubba S. (2012). Handbook of Green Building Design and Construction, Elsevier
2. Iyer G.H. (2022). Green Building Fundamentals, Notion Press
3. Jayamaha L. (2006). Energy-Efficient Building Systems, McGraw-Hill Professional

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	-	3	-	1	-	-	-	-	-	-	-	-	-	2
CO 2	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 3	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 4	-	-	3	1	-	-	-	3	-	3	-	-	-	3
Average	**-**	**3**	**3**	**1**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**2.75**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
HSFS3031P	**DISASTER MANAGEMENT**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Basic knowledge of Environmental Studies**				
Co-requisites					

Course Objectives

I. To expose to the students about the concepts of disaster and risk analysis.
II. To provide knowledge regarding disaster prediction and its phases.
III. To understand the challenges posed by disasters and their impacts.
IV. To make aware students on the policies, acts and regulations related to disaster management.

Course Outcomes

On completion of this course, the students will be able to

CO1. Comprehend key concepts of disaster and risk analysis.

CO2. Analyze the disaster prediction and risk mitigation strategies.

CO3. Develop ability to identify possible impacts of disaster on environment.

CO4. Analyze the planning aspects, acts and policies adopted for disaster management.

Catalog Description

Disaster Management deals with the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies (preparedness, response, and recovery) in order to reduce the harmful effects of all hazards/disasters. It covers detailed study about disaster, risk analysis and prediction studies for the same. In this course, students will also learn about approaches/aspects adopted for disaster risk mitigation and effective disaster management.

Course Content

Unit 1: Introduction **(06 Lecture Hours)**

Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Unit 2: Disasters - Disasters classification **(07 Lecture Hours)**

Natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Unit 3: Disaster Impact **(09 Lecture Hours)**

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit 4: Disaster Risk Reduction (DRR) **(13 Lecture Hours)**

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmers in India and the activities of National Disaster Management Authority.

Unit 5: Disasters, Environment and Development **(10 Lecture Hours)**

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Textbooks

1. Singh, J. (2012). Disaster Management, APH Publishing Corporation.

2. Carter, W. N. (1991). Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok.

Reference Books

1. Subramanian, R. (2018). Disaster Management, Vikas Publishing House.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	-	-	-	-	1	3	1	-	-	-	-	2	-
CO2	2	-	-	-	-	1	3	1	-	-	-	-	2	-
CO3	2	-	-	-	-	1	3	1	-	-	-	-	3	-
CO4	2	-	-	-	-	1	3	1	-	-	-	-	3	-
Average	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**2.5**	-

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
AE	**EMERGING CONTAMINANTS AND ADVANCES**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Knowledge of Chemistry** • **Environmental Engineering**				
Co-requisites	**--**				

Course Objectives

I. To provide students the knowledge of the fundamental concepts of geoenvironmental engineering.
II. To make students familiar with the sources and effects of subsurface contamination.
III. To provide students an in-depth understanding of soil-water-contaminant interaction.
IV. To make students comprehend the procedure of detection, control, and remediation of subsurface contamination.
V. To enable students to conduct environmental monitoring around landfills.

Course Outcomes

On completion of this course, the students will be able to

CO1. Identify the sources of subsurface contamination.
CO2. Determine the effects of subsurface contamination.
CO3. Assess the soil-water-contaminant interaction.
CO4. Comprehend the procedure of detection, control, and remediation of subsurface contamination.
CO5. Conduct environmental monitoring around landfills and design liners.

Catalog Description

Geo-environmental Engineering is a scientific field that involves rock and soil mechanics, environmental engineering, groundwater hydrology, and their impact on human health and the environment. Geo-environmental Engineering addresses issues related to complex problems, such as containment systems (such as landfills), contaminant transport, remediation of contaminated sites, and material reuse.

Course Content

Unit 1: Fundamentals of Geo-environmental engineering (5 Lecture Hours)

Scope of geo-environmental engineering, multiphase behavior of soil role of soil in geo-environmental applications importance of soil physics, soil chemistry, hydrogeology, biological process, sources, and type of ground contamination impact of ground contamination on geo-environmental, case histories on geo-environmental problems.

Unit 2: Soil-water-contaminant interaction (7 Lecture Hours)

Soil mineralogy characterization and its significance in determining soil behavior soil-water interaction and concepts of double layer forces of interaction between soil particles. Concepts of unsaturated soil importance of unsaturated soil in geo-environmental problems – measurement of soil suction – water retention curves – water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and their implications, factors affecting retention and transport of contaminants.

Unit 3: Sources of subsurface contamination (5 Lecture Hours)

Identification, physical, chemical, and biological characteristics of solid waste, characterization, and regulatory requirements for disposal of hazardous, non-hazardous, and domestic waste, waste disposal on land, soil-waste interaction.

Unit 4: Effect of subsurface contamination (6 Lecture Hours)

Cation exchange reactions and effect of pollutants on soil properties, credibility of soil in relation to moisture content, containment transport, laboratory and field evaluation of permeability, factors affecting permeability, design of dewatering.

Unit 5: Contaminant Site Remediation (8 Lecture Hours)

Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater, selection and planning of remediation methods, contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

Unit 6: Landfills **(6 Lecture Hours)**

Types of landfills: Silting criteria; waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal in landfills, Landfills – ash ponds and tailing ponds, and in rocks.

Unit 7: Remediation of subsurface contamination **(8 Lecture Hours)**

Environmental monitoring around landfills, detection, control, and remediation of subsurface contamination, Single and double lined landfill, applications of Geo-synthetics in waste disposal design, landfill construction, construction quality control and performance monitoring, clay liner types and application.

Textbooks

1. Reddi, L. N. and Anyang, H. I. (2000). *Geo-environmental Engineering, Principles and Applications*, Marcel Dekker Inc. New York.
2. Sharma, H. D., and Reddy K. R. (2004). *Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies*, John Wiley & Sons, Inc., USA.
3. Rowe, R. K. (2000). *Geotechnical and Geo-environmental Engineering Handbook*, Kluwer Academic Publications, London.

Reference books

4. Yong, R. N. (2001). *Geo-environmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation.* CRC Press, New York.
5. Hillel, D. (2003). *Introduction to Environmental Soil Physics.* Academic Press, New York.
6. Sparks, D. L. (2002). *Environmental Soil Chemistry*, Academic Press, New York.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	30%	20%	50%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
CIVL4078P	**Environmental Modelling and Simulation**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	• **Basic programming skills in a high-level language like MATLAB, Python, or R** • **Environmental Engineering**				
Co-requisites	**-**				

Course Objectives

On the completion of this course, student will be able to:

I. To provide students with an understanding of the principles and techniques of environmental modelling and simulation.
II. To introduce students to different modelling and simulation methodologies, including continuous, discrete, Monte-Carlo, agent-based, and game theory models.
III. To equip students with the skills to design and implement environmental models using software packages such as MATLAB.
IV. To enable students to critically evaluate and analyse environmental models, including their strengths, limitations, and assumptions.

Course Outcomes

On the completion of this course, student will be able to:

CO1. Understand the fundamentals of modelling and simulation

CO2. Comprehend the modelling transport phenomena, atmospheric and porous media transport

CO3. Analyse and interpret ecological data using cluster analysis, ecological modelling, and stability of complex ecosystems

CO4. Develop and apply lumped and distributed parameter models, solution methods using MATLAB

Catalog Description

This course introduces modelling and simulation and its applications in the environmental field. The course covers the development process of models, model classification, and evaluation, as well as an overview of environmental system design. The course also introduces students to software packages commonly used for modelling and simulation. The course covers both lumped and distributed parameter models and their solution methods using MATLAB. The simulation methodologies, including continuous, discrete, Monte-Carlo, and agent-based models will also be discussed. The course covers modelling transport phenomena, including atmospheric and porous media transport and transformation of pollutants. Environmental risk management, health risk assessment, and uncertainty analysis are also discussed through this course.

Course Content

Unit 1: Introduction to Modelling and Simulation (08 Lecture Hours)

Overview of environmental modeling and simulation, Development process and applications, Benefits and limitations of modeling and simulation, Types of models and modeling frameworks, Environmental system decision-making.

Unit 2: Model Classification and Evaluation (08 Lecture Hours)

Model evaluation and selection criteria, Model classification based on structure and behaviour, Validation and verification of models, Sensitivity analysis and uncertainty assessment.

Unit 3: Modelling Softwires (09 Lecture Hours)

Introduction to software packages used for environmental modelling and simulation, Comparison of software packages for specific applications, Basic skills and functions of software packages, Strengths, and limitations of different software packages.

Unit 4: Modelling Methods and Techniques (12 Lecture Hours)

Lumped and distributed parameter models, Solution methods using MATLAB, Simulation methodologies, including continuous, discrete, Monte Carlo, and agent-based models, Game theory and system dynamics, Design of experiments and reactor modelling, Parameter estimation and RTO studies.

