SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS

B.E. CIVIL ENGINEERING

2024-25

Vision of the Department of Civil Engineering

To become a premier Civil Engineering Department offering excellent engineering education in design methods and advanced technologies to the students, to pursue research in thrust areas and to offer professional services to the society.

Mission of the Department of Civil Engineering

The Department is committed to develop competent professionals by offering need based curriculum in Civil Engineering areas, promoting research and innovation to prepare the students for higher study, life-long learning and societal responsibility. The department is also committed to provide good learning environment to develop professional ethics and skills in our students and to provide engineering services to the society.

Programme Educational Objectives of Civil Engineering

PEO#1	Graduates of the program will practice Engineering profession as competent professionals applying fundamentals, state-of-the-art knowledge and technical skills. ***[Theme: Practice Engineering profession as competent professionals]***
PEO#2	Graduates of the program will excel in higher education with life-long learning. ***[Theme: Higher education and life-long learning]***
PEO#3	Graduates of the program will exhibit leadership qualities, communication skills and team spirit. ***[Theme: Communication and team work]***
PEO#4	Graduates of the program will contribute to societal needs with ethical attitude. ***[Theme: Initiated to Society and ethical practice]***

Programme Outcomes of Civil Engineering

The following list of program outcomes describes what graduates are expected to know and be able to do at the time of graduation. Graduates will have:

PSO#1	An ability to conduct standardized field testing on civil engineering materials, interpret experimental data and provide conclusions. Demonstrate the construction of masonry, reinforcement fabrication for beams columns, slabs, etc., electrical wiring, assembling of water supply and sanitary layouts, application of painting and welding of joints. *[Short title: CE Field experiments and demonstration].*
PSO#2	An ability to estimate material quantities, cost estimates, prepare specifications, produce engineering drawings by conducting appropriate survey works and 3D modeling of systems/components using modern tools for technical projects *[Short title: CE technical reports and 3D modeling].*
PSO#3	Able to perform analysis and design in at least three to four of the technical areas appropriate to Civil Engineering. *[Short title: CE Technical areas].*

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **Design/development of solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
5. **Engineering tool usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
10. **Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **Life-long learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Civil Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

Sl. No.	Course and Course Code		Course Title	Teaching /Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutoria l	Practical/ Drawing	Self Study Component	Durationin hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	PCC	N7CV01	Estimation costing, Valuation and Contract Management		42	0	0	48	3	50	50	100	3
2.	PEC	N7CVPE2x	Professional Elective Course-II		42	0	0	48	3	50	50	100	3
3.	PEC	N7CVPE3x	Professional Elective Course-III		42	0	0	48	3	50	50	100	3
4.	OEC	NOE71	Open Elective Course-II		42	0	0	48	3	50	50	100	3
5.	AEC	NSH09	Research Methodology & Intellectual Property Rights		28	0	0	32	3	50	50	100	2
6.	Project	N7CVP	Project Work		Monday to Thursday shall be earmarked for carrying out Project work				3	100	100	200	10
			Total							**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points		40 hours community service to be documented and produced for the examination								
VIII Semester													
1.	Seminar	CVTS	Technical Seminar		One contact hour /week for interaction between the faculty and students.					100	--	100	1
2.	Internship	CVINT3	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students.					100	100	200	15
3.	NCMC		National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.					50	50	100	0
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**	---	**100**	**0**

Professional Elective -II		**Professional Elective - III**	
N7CVPE21	Green Construction and Alternate Building Materials	N7CVPE31	Prestressed Concrete Structures
N7CVPE22	Design of Reinforced Earthl Structures	N7CVPE32	Bridge Engineering
N7CVPE23	Urban Transportation and Planning	N7CVPE33	Advanced Geotechnical Engineering
N7CVPE24	Air Pollution and Control	N7CVPE34	Earthquake Resistant Design of Structures
N7CVPE25	Watershed Management	N7CVPE35	Traffic Engineering
N7CVPE26	Industrial waste treatment	N7CVPE36	Construction Automation and Robotics

Note: **PCC**: Professional Core Course, **PEC**: Professional Elective Course, **OEC** –Open Elective Course, **AEC** –Ability Enhancement Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

Estimation costing, Valuation and Contract Management

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CV01	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	•To prepare the different types of estimates for various structures, taking out quantities, preparing specifications and rate analysis for buildings.
2	•To understand the types of Valuation including its preparation, documentation.
3	•To understand the Alternate Dispute Resolution and its mechanisms.