Unit 5: Advanced Modelling Techniques (08 Lecture Hours)

Nonlinear dynamics and bifurcations, 2D models and sensitivity analysis, Lotka-Volterra and outbreak models, Modelling transport phenomena, including atmospheric and porous media transport and transformation of pollutants, Environmental risk management, Health risk assessment, and Uncertainty analysis.

Textbooks

1. Schnoor, J.L. *Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil,* Environmental Science and Technology: A Wiley-Interscience Series.
2. Wainwright, J., and Mulligan, M. *Introduction to Environmental Modelling: An Introduction to the Principle of Environmental Modelling*.

Reference Books

1. Holzbecher, E. (2012). *Environmental Modeling: Using MATLAB*, Second edition, Springer Berlin, Heidelberg.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	1	3	1	-	-	-	-	2	1
CO2	1	-	-	-	-	1	3	1	-	-	-	-	3	1
CO3	1	-	-	-	-	1	3	1	-	-	-	-	3	1
CO4	1	-	-	-	-	1	3	1	-	-	-	-	3	2
Average	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**2.75**	**1.25**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4079P	**GEO-ENVIRONMENTAL ENGINEERING**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Basic knowledge of Engineering Mechanics and Engineering Mathematics**				
Co-requisites	**--**				

Course Objectives

I. To provide students the knowledge of the fundamental concepts of geoenvironmental engineering.
II. To make students familiar with the sources and effects of subsurface contamination.
III. To provide students an in-depth understanding of soil-water-contaminant interaction.
IV. To make students comprehend the procedure of detection, control, and remediation of subsurface contamination.
V. To enable students to conduct environmental monitoring around landfills.

Course Outcomes

On completion of this course, the students will be able to

CO1.Identify the sources of subsurface contamination.

CO2.mine the effects of subsurface contamination.

CO3.Assess the soil-water-contaminant interaction.

CO4.Comprehend the procedure of detection, control, and remediation of subsurface contamination.

CO5.Conduct environmental monitoring around landfills and design liners.

Catalog Description

Geo-environmental Engineering is a scientific field that involves rock and soil mechanics, environmental engineering, groundwater hydrology, and their impact on human health and the environment. Geo-environmental Engineering addresses issues related to complex problems, such as containment systems (such as landfills), contaminant transport, remediation of contaminated sites, and material reuse.

Course Content

Unit 1: Fundamentals of Geo-environmental engineering (5 Lecture Hours)

Scope of geo-environmental engineering, multiphase behavior of soil role of soil in geo-environmental applications importance of soil physics, soil chemistry, hydrogeology, biological process, sources, and type of ground contamination impact of ground contamination on geo-environmental, case histories on geo-environmental problems.

Unit 2: Soil-water-contaminant interaction (7 Lecture Hours)

Soil mineralogy characterization and its significance in determining soil behavior soil-water interaction and concepts of double layer forces of interaction between soil particles. Concepts of unsaturated soil importance of unsaturated soil in geo-environmental problems – measurement of soil suction – water retention curves – water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and their implications, factors affecting retention and transport of contaminants.

Unit 3: Sources of subsurface contamination (5 Lecture Hours)

Identification, physical, chemical, and biological characteristics of solid waste, characterization, and regulatory requirements for disposal of hazardous, non-hazardous, and domestic waste, waste disposal on land, soil-waste interaction.

Unit 4: Effect of subsurface contamination (6 Lecture Hours)

Cation exchange reactions and effect of pollutants on soil properties, credibility of soil in relation to moisture content, containment transport, laboratory and field evaluation of permeability, factors affecting permeability, design of dewatering.

Unit 5: Contaminant Site Remediation (8 Lecture Hours)

Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater, selection and planning of remediation methods, contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

Unit 6: Landfills **(6 Lecture Hours)**

Types of landfills: Silting criteria; waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal in landfills, Landfills – ash ponds and tailing ponds, and in rocks.

Unit 7: Remediation of subsurface contamination **(8 Lecture Hours)**

Environmental monitoring around landfills, detection, control, and remediation of subsurface contamination, Single and double lined landfill, applications of Geo-synthetics in waste disposal design, landfill construction, construction quality control and performance monitoring, clay liner types and application.

Textbooks

1. Reddi, L. N. and Anyang, H. I. (2000). *Geo-environmental Engineering, Principles and Applications*, Marcel Dekker Inc. New York.
2. Sharma, H. D., and Reddy K. R. (2004). *Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies*, John Wiley & Sons, Inc., USA.
3. Rowe, R. K. (2000). *Geotechnical and Geo-environmental Engineering Handbook*, Kluwer Academic Publications, London.

Reference books

1. Yong, R. N. (2001). *Geo-environmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation.* CRC Press, New York.
2. Hillel, D. (2003). *Introduction to Environmental Soil Physics.* Academic Press, New York.
3. Sparks, D. L. (2002). *Environmental Soil Chemistry*, Academic Press, New York.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	30%	20%	50%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course name		L	T	P	C
HSFS3044PP	Occupational Health & Safety		3	0	0	3
Total Units to be Covered: 5		Total Contact Hours: 45				
Prerequisite(s):	1. Basic knowledge of physics and chemistry (Environmental science) 2. Basic knowledge of natural resources	Syllabus version:				

Course Objectives

- To inculcate the condition of the global scenario of Health & safety at the workplace and its relevant consequences.
- To analyse the gaps between reference standards & pertinent conditions of occupational health and safety in India and adapt the feasible solutions.
- To solve complex human factors and ergonomics-related issues and develop a ergonomic work bench and advise on right methodology to perform a work.
- To understand the effects of various occupational hazards and their consequences on human health and advise on effective control strategies.

Course Outcomes:

On completion of this course, the students will be able to

CO-1: Understand the different occupational hazards and their implications on the human body.

CO-2: Identify the root cause for the occupational hazards and adopt the standard global practices to control them.

CO-3: Apply an effective industrial hygiene program for the workplace and monitor its effectiveness.

CO-4: Develop an occupational health management plan to prevent the employees form the dangers arising due to occupational hazards in the workplace.

Course Content

UNIT 1: PHYSICAL AND CHEMICAL HAZARDS (9 lecture hours)

Recognition, Evaluation and Control of Physical Hazards- Noise and Vibration - Effects and Control Measures- Thermal Stress - Parameter Control, Radiation - Types - Source - Effect and Control- Illumination & Lighting. Recognition, Evaluation and Control of Chemical Hazards- Types - Dust-Fumes -Mist -Vapor-Fog etc., Air Contaminants- Evaluation - Types of Sampling-Air Sampling System-Method Analysis-Control Measures.

UNIT 2: INDUSTRIAL TOXICOLOGY (9 lecture hours)

Concept and Spectrum of Health-Functional Units and Activities of Occupational Health Services-Occupational and Work Related Disease-Levels of Prevention of Diseases - Notifiable Occupational Diseases such as Silicosis- Asbestosis- Pneumoconiosis-- Aluminises and Anthrax. Lead-Nickel, Chromium and Manganese Toxicity-Gas Poisoning (such as CO, Ammonia, Coal Dust etc.,) their effects and Prevention- Cardio Pulmonary Resuscitation- Audiology-Hearing Conservation Programme-Effects of Ultra Violet Radiation and Infrared Radiation on Human Systems

Industrial Toxicology-Local and Systemic and Chronic Effects Temporary and Cumulative Effects-Carcinogens Entry into Human System Ergonomics, Personnel Protective Equipment, Personnel Monitoring

UNIT 3: PERSONAL HYGIENE AND FIRST AID (13 lecture hours)

Hygiene Concepts-Correct and Clean Dresses-Clean Body - Washing - Good Habits-Oral and Stomach Hygiene-Cleaning - Compressed Air and Degreasing Agents-Long Hair and Nails and Torn and loosely Hanging Clothes-Smoking - Lavatories Maintenance- Living in Unhygienic Areas. First aid concept- -First Aid Boxes-Legal Requirements, Industrial Hygiene, Medical Surveillance, Medical Surveillance Program Development, Recommended Medical Programme, Emergency Treatment, Non-Emergency Treatment, Exposures to Hazardous Materials.

UNIT 4: RADIATION CONTROL (05 lecture hours)

Radiation Shielding - Radiation Dose - Dose Measurements - Units of Exposure- Exposure Limits- Barriers for Control of Radioactivity Release, Control of Radiation Exposure to Plant Personnel, Health Physics Surveillance - Waste Management and Disposal Practices – Environmental Releases.

UNIT 5: BIOLOGICAL AND ERGONOMIC HAZARD (9 lecture hours)

Classification of Bio-hazardous agents –bacterial agents, viral agents, fungal, parasitic agents, -infectious diseases; Biohazard control program, employee health program-laboratory safety program-animal care and handling; Ergonomics-Concepts, objectives, Work Related Musculoskeletal Disorders –Carpal Tunnel Syndrome CTS- Tendon pain disorders of the neck-back injuries, Ergonomic management program; Pandemic and Management with Case Study

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Internal Assessment**	**MSE**	**ESE**
Weightage (%)	50	20	30

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS-O1	PS-O2
CO1	3	1	-	1	-	2	-	-	2	-	2	-	-	3
CO2	3	1	-	1	-	-	-	-	2	-	-	-	-	3
CO3	2	2	-		-	-	-	-		-	-	-	-	1
CO4	3	3	3	1	2	1	-	-	2	-	-	-	-	3
Avg.	**2.75**	**1.75**	**3**	**1**	**2**	**1.5**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**2.5**

Textbooks

1. National Safety Council. (1982). Handbook of occupational safety and health. Chicago, IL: Author.
2. Koradecka, D. (2010). Handbook of occupational safety and health. Boca Raton, FL: CRC Press.
3. Stellman, J. M. (Ed.). (1998). Encyclopedia of occupational health and safety (Vols. 1-2). Geneva, Switzerland: International Labour Organization.
4. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). Itasca, IL: National Safety Council.

Reference Books

1. Wegman, D. H., & McGlothlin, J. D. (2019). Occupational medicine (8th ed.). Lippincott Williams & Wilkins.
2. LaDou, J., Himmelstein, J. A., & Aschner, M. (2018). Occupational and environmental medicine (5th ed.). McGraw-Hill.
3. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). National Safety Council.
4. Goldstein, B. D., Hilado, C. O., & Adams, R. N. (2014). Patty's industrial hygiene (6th ed.). John Wiley & Sons.
5. Proctor, N. H., Hughes, J. P., & Lemke, W. E. (2015). Proctor and Hughes' chemical hazards of the workplace (6th ed.). John Wiley & Sons.
6. American Conference of Governmental Industrial Hygienists. (2021). ACGIH industrial ventilation: A manual of recommended practices (29th ed.). ACGIH.
7. Heinrich, H. H. W. (1980). Industrial accident prevention (5th ed.). McGraw-Hill.
8. Reese, C. D. (2018). Occupational safety and health management (3rd ed.). CRC Press.
9. Yates, D. (2018). Safety professional's reference and study guide (6th ed.). Delmar Cengage Learning.
10. American Society of Safety Professionals. (2021). ASSP safety and health fundamentals: A complete guide to protecting people, property, and the environment (6th ed.). ASSP.
11. Yates, D. (2016). The occupational safety and health handbook (4th ed.). CRC Press.
12. Headley, G. C. (2010). The complete safety guide (6th ed.). Prentice Hall.
13. Conway, J. T. (2019). The safety officer's handbook (6th ed.). American Society of Safety Professionals.

Course code	Course name	L	T	P	C
SUST 0000	**Remote Sensing and its applications**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	Basic understanding of surveying				
Co-requisites	Arc-GIS				

Course Objectives:

- To summarize the basic spectral mechanism behind remote sensing and GIS techniques
- To explain different software for data creation, analysis and modelling
- To understand geo database development and geo-spatial analysis for environmental applications
- To apply the image processing techniques for various environmental problems
- To provide the knowledge of RS and GIS to various disaster, water resource and environmental applications

Course Outcomes:

On completion of this course the students will be able to

CO1: Incorporate the analytical abilities in the processing and retrieving information from the satellite images.

CO2: Acquire fundamentals of various geodata and its sources.

CO3: Understand the geospatial applications to various civil engineering problems.

CO4: Apply various GIS models used in environmental applications.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Program Outcomes (POs)												POs	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO-1	2	3	3	-	-	3	-	-	-	-	-	-	-	3
CO-2	2	3	3	-	-	3	-	-	-	-	-	-	-	3
CO-3	2	3	3	-	-	3	-	-	-	-	-	-	-	3
CO-4	2	3	3	-	-	3	-	-	-	-	-	-	-	3
Average	2	3	3	-	-	3	-	-	-	-	-	-	-	3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Content

Unit I: Introduction to Remote Sensing (09 lecture hours)

Introduction to Remote sensing - Electro Magnetic energy - EMR spectrum - EMR interaction with atmosphere- Scattering - Atmospheric Windows and its Significance – EMR interaction with Earth Surface Materials -Spectral Signature - EMR interaction with water, soil and Earth Surface – Satellites, orbits and missions –Image characteristics and Resolution concepts.

Unit II: Principles of Image Processing (09 lecture hours)

Introduction to image processing - Pre-processing and corrections – image enhancement – image compression techniques – spatial filtering technique - image classification techniques - Visual and digital Interpretation of Satellite Images - Environmental Satellites - GOES, NOAA, AVHRR, CZCR, OCM and MODIS .

Unit III: Fundamentals of GIS (09 lecture hours)

Fundamentals of Geographic Information System - geo-data - type - Input Sources - Raster and Vector data structures - Comparison of Raster and Vector data - errors in data - Projection and transformation - Reclassification - proximity analysis – Digitization techniques – cartography principles - various geo-spatial analysis – Concepts of RDBMS – Network analysis – web based GIS.

Unit IV: Data processing in GIS (09 lecture hours)

Analysis using Raster and Vector data – Operations – Overlaying - Buffering –Modelling in GIS – Digital Terrain Modelling, Analysis and application – Products of DEMs and their uses – Sources of errors in GIS and their elimination.

Unit V: Application of GIS in environmental engineering (09 lecture hours)

Spectral responses of clear and contaminated water – water quality mapping and monitoring – Water supply and sewerage network modelling - Groundwater vulnerability for pollution - DRASTIC and SINTAC model - Eutrophication and sedimentation in lakes and reservoir – Impact urbanization on catchment -nutrients transport modeling.

Textbooks / Reference Books

1. Sabins, F., Remote Sensing Principles and Interpretation, W. H. Freeman and Company, New York, Third edition, 2007.
2. Lillesand, T. M. and R.W. Kiefer, remote Sensing and Image Interpretation, Fourth Edition, John Wiley.
3. Lai, Poh C., Mak, Ann S.H. (Eds.) GIS for Health and Environment, Springer Publication, 2007.
4. Uzair M.S., GIS Tools for Water, Wastewater, and Storm water Systems, ASCE Press, 2002.
5. George Joseph, Fundamentals of Remote sensing, University Press, Second edition, 2005.
6. Agarwal, C. S., Garg P. K., Remote Sensing in Natural Resources Monitoring and Management, A. H. Wheeler & Co. Ltd., New Delhi.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Specialization in Construction Management

Course code	Course Name	L	T	P	C
SPL	Green Building and Energy Efficiency	3	0	0	3
Pre-requisites/Exposure	Environmental Science, Environmental Economics, Construction Technology, Engineering Principle				
Co-requisites	--				

Course Objectives

I. To understand sustainable construction principles

II. To evaluate building materials for sustainability.

III. To design energy-efficient building systems

IV. To enhance indoor environmental quality.

V. To analyse economic aspects of sustainable construction

VI. To evaluate case studies and real-world applications

Course Outcomes

On completion of this course, the students will be able to;

CO1. Explain the fundamental principles and concepts of sustainable construction, including! Environmental, social and economic considerations

CO2. Assess the environmental impact of various building materials and construction methods using life Cycle analysis.

CO3. Develop energy-efficient building designs that incorporate passive and active strategies to reduce Energy consumption and describe factors affecting indoor air quality, thermal comfort, daylighting, and acoustics in green buildings.

CO4. Conduct cost-benefit analyses to evaluate the financial viability and long-term benefits of Sustainable building practices.

Catalog Description

This undergraduate course explores the principles and practices of green building design and energy-efficient construction. Students will learn how to design and construct buildings that minimize their environmental impact, optimize energy performance, and enhance occupant comfort and health. The course covers sustainable building materials, energy-efficient systems, green certification programs, and regulatory aspects.

Course Content

Unit 1: Introduction to green building (06 Lecture Hours)

Definition and principles of green building, Historical context and evolution, Environmental and social benefits, Green building rating systems (e.g., LEED, BREEAM)

Unit 2: Sustainable Materials and Resources (10 Lecture Hours)

Sustainable building materials and products, Life cycle assessment (LCA), Sustainable sourcing and procurement, Recycling and waste reduction in construction.

Unit 3: Energy Efficiency in Building Design (10 Lecture Hours)

Building envelope design for energy efficiency, Efficient lighting and HVAC systems, Renewable energy Integration, Passive design strategies, Indoor air quality (IAQ) considerations, Thermal comfort and daylighting, Acoustics and noise control, Health and well-being in green buildings

Unit 4: Indoor Environmental Quality (06 Lecture Hours)

Cost-benefit analysis of green building, Government policies and incentives for sustainability, Legal and regulatory frameworks, Global and local perspectives on green building

Unit 5: Economics and Policy (06 Lecture Hours)

Cost-benefit analysis of green building, Government policies and incentives for sustainability, Legal and regulatory frameworks, Global and local perspectives on green building

Unit 6: Green Building Certification (07 Lecture Hours)

Overview of green building certification programs, Case studies of certified green buildings, The role of sustainable design in certification, Peer evaluation and feedback

Text Books

1. "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert.
2. "Energy-Efficient Building Systems" by Lilburn, F., & Liu, Y.