UNIT I

9 Hours

Introduction: Importance of estimation in civil engineering, different type of estimates, methods of estimations, study of various drawings and preparing estimates. Concept and units of measurement. • Estimation: Calculating the quantities and cost by center line, long wall and short wall methods. Preparing of detailed and abstract of estimates for the buildings of flat roof. •

UNIT II

9 Hours

Building Components: Estimating the quantities and cost of RCC beams, columns and footings, roof slabs, water supply and sewerage works like manhole, septic tank. • Specifications: Definition, objective and writing general and detailed specifications of item of works in buildings, roads, minor bridges and industrial structures. • Rate analysis from first principles: Definition and purpose, working out quantities and rates for standard items of earthwork, cement concrete mixes, brick and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items. •

UNIT III

8 Hours

Contracts - Types of contract-essentials of contract agreement- legal aspects, penal provisions on breach of contract. Definition of the terms-Tender, earnest money deposit, security deposit, tender forms, documents and types. Pre-qualification tenders, Comparative statements, acceptance of contract documents and issue of work orders. Duties and liabilities, arbitration, termination of contract, completion certificate, quality control certification, right of contractor, refund of deposit. Administrative approval-Technical sanction. Nominal muster roll, measurement books-procedure for recording and checking measurements preparation of bills. • Measurements of Earth work for roads: Methods for computation of earth work-cross sections-Mean depth or mid-section formula, mean sectional area or Trapezoidal formula. Prismoidal formula, with and without cross slopes. •

UNIT IV

8 Hours

Valuation: Purpose and different forms of valuations and methods, factors affecting intrinsic values of land, comparative method, abstractive method, belting method. Cost of structure, BIS rules for measuring plinth area and cubical contents. Valuation of land with buildings: Rental, land and building, valuation on profit basis, direct comparison of capital value, residual or development methods. Rights and liabilities of lessor and lessee, leasehold properties, freehold properties. •

UNIT V	
	8 Hours
Introduction to ADR: • Definition, nature, and scope of ADR, History and development of ADR in India, Advantages and disadvantages of ADR, Comparison with the traditional judicial system • Types of ADR Mechanisms: • Negotiation: Definition, features, and types of negotiation, Techniques and strategies • Mediation: Concept and role of a mediator, Types of mediation (facilitative, evaluative, transformative), Mediation process and stages, Ethical concerns in mediation • Conciliation: Legal framework (Arbitration and Conciliation Act, 1996), Differences between mediation and conciliation • Arbitration: Meaning, features, and types of arbitration (institutional and ad hoc arbitration), Arbitrability of disputes, Composition of arbitral tribunals, Arbitration process and proceedings •	

TEXT BOOKS:		
1	Dutta B.N.	"Estimating & Costing in civil engineering- theory and practice including Specifications &valuation", 28th Rev. Ed., CBS publications and distributors, New Delhi, 2020, ISBN- 10:8174767703, ISBN-13:978-8174767707
2	Rangwala,S.C.	"Valuation of Real properties", 10th Ed., Charotar Publishing House, Anand, New Delhi,2015, ISBN-10:9385039016, ISBN-13:978-9385039010
3	Narang, S.S.	Alternative Dispute Resolution: An Indian Perspective, Eastern Book Company, FirstEdition, 2022

REFERENCES:		
1	Rangwala,S.C.	"Estimating, costing and valuation", 17th Ed., Charotar Publishing House, Anand, NewDelhi, 2017, ISBN:978-93-85039-05-8.
2	Chakraborti,N.	"Estimating, Costing, specification & valuation in Civil Engg.",28th Edition 2010, M KPublisher and Distributor, Calcutta.ISBN-10:8185304366, ISBN-13:978-8185304366
3	Singh, S. K.	Understanding Arbitration and Conciliation, LexisNexis India, First Edition, 2021

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Estimate the quantity and cost of the building and its components as per standard procedures
CO2	Write specifications and estimate the quantity and cost for different civil engineering items and perform rate analysis.
CO3	Write departmental procedure for preparing contracts, agreements, legal aspects, tenders etc. Estimate the quantities and cost of road work.
CO4	Identify the different valuation methods for different types of real properties and perform valuation.
CO5	Understand the basic terminologies and mechanisms of Alternate Dispute Resolution (ADR)

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1										1			3	
CO2										1			3	
CO3										1			2	
CO4										1			1	
CO5						2				1			1	

Green Construction and Alternate Building Materials

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE21	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Explain the concepts of green buildings,
2	Explain the use of alternate building materials and alternate building technologies
3	Explain the energy-efficient measures in the construction practices to reduce the carbon footprint.

UNIT I

9 Hours

Green Buidlings: • Environmental