Additional Resources:

1. Green building certification program guidelines and materials.
2. Case studies of green building projects.
3. Research articles on sustainable construction and energy efficiency

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	30%	20%	50%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	-	3	-	1	-	-	-	-	-	-	-	-	-	2
CO 2	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 3	-	-	3	1	-	-	-	3	-	3	-	-	-	3
CO 4	-	-	3	1	-	-	-	3	-	3	-	-	-	3
Average	**-**	**3**	**3**	**1**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**2.75**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
HSFS3031P	**DISASTER MANAGEMENT**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Basic knowledge of Environmental Studies**				
Co-requisites					

Course Objectives

I. To understand basic concepts in Disaster Management
II. To understand definitions and terminologies used in Disaster Management
III. To understand types and categories of Disasters
IV. To understand the challenges posed by Disasters and their impacts

Course Outcomes

On completion of this course, the students will be able to

CO1. Develop better understanding about disaster and risk analysis

CO2. Learn and analyze the key concepts for disaster prediction and risk mitigation

CO3. Develop ability to identify possible impacts of disaster on environment

CO4. Analyze the planning aspects, acts and policies adopted for disaster management

Catalog Description

Disaster Management deals with the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies (preparedness, response, and recovery) in order to reduce the harmful effects of all hazards/disasters. It covers detailed study about disaster, risk analysis and prediction studies for the same. In this course, students will also learn about approaches/aspects adopted for disaster risk mitigation and effective disaster management.

Course Content

Unit 1: Introduction **(06 Lecture Hours)**

Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Unit 2: Disasters - Disasters classification **(07 Lecture Hours)**

Natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents,Terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Unit 3: Disaster Impact **(09 Lecture Hours)**

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit 4: Disaster Risk Reduction (DRR) **(13 Lecture Hours)**

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmers in India and the activities of National Disaster Management Authority.

Unit 5: Disasters, Environment and Development **(10 Lecture Hours)**

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Textbooks/Reference Books

"Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991. Carter W. N. Disaster Management – Jagbir Singh National Disaster Management Plan National Disaster management Policy

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Tutorial/Faculty Assessment**	**Class Tests**	**MSE**	**ESE**
Weightage (%)	15	15	20	50

Relationship between Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs)

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	-	-	1	3	1	-	-	-	-	1	-
CO2	1	-	-	-	-	1	3	1	-	-	-	-	1	-
CO3	1	-	-	-	-	1	3	1	-	-	-	-	1	-
CO4	1	-	-	-	-	1	3	1	-	-	-	-	1	-
Average	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	-

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course code	Course Name	L	T	P	C
CIVL3089P	**Advanced Concrete Technology**	**4**	**0**	**0**	**4**
Pre-requisites/Exposure	**Basic knowledge of civil engineering materials and sustainability, concrete technology, structural engineering**				
Co-requisites	**--**				

Course Objectives

I. To develop a deep understanding of advanced concrete materials and their properties
II. To explore advanced mix design techniques for various concrete applications.
III. To develop understanding of the factors affecting the durability and sustainability of concrete structures.
IV. To stay updated on the latest trends and innovations in the field of concrete technology.
V. To demonstrate proficiency in quality control and testing procedures for concrete.
VI. To explore emerging trends and technologies in the concrete industry

Course Outcomes

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

CO1. Demonstrate a deep understanding of the composition and properties of concrete materials and explain how various materials influence concrete performance.

CO2. Design concrete mixes for specific construction needs and be capable of adjusting mix designs based on project requirements.

CO3: Conduct various tests on concrete to assess its properties and interpret test results and

Make necessary adjustments to maintain good quality.

CO4: Develop preventive maintenance plans for concrete structures and demonstrate the ability to assess the feasibility of adopting emerging technologies.

Catalog Description

Advanced Concrete Technology is a comprehensive course designed to provide students with an in-depth understanding of concrete materials, their properties, and advanced techniques for concrete design, construction, and maintenance. This course will cover the latest advancements in concrete technology, including sustainable concrete practices and innovative construction methods. Students will gain the knowledge and skills necessary to excel in the field of concrete engineering and construction.

Course Content

Unit I: Concrete Materials and Proerties (07 Lecture Hours)

Introduction to concrete materials, Physical, chemical and mechanical properties of concrete materials. Fresh and hardened properties of concrete. Dimensional stability of concrete. Mix design principles and methods.

Unit II: Advanced Concrete Materials (08 Lecture Hours)

Production and properties of high-strength concrete, high performance and ultra-high-performance concrete and their fresh and hardened properties, Types of fibers used in concrete, production of fiber-reinforced concrete, fresh and hardened properties of fiber-reinforced concrete, Alkali activated concrete and geo-polymer concrete.

Unit III: Advanced Concrete Mix Design (10 Lecture Hours)

Advanced mix proportioning methods, mix design for self-compacting concrete, mix design for fiber-reinforced concrete, mix design for alkali activated concrete and geo-polymer concrete, mix design for ultra-high-performance concrete, light weight and heavy weight concrete.

Unit I: Quality Control and Testing (08 Lecture Hours)

Quality control and quality assurance in concrete production. Non-destructive test methods and their use in assessing the quality of concrete. Concrete testing in laboratory and field.

Unit V: Repair and Maintenance of Concrete Structures (10 Lecture Hours)

Mechanism of concrete deterioration, Various techniques of repairing of damaged concrete, Corrosion protection and prevention, preventive maintenance strategies, Rehabilitation of ageing infrastructure, life cycle assessment of concrete structures.

Unit VI: Emerging Trend in Concrete Technology (7 Lecture Hours)

Self-healing concrete, light-weight concrete, 3D printing of concrete, Sustainable concrete materials and practices, Future directions in concrete research and development.

Textbooks

1. Neville A.M. (2012). Properties of Concrete, 5th edition, Pearson Education India
2. Mehta, P. K., & Monteiro, P. J. M. (2019). Concrete: Microstructure, Properties, and Materials. McGraw-Hill Education.

Reference books

1. Neville, A. M., & Brooks, J. J. (2010). Concrete Technology. Pearson Education.
2. Li Z. (2011). Advanced Concrete Technology, John Wiley & Sons.
3. Aïtcin P. (1998). High Performance Concrete. CRC Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO2	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO3	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO4	-	-	3	1	-	-	-	3	3	3	-	-	-	3
Averag e.	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**3**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4081P	Construction Specifications, Law & Finance	3	0	0	3
Pre-requisites/Exposure	▪ Basic Knowledge of contracts. ▪ Basic knowledge of accounting.				
Co-requisites	None				

Course Objectives (CO):

I. To bring about an exposure to construction economics, financing, accounting methods, laws and specifications, and their usefulness in executing construction projects.
II. To study the elements of construction laws.
III. To study the need for financial management and means of achieving the same.
IV. To study accounting methods used in construction field.

Course Outcomes

On completion of this course, the students will be able to:

CO1: Understand features of construction economics and financial management of construction projects, including contracts laws and specifications.
CO2: Understand knowledge on basics of construction laws and specifications.
CO3: Demonstrate knowledge of applicable laws, financial management of construction projects.
CO4: Apply knowledge to evaluate construction projects on cost analysis in relation to project time consumed, basics of contract management and applicable laws.

Catalog Description

For any construction project to be successful, it must be technically sound and the resulting benefits must exceed the cost associated with the project. In addition, it should be compliant to required legislations and shall be completed within the parameters of the law related to contract management and project management. This course basically aims at describing various aspects of economics, finance and applicable laws in the construction sector. The field of construction economics and finance deals with the systematic evaluation of cost and benefit associated with different projects. The topics in this course cover principles of economy followed by basic methods for carrying out economic studies considering the time value of money. In addition, other topics those will be covered are different methods of depreciation, taxes, and cost analysis of construction equipment followed by cost estimating. The course would also include an overview of the laws related to contract management, labour management, workmen compensation and insurance etc. The topics will be developed in a logical sequence. This course will definitely help the students in understanding the underlying principles and concepts in construction economics and finance and the related laws required for effective project management.

Course Content

Unit I: Construction Economics- Principles of Time value of Money

(10 Lecture Hours)

Basic principles – Time value of money; Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future; Present payment compared to uniform series payments; Future payment compared to uniform series payments, Arithmetic gradient, Geometric gradient.

Unit II: Accounting Methods and Construction Costing (15 Lecture Hours)

Methods of construction costing, Escalation clause; Sources of Finance & Infrastructure Financing; Life cycle costing, construction cost control; Depreciation Accounting; Income Tax accounting, Inflation accounting. Preparation of Balance sheet & Profit and loss accounts; Ratio analysis; Working capital management; Financial Control-Management accounting; Funds flow statement, Cash Flow statement

Unit III: Contracts Management (10 Lecture Hours)

Indian contract act 1872, preliminary basic concepts of the law. Construction contracts; nature of contracts, Stipulated sum contracts; cost plus fee contracts; Unit-price contracts; Contracts with quantities; Other conditions of contracts; Subcontracts and supply contracts; Arrangements of contracts for construction; Design-build contracts; Claims and disputes; Changes in the work of contracts; Completion of contracts and payments; The uncovering and correction of work in contracts; -How to avoid and/or resolve construction disputes in different countries; Review how to review and make good construction contracts and specifications.

Unit IV: Laws applicable to the construction Industry (10 Lecture Hours)

The Contract Labour (Regulation and Abolition) Act 1988, the labour codes 1955, The Factories Act 1948 (applicable sections); Employee State Insurance Act; Workmen

Compensation Act 1923, The Hazardous Waste Management Rules 2016 and all related amendments.

Textbooks

1. Blank, L.T., and Tarquin,a.J (1988) Engineering Economy,4th Edn. Mc-Graw Hill Book Co.
2. Collier C and GlaGola C (1998) "Engineering Economics & Cost Analysis", 3nd Edn Addison Wesley Education Publishers.
3. Patel, B M (2000) "Project management- strategic Financial Planning, Evaluation and Control", Vikas Publishing House Pvt. Ltd. New Delhi.
4. Steiner, H.M. (1996) "Engineering Economic principles", 2nd Edn. Mc-Graw Hill Book Co.
5. Maheshwari S.N., (1996), Management Accounting and Financial Control, 10th edition, Sultan Chand & Sons, New Delhi.
6. Construction Management & Planning by B. Sengupta & H. Guha, Tata McGraw Hill

Reference Books

1. Kelleher Jr., T. J., & Walters, G. S. (2009). Smith, Currie &Hancock’s common sense construction law: a practical guide for the construction professional (4th ed.). New York City: John Wiley & Sons Inc. ISBN 047023136x

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	-	-	-	-	-	3	2	3	-	-	-	3	3
CO2	2	3	2	-	3	-	-	-	-	-	2	-	2	-
CO3	2	-	-	-	3	2	-	-	-	3	-	-	-	-
CO4	2	-	-	2	3	-	-	-	-	3	-	1	-	2
Averag e.	2	3	2	2	3	2	3	2	3	3	2	1	2.5	2.5

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4082P	**Forensic engineering and rehabilitation of structure**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	Basic knowledge of Building materials & Construction, Concrete Technology, and Engineering Mathematics				
Co-requisites	--				

Course Objectives

I. To provide students with the knowledge of construction material behavior.
II. To make students familiar with the enable students to diagnose distress and failure of structures.
III. To provide students with an in-depth understanding of various environmental problems and natural hazards.
IV. To expose students to modern techniques of retrofitting and rehabilitation of structures.

Course Outcomes

On completion of this course, the students will be able to

CO1. Investigate and predict construction material behavior.
CO2. Diagnose and analyze the distress and failure of structures.
CO3. Assess the impact of various environmental problems and natural hazards on the construction material and structures.
CO4. Apply the modern techniques of retrofitting and rehabilitation of structures.
CO5. Estimate soil shear strength parameters with respect to the drainage conditions in the field or lab and analyze soil failure.

Catalog Description

Forensic structural engineering is all about determining the integrity of a building or structure. This study includes building code violations, water damage, design flaws, foundation issues, framing issues, soil movements such as settlement and heave, and geotechnical issues to determine the probable cause of structural failures. To determine this cause of failure, this study employ structural analysis, building science, project rehabilitation as well as the application of various building codes and rehabilitation techniques.

Course Content

Unit 1: Failure of Material and structures (7 Lecture Hours)

Review of the construction theory, performance problems, responsibility and accountability, case studies – learning from failures, causes of distress in structural members, design and material deficiencies, overloading.

Unit 2: Diagnosis and Assessment of Distress (7 Lecture Hours)

Visual inspection – non-destructive tests – ultrasonic pulse velocity method – rebound hammer technique – pullout tests – Windsor probe test – crack detection techniques – case studies – single and multistorey buildings – Fibreoptic method for prediction of structural weakness.

Unit 3: Environmental Problems and Natural Hazards (7 Lecture Hours)

Effect of corrosive, chemical and marine environment – pollution and carbonation problems – durability of RCC structures – damage due to earthquakes and strengthening of buildings – provisions of BIS 1893 and 4326. Methods of repair in concrete, steel and timber structural components.

Unit 4: Modern Techniques of Retrofitting (7 Lecture Hours)

Principle Structural first aid after a disaster, guniting, jacketing, use of chemicals in repair, application of polymer, ferrocement and fiber concretes as rehabilitation materials, strengthening by pre-stressing, case studies, Maintenance – inspection and planning, budgeting, and management.

Unit 5: Environmental impact (7 Lecture Hours)

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties, and cracking. Influence on serviceability and durability–Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

Unit 6: Repair and retrofitting **(10 Lecture Hours)**

Materials for repair, techniques for repair – Surface Repair, Material Selection, Surface Preparation – Rust Eliminators and Polymers Coating for Rebar During Repair, Repair Of Cracks in Concrete and Masonry, Methods of Repair – Epoxy Injection, Mortar repair for Cracks, Waterproofing Of concrete roofs; Strengthening measures - Flexural strengthening, Beam shear capacity strengthening, Column strengthening, Shoring, Under Pinning and Jacketing. Demolition of Buildings – Planning, Precautions and protective measures in demolition work, Sequence of operations, demolition of structural elements.

Textbooks

1. Campbell-Allen, D. and Roper, H., *Concrete Structures*, *Materials, Maintenance and Repair*, Longman Scientific and Technical, UK
2. Allen, R.T and Edwards, S.C, *Repair of Concrete Structures*, Blakie and Sons, UK
3. Santhakumar A.R., *Concrete Technology*, Oxford University Press
4. Dayaratnam, P. and Rao, R., *Maintenance and Durability of Concrete Structures*, University Press, India.

Reference books

1. Design and Construction Failures, Dovkaminetzky, Galgotia Publication, New Delhi, 2009.
2. Concrete – Building Pathology, Macdonald S, John Wiley and Sons, 2002.
3. Forensic Structural Engineering Handbook, Robert. T Ratay, Mc Graw Hill, 2009.
4. Understanding Building Failures, James Douglas and Bill Ransom, Taylor and Francis Group, 2007.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	30%	20%	50%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL4083P	Artificial Intelligence in the Built Environment	3	0	0	3
Pre-requisites/Exposure	• Basic understanding of construction technology • Basic knowledge of Artificial Intelligence				
Co-requisites	None				

Course Objectives:

i. Understand how AI technologies can be used to guide planning, design, and construction of the built environment.
ii. Apply existing AI models in architecture, construction management, interior design, landscape architecture, sustainability and the built environment, and urban and regional planning disciplines.
iii. To be able to build a simple Machine Learning model.
iv. Understand the current limitations of machine learning technologies.

Course Outcomes (CO):

On completion of this course, the students will be able to:

CO1. Understand the implication of AI technologies for the discourse of the discipline and emerging ecology of AI applications.
CO2. Explore how AI and machine learning empower geospatial problem solving and cultivate community resilience and emergency response.
CO3. Assess the AI abilities in the construction together with misconceptions around its capabilities, and its limitations.
CO4. Predict the AI based design's ability to meet expected and evolving performance outcomes.

Catalog Description

The planning, design, and construction of the built environment is on the verge of a fundamental transformation. A key element of this transformation is a radical shift in paradigm from planning and design representations of unconnected data to practices with an overwhelming amount of information-rich data. Artificial Intelligence (AI), in particular Machine Learning (ML), provides planners, designers, and constructors with new models and methods to engage in these data heavy processes in order to synthesize meaningful information for all areas of their practice from planning to design to fabrication to erection. This course provides the undergraduate Civil Engineering students an opportunity to learn about application of AI in their disciplines. This course focused on an introduction to Artificial Intelligence (AI) and its applications to real-world problems in planning, design, and construction of the built environment and includes application in professional practice in architecture, construction management, interior design, landscape architecture, sustainability and the built environment, and urban and regional planning.

Course Content

Unit I: AI in Architecture **06 lecture hours**

Introduction to AI; Precise and vague, qualitative, and quantitative, measurable and immeasurable competing factors and criteria of Architecture; application of AI in design and production of architecture on many levels: theoretical, cultural, or technical.

Unit II: AI in Landscape Architecture **04 lecture hours**

AI applications to help understand, monitor, and conserve nature. Applications of AI in innovative designing and creating Landscape Architecture.

Unit III: AI in Construction Management **12 lecture hours**

AI application in design optimization, scheduling, estimating, project documentation, safety inspection, and construction project; monitoring; AI-driven solution methods to increase efficiency and decrease risk in construction industry;

Unit IV: AI in Interior Design **08 lecture hours**

AI application in the design of the environments in which we live, learn, and work; and AI application in interior design: creation of data driven, well-conceived, and adaptive spaces; case studies of AI application for inform space programming and environmental planning.

Unit V: Sustainability in the Built Environment **10 lecture hours**

Science and applications fusing design thinking with geospatial data analytics and decision-support to solve problems related to land use change and human habitation. Geospatial problem solving and monitoring, measuring, and modeling of natural resource conservation and social-ecological system management using AI and ML; Knowledge of computer vision, crowd-sourced geospatial data, digital twins, procedural models, and related decision support technologies like building information modeling (BIM) and geographic information systems (GIS).

Unit VI: Urban and Regional Planning **05 lecture hours**

Applications of AI in embedded environmental sensors, distributed intelligence and control in infrastructure, the sharing economy, and social networks with case studies.

Text Books

8. Tan, P. N., Steinbach, M., & Kumar, V. (2016). Introduction to Data Mining. Pearson Education India, Chapter 2: “Data” and Chapter 3 “Exploring Data.”

9. Bradley E Cantrell, Justine Holzman; Responsive Landscapes: Strategies for Responsive Technologies in Landscape Architecture; Routledge, 2016.
10. Rajagopal, A., & Tetrick, C. (2017). The rise of AI and machine learning in construction. Autodesk University.

Reference Books

1. Mario Carpo, The Second Digital Turn – Design Beyond Intelligence, Cambridge, MIT Press, 2017, AI & Architecture: An Experimental Perspective.
2. Nishant, R., Kennedy, M., & Corbett, J. (2020). Artificial intelligence for sustainability: Challenges, opportunities, and a research agenda. International Journal of Information Management, 53, 102104.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Internal assessment**	**Mid-Semester Examination (MSE)**	**End-Semester Examination (ESE)**	**Total**
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO-1	2	-	-	-	-	3	-	-	-	-	-	-	-	1
CO-2	-	2	-	-	-	3	-	-	-	-	-	-	-	2
CO-3	2	-	-	-	-	2	-	-	-	-	-	-	-	1
CO-4	2	2	-	-	-	2	-	-	-	-	-	-	-	2
Average	**2**	**2**	**-**	**-**	**-**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

1=weakly mapped 2= moderately mapped 3= strongly mapped

Minor Tracks

Course Code	Course Name	L	T	P	C
CIVL2130	**Building Materials and Concrete Technology**	**0**	**0**	**2**	**1**
Pre-requisites/Exposure	**Knowledge of mathematics, mechanics of solids and concrete technology theory**				
Co-requisites	**--**				

Course Objectives

VII. To provide scientific basis for understanding & development of construction materials

VIII. To give an overview of the fundamentals needed to understand material structure & behaviour.

IX. To discuss the important materials used in construction today

X. To teach students about the principles and methods to be followed in constructing various components of a building

XI. To teach students about the deterioration and repair of buildings.

XII. To expose the students to the concepts of sustainability in the context of building and conventional engineered building materials.

Course Outcomes

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

CO1: Understand the physical and mechanical properties of building materials

CO2: Understand the construction to be followed in brick, stone and concreting

CO3: Explain innovative sustainable construction materials and their uses in construction.

CO4: Examine the green building rating systems and its contribution to sustainability.

Catalog Description

This course provides a comprehensive understanding of building materials and concrete technology, two fundamental aspects of the construction industry. Students will explore various types of construction materials, their properties, selection criteria, and sustainable practices. The course will also delve into the science and technology of concrete, including mix design, production, and quality control. Through theoretical learning and practical applications, students will gain the knowledge and skills necessary for a successful career in construction and civil engineering.

Course content

Unit I: Bricks (7 Lecture Hours)

Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick Earth, Different forms of bricks, Testing of bricks as per BIS. Defects of bricks. Lime: Impurities in limestone, Classification, Slaking and hydration, Hardening, Testing, Storage, Handling

Unit II: Cement & Concrete (10 Lecture Hours)

OPC: Composition, PPC, Slag cement, Hydration, setting time, Concrete: Types, ingredients, W/C ratio, Workability, Different grades in cement concrete, Tests on cement concrete, Mix design of concrete. Mortars: Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars, Other materials: Wood products, Paints etc.

Unit III: Masonry (10 Lecture Hours)

Principles of masonry construction, types of masonry, types of walls, types of partition walls such as brick partition, timber partition, glass partition etc., Stone masonry - Types of stone masonry & construction method, Dressing & Bonding Brick and block masonry, Brick & Block Masonry – Various types of bonds in brick masonry, reinforced brick masonry Formworks.

Unit IV: Steel Trusses (7 Lecture Hours)

Sections used for steel work, method of connections i.e. riveted, bolted & welded, types of trusses & theirs uses, roofs, covering materials & method of fixing tabular structures. Building finishes, objectives & processes, pointing, plastering & painting, white-wash & colour wash, distempering etc, on old & new surfaces, repairs & maintenance.

Unit V: Sustainable Material (7 Lecture Hours)

Introduction to sustainable construction, Role of Material - Carbon from Cement, alternative cements and cementitious material, Role of quality - minimization of natural resource utilization, Sustainable material choices, Recycling and reuse of construction materials, Recycled aggregate concrete, geo-polymer concrete, high volume fly-ash concrete.

UNIT VI: Green Building (7 Lecture Hours)

Operational energy reduction and net zero building, Optimization for design of building for energy efficiency. Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. Energy codes ECBC requirement, Concepts of OTTV etc. Green Performance rating, requirements of LEED, GRIHA etc.

Text Books

4. Rangawala S. C. (2016). Building Construction, 33rd edition, Charotar Publishing House Pvt. Ltd.
5. Neville A.M. (2012). Properties of Concrete, 5th edition, Pearson Education India.
6. Charles J. K. (2008). Sustainable Construction - Green Building Design and Delivery, 2nd edition, John Wiley & Sons.

Reference Books

3. Punmia B.C., Jain A. K. and Jain A. K. (2016). Building Construction, 11th edition, Laxmi Publications.
4. Mehta P. K., and Monteiro P.J.M (2017). Concrete microstructure, properties and materials, 4th edition, McGraw Hill Education

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Course Code	Course Name	L	T	P	C
CIVL3055	**Environmental engineering**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Mathematics, Chemistry, Engineering Hydrology and Environmental Engineering I**				

Relationship between the Program Outcomes (POs), Program Specific outcomes (PSO) and Course Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO2	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO3	-	-	3	1	-	-	-	3	3	3	-	-	-	3
CO4	-	-	3	1	-	-	-	3	3	3	-	-	-	3
Average.	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**3**

1.Weakly Mapped 2. Moderately Mapped 3. Strongly Mapped

Co-requisites	--

Course Objectives

I. To present various concepts and impart proficiency in designing of sewerage system and its various components.
II. To provide knowledge about the qualitative analysis of sewage and their standard permissible limits before disposal
III. To teach students in detail about the processes involved in treatment of sewage
IV. To provide knowledge in detail about the air and noise quality, its control and monitoring practices
V. To provide knowledge about the solid waste generation, its impact and management strategies

Course Outcomes

On completion of this course, the students will be able to.
CO1. Analyze the relevant physical and chemical characteristics of sewage.

CO2. Analyze sewage disposal and sludge digestion processes.

CO3. Comprehend the air and noise quality concepts along with their monitoring and control. methods

CO4. Compare the various solid waste management practices

CO5. Design the various components of sewerage system

Catalog Description

Environmental Engineering in civil engineering deals with one of the major infrastructure components i.e., sewerage system for a city. It also covers qualitative analysis study of sewage and processes adopted in sewage treatment plant for treatment of sewage. In this course, the focus will be on developing the understanding of the students regarding sewerage system and detailed study of its various components. It also provides knowledge to the students regarding air and noise quality concepts along with their monitoring and control procedures. Additionally, knowledge about the solid waste and management strategies will also be provided to the students under the course.

Course Content

Unit 1: Design of Sewerage System (08 Lecture Hours)

Sewerage schemes and their importance, collection & conveyance of sewage, storm water quantity, fluctuation in sewage flow, flow through sewer, design of sewer, construction & maintenance of sewer, sewer appurtenances, pumps & pumping stations

Unit 2: Quality and Characteristics Of Sewage (10 Lecture Hours)

Characteristics and analysis of wastewater, cycles of decomposition, physical, chemical & biological parameters. Oxygen demand i.e., BOD & COD, TOC, TOD, Th OD, Relative Stability, population equivalent, instrumentation involved in analysis, natural methods of wastewater disposal i.e. by land treatment & by dilution, self-purification capacity of stream, Oxygen sag analysis.

Unit 3: Treatment of Sewage (12 Lecture Hours)

Unit operations for wastewater treatment, preliminary treatment such as screens, grit chamber, floatation tank, sedimentation and chemical clarification, role of micro-organism in biological treatment, Sewage filtration-theory & design. Methods of Biological Treatment (Theory & Design) - Activated Sludge process, Oxidation ditch, stabilization ponds, aerated lagoon, anaerobic lagoons, septic tank & Imhoff tank, sources & treatment of sludge, sludge thickening and digestion sludge drying beds, sludge disposal.

Unit 4: Air and Noise Pollution Engineering (09 Lecture Hours)

Composition and properties of air, Quantification of air pollutants, Monitoring of air polluta nts, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions, and interrelationship. Air quality standards, Control measures for Air pollution, construction, and limitations. Noise-Basic concept, measurement, and various control methods

Unit 5: Solid Waste Management (06 Lecture Hours)

Municipal Solid Waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activit ies, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards.

Textbooks

1. Garg, S.K. *Sewage Disposal and Air Pollution Engineering*, Volume II, Khanna Publishers.
2. Metcalf and Eddy. *Wastewater Engineering: Treatment & Reuse*. McGraw Hill Education.

Reference books

1. Punmia, B.C., Jain, A.K. *Wastewater Engineering (Including Air Pollution).* Laxmi Publications Limited.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	3	-	-	-	3	1	2	-	-	-	-	3	-
CO2	-	3	-	-	-	3	1	3	-	-	-	-	3	-
CO3	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO4	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO5	-	-	3	-	-	3	1	-	-	-	-	-	2	3
Average	**2**	**3**	**3**	**-**	**-**	**2.6**	**1.4**	**2.5**	**-**	**-**	**-**	**-**	**2.4**	**3**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3018	**Structural engineering**	**2**	**1**	**0**	**3**

Pre-requisites/Exposure	**Mechanics of Solids, Structural Analysis I**
Co-requisites	**--**

Course Objectives

I. To determine the static degree of indeterminacy, kinematic degree of indeterminacy, to understand concept of force method and displacement method.

II. To be able to perform analysis of indeterminate beams, frames using slope deflection n method, energy method and to perform approximate analysis for beams, frames, and trusses by approximate method.

III. To be able to create stiffness matrix and flexibility matrix and perform the analysis by the matrix methods.

IV. To perform the plastic analysis and its application in real life situations

Course Outcomes

On completion of this course, the students will be able to;

CO1. Determine the Degree of Static and Degree of Kinematic Indeterminacy for any structureand ability to select suitable method for analysis.

CO2. Perform analysis of indeterminate beams, frames by slope deflection method, momentdistribution method, Kani's Method and approximate analysis for frames.

CO3. Analyze the structure by flexibility and stiffness methods.

CO4. Determine plastic strength of a section, plastic mechanisms, plastic analysis and its application

Catalog Description

A structure refers to a system of connected parts used to support a load. Before designing, the structure must be analyzed to ensure that it has its required stiffness and strength. The results of the analysis are used for redesign the structure, accounting for a more accurate determination of the weight of the members and their size and simultaneous optimization. This course includes determination of degree of static and kinematic indeterminacy, understanding displacement and force method of analysis. Analysis of indeterminate beams, frames by slope deflection method, moment distribution method and approximate methods. Analysis by stiffness and flexibility matrix method and plastic analysis.

Course Content

Unit 1: Basic Concepts of Structural Analysis (06 Lecture Hours)

Types of skeletal structures, static and kinematics indeterminacy, equilibrium and compatibility conditions, stress-strain relations, force-displacement relations. Concept of linear /non-linear behavior of structures. Energy theorem, concept of complementary energy, Fundamental concept of Force and the Displacement method of analysis.

Unit 2: Slope Deflection Method and Approximate Metho (15 Lecture Hours)

Slope deflection method, applied to continuous and rigid jointed frames, transverse and rotational yielding of supports. (up to three unknown). Moment distribution & Kani's method applied to continuous beams and rigid jointed rectangular frames, transnational and rotational yielding of supports. Approximate analysis of trusses and multistory frames for vertical and cantilever method.lateral loads, substitute frame, portal frame

Unit 3: Fundamental Concept of Flexibility (06 Lecture Hours)

Method for structural analysis, flexibility coefficient, matrix formulation for flexibility methods, degree of freedom. Choice of redundant forces, compatibility equations, effect of settlement and rotation of supports, hand solution of simple problems on beams and rigid jointed frames (involving not more than three unknown)

Unit 4: Fundamental Concept of Stiffness (09 Lecture Hours)

Method of stiffness analysis, stiffness coefficient, matrix formulation for stiffness methods, degree of freedom. Stiffness matrix for frames with inclined member, physical significance of stiffness, effect of settlement and rotation on rigid jointed plane frames (involving not more than three unknown)

Unit 5: Plastic Analysis of Steel Structures (09 Lecture Hours)

Introduction, Shape factor, plastic hinge, collapse mechanism, upper bound and lower bound theories, application to continuous, fixed and single bay single storey rectangular frames.

Text Books

1. Hibbeler R.C. (2022), Structural Analysis, 10th edition, Pearson Education
2. Ramamrutham S. and Narayanan R. (2020), Theory of structures, 11th edition, Dhanpat Rai Publishing Company Ltd.

Reference Books

1. Bhavikatti S.S. (2021), Structural Analysis Vol-2, 5th edition, Vikas Publishing
2. Menon D (2010), Structural Analysis, Narosa

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination
Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) andCourse Outcomes (COs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Average	-	3	-	-	-	-	-	-	-	-	-	-	-	3

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3020	**Geotechnical engineering**	**2**	**1**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Mechanics and Engineering Mathematics**				
Co-requisites					

Course Objectives

I. To establish and understand the fundamental concepts of mechanics of soil particles, including the behaviour of soil in multiphase and constitutive behaviour of soil.
II. To provide students the exposure to the systematic methods for solving engineering problems in geotechnical engineering using basic mechanical principles
III. To analyse and predict soil behaviour under various loading conditions.

Course Outcomes

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

CO1. Identify and classify soil required for design purposes using various soil parameters.
CO2. Apply the concept of effective stresses, vertical stress due to external load, and permeability to predict soil behaviour under stress and seepage.
CO3. Utilize the mechanism of compaction to solve problems related to compaction in the field or lab.
CO4. Assess the magnitude and time-rate of settlement due to consolidation.
CO5. Estimate soil shear strength parameters with respect to the drainage conditions in the field or lab and analyze soil failure.

Catalog Description

Loads of any civil engineering structure will need to be transferred to and carried by earth through a foundation system. Foundation engineering requires knowledge of soil and its behaviour, i.e., geotechnical engineering. The objective of this course is to introduce the basics of geotechnical engineering to the students. Some of the topics that students will learn are soil structure, compaction, consolidation, permeability, seepage through soil and fundamental behaviour of soil under stress. After successful completion of this course students will be able to apply fundamentals of geotechnical engineering in the analysis and design of civil engineering projects.

Course Content

Unit 1: Soil Formation and Composition **(05 Lecture Hours)**

Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, interparticle forces, soil structure, principal clay minerals.

Unit 2: Soil properties and classification **(08 Lecture Hours)**

Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, relative density, consistency limits and their determination, activity of clays, Soil classification - classification based on grain size, classification on the basis of plasticity, plasticity chart, Indian Standard Classification System.

Unit 3: Permeability of Soil **(06 Lecture Hours)**

Soil-water systems – capillarity, Darcy's law, permeability, estimation of permeability in the laboratory and field, permeability of stratified soils, factors affecting permeability of soil.

Unit 4: Effective Stress Principle **(08 Lecture Hours)**

Principle of effective stress, effective stress under hydrostatic conditions, effective stress in the zone of capillary rise, effective stress under steady state hydro-dynamic conditions, seepage force, quick condition, critical hydraulic gradient, two-dimensional flow, Laplace's equation, properties and utilities of flownet, graphical method of construction of flownets, piping, protective filter.

Unit 5: Vertical stresses in soils **(05 Lecture Hours)**

Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart, contact pressure under rigid and flexible area, computation of displacements from elastic theory.

Unit 6: Compaction of Soil **(05 Lecture Hours)**

Introduction, role of moisture and compactive effect in compaction, laboratory determination of optimum moisture content, moisture density relationship, compaction in field, compaction specifications and field control of compaction.

Unit 7: Consolidation of Soil **(09 Lecture Hours)**

Introduction, components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande's graphical method of estimating pre-consolidation pressure, Terzaghi's theory of one-dimensional primary consolidation, determination of coefficients of consolidation, computation of consolidation settlement, secondary consolidation.

Unit 8: Shear Strength (09 Lecture Hours)

Introduction, Mohr stress circle, Mohr-Coulomb failure-criterion, relationship between principal stresses at failure, shear tests, direct shear test, unconfined compression test, triaxial compression tests, drainage conditions and strength parameters, Vane shear test, shear strength characteristics of sands, normally consolidated clays, over-consolidated clays and partially saturated soils, sensitivity and thixotropy.

Textbooks

1. Ranjan, G. & Rao, A. S. R. (2016). *Basic and Applied Soil Mechanics (Theory & Practice)*, Third Edition, New Age International Publishers.
2. V.N.S. Murthy, *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*, CRC Press.
3. Holtz, R. D. and Kovacs, W. D. *An Introduction to Geotechnical Engineering*, Prentice Hall, NJ.

Reference books

1. Das, B. M. Principles of Geotechnical Engineering, Cengage Learning.
2. Terzaghi, K., Peck, R. B. and Mesri, G. *Soil Mechanics in Engineering Practice*, John Wiley & Sons Inc.
3. Taylor, J. *Fundamentals of Soil Engineering*, Wiley & Sons.
4. Craig, R. F. *Soil Mechanics*, Chapman & Hall.
5. McCarthy, D. F. (2006) *Essentials of Soil Mechanics and Foundations: Basic Geotechnics*, Pearson.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Scheme:

Components	**Internal**	**Mid term**	**End Term examination**	**Total**
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives(PSOs)

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
Average	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3022	**Transportation Engineering**	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	**Knowledge of Surveying, Basic Knowledge of dynamics,** **Knowledge of construction materials**				
Co-requisites	**Not Any**				

Course Objectives

I. To educate the students on the fundamentals of transportation engineering along with the diverse aspects of highway development, planning and materials.
II. To provide knowledge of highway geometric design, road alignment, and traffic systems.
III. To make students familiar with various pavement materials, pavement design and testing methodologies.
IV. To give them detailed insight on the road construction practices and maintenance.

Course Outcomes (CO)

On completion of this course, the students will be able to:

CO1. Understand the concepts of highway development, planning and materials
CO2. Implement geometric design of roads and traffic engineering
CO3. Evaluate highway construction and maintenance
CO4. Design flexible and rigid pavements according to IRC codes

Catalog Description

Transportation Engineering is the application of scientific processes like observation, analysis and deduction to the planning, design, operation, and management of transportation facilities. It is also multidisciplinary and requires knowledge from specialized filed such as psychology, economics, ecology and environment, sociology, management, optimization, graph theory, probability theory, statistics, computer simulation and other areas of civil engineering such as structural and geotechnical engineering.

Course Content

Unit 1: Highway Development and Planning (06 Lecture Hours)

Historical Development, road patterns, master plans, road development plans, PMGSY, engineering surveys, highway projects. Highway Materials and Testing: Subgrade soil, sub base and base course materials, bituminous materials, testing of soil, stone aggregates and bitumen.

Unit 2: Highway Geometric Design (06 Lecture Hours)

Cross section elements, sight distances, horizontal and vertical alignment.

Unit 3: Traffic Engineering (10 Lecture Hours)

Traffic characteristics, road user & vehicular characteristics, traffic studies, accident studies, traffic operations, traffic control devices, intelligent transport systems, pollution due to traffic.

Unit 4: Design of Highway Pavements (09 Lecture Hours)

Flexible pavements and their design, review of old methods, CBR method, IRC: 37-2001, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method (IRC: 58-2002).

Unit 5: Highway Construction (07 Lecture Hours)

Construction of various layers, earthwork, WBM, GSB, WMM, various types of bituminous layers, joints in rigid pavements.

Unit 6: Highway Maintenance (07 Lecture Hours)

Various type of pavement failures, evaluation and remedial measures.

Text Books

1. Khanna, S.K. and Justo, C.E.G., "*Highway Engineering*", Nem Chand & Bros.
2. Khanna, S.K. and Justo, C.E.G., "*Highway Material Testing Manual*", Nem Chand & Bros.
3. Kadiyali, L.R., "*Traffic Engineering and Transportation Planning*", Khanna Publishers.

Reference Books

1. Sharma, S.K., "*Principles and Design of Highway Engineering*", S. Chand & Co.
2. Papacostas, C.S. and Prevedouros, P.D., "*Transportation Engineering and Planning*", Prentice Hall.
3. Jotin Khisty, C. and Kent Lall, B., "*Transportation Engineering – An Introduction*", Prentice Hall.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Scheme:

Components	Internal	Mid-term examination	End term examination	Total
Weightage (%)	50%	20%	30%	100%

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO-1	3	-	-	-	-	3	-	3	-	-	-	-	3	-
CO-2	-	-	3	-	-	-	-	3	3	3	-	-	-	3
CO-3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO-4	-	-	3	-	-	-	-	3	3	3	-	-	-	3
Average	**3**		**3**			**3**		**3**	**3**	**3**			**3**	**3**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
CIVL3084	**Water Resources Engineering**	**3**	**1**	**0**	**4**
Pre-requisites/Exposure	• **Knowledge of Mathematics,** • **Knowledge of Introduction to Fluid Mechanics**				
Co-requisites	**Not Any**				

Course Objectives (COs):

I. To know the general elements of rainfall and its characteristic from India's point ofview.

II. To study precipitation, infiltration, and evapotranspiration.

III. To discuss various parameters of Runoff and hydrographs.

IV. To design a canal outlet and associated hydraulic structures.

Course Outcomes:

On completion of this course, the students will be able to;

CO1. Estimate precipitation and various losses in hydrological system.

CO2. Implement the concepts of infiltration, runoff, hydrograph and design flood

CO3. Analyze the various irrigation system and soil-water relationship.

CO4. Design irrigation canal system and modeling of rainfall-runoff system

Catalog Description:

Water Resources in one of the most important aspects for a nation. Its study becomes more important for a monsoon dependent nation like ours. The processes affecting rainfall and runoff and their quantification is one of the most challenging tasks for a water resources engineer. As rainfall is a stochastic process, its prediction is a very complex process indeed. All these challenges are reflected in this course. This course also deals with Evapotranspiration, infiltration, flood forecasting, hydrographs and irrigation engineering with topics like canal irrigation and river training. Each of the aforementioned components are indispensable for a nation and its careful study and analysis thus should be the duty of a water resource engineer.

Course Content

Unit 1: Introduction (02 Lecture Hours)

Hydrologic cycle, water-budget equation, history of hydrology, world water balance, application in engineering, sources of data. Comparison of water budget of India and World. Water stress situation and factor responsible for the same. Water crises in India.

Unit 2: Precipitation (08 Lecture Hours)

Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, raingauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India. Collection of rainfall, temperature, humidity and other data from various sources and their real time application in predication modeling. Errors and corrections in data sets. Consistency checks for data.

Unit 3: Abstractions from precipitation (08 Lecture Hours)

Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration , interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices. Application of MATLAB in quantification of potential evapotranspiration, development of code and plotting of time series plots.

Unit 4: Runoff (10 Lecture Hours)

Runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows. Introduction to hydrological modelling software like HEC-HMS, HEC-RAS, MIKE-SHE etc. Project based on the any hydrological modelling software and their used in design of hydraulic structure.

Unit 5: Water Withdrawals and Uses (10 Lecture Hours)

Water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigat io n; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigatio n. Ask students to prepare a water budget of any state of India, so that they can aware about the water resources in local regions. Policies, act and law related of water use in India.

Unit 6: Distribution Systems **(10 Lecture Hours)**

Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods. Application of various soft computing techniques in design and optimization of distribution systems.

Textbooks

1. Subramanya, K. (2008). Engineering hydrology. McGraw-Hill.
2. Asawa, G. L. (2011). Irrigation Engineering, Wiley Eastern
3. Mays, L. W. (2010). Water resources engineering. John Wiley & Sons.
4. Zimmerman J. D. (2013) Irrigation. John Wiley & Sons.
5. Ojha, C. S. P., Berndtsson, R., & Bhunya, P. (2008). Engineering hydrology.

Reference Books

1. Garg, V., Singh, V. P., & Raj, V. (Eds.). (2017). *Development of Water Resources in India*. Springer International Publishing.
2. Maidment, D. R. (2002). *Arc Hydro: GIS for water resources*. ESRI, Inc..
3. Mays, L. W. (2010). *Water resources engineering*. John Wiley & Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	50%	20%	30%	100%

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and ProgramSpecific Objectives (PSOs):

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO-1	-	3	-	3	-	3	-	-	-	-	-	-	-	2
CO-2	-	3	-	3	-	3	-	-	-	-	-	-	-	2
CO-3	-	3	-	2	-	3	-	-	-	-	-	-	-	2
CO-4	-	-	3	3	-	3	-	3	3	3	-	-	-	2
Average	**-**	**3**	**3**	**2.75**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**2**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**

Course Code	Course Name	L	T	P	C
PROJ4135	**RESEARCH PROJECT I**	**0**	**0**	**4**	**2**
Pre-requisites/Exposure	**Knowledge of civil engineering**				
Co-requisites	**--**				

Course Objectives

I. To allow students to develop better understanding about the literature search and identify a problem statement for the project work.

II. To enable students to develop the ability to apply principles, tools, and techniques to address the problem statement.

III. To make students aware with the practical work-environment related to civil engineering domain.

IV. To make students familiar with the experience of working in a team, prepare project reports and presentation related to the project work.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the real-life / practical problems and the literature review.

CO2. Develop better understanding about research approach and project report preparation.

CO3. Work effectively and efficiently as a team member.

CO4. Address the problem statement and work towards the solution for the same by using the

Principles, tools, and techniques.

Catalog Description

Research project I aims at providing students with practical knowledge of the civil engineering domain. In the research project I students will identify through literature search or from industry and address the real-life problem related to civil engineering and will attempt to find the solution for it. In this course students will be divided into groups, and they will collectively work to find the solution to the problem applying appropriate principles, tools, and techniques.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination

Scheme:

Evaluation will be assessed through detailed report of the project work, presentation, and viva of the students regarding their project work.

Components	**Continuous evaluation**	**Format**
Weightage (%)	100%	Viva, Performance and Technical Report

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO2	3	3	3	3	3	3	3	3	3	3	-	3	-	2
CO3	-	-	-	3	3	-	-	-	-	3	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	2
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	-	**3**	-	**2**

1- Weakly mapped **2- Moderately mapped** **3-Strongly mapped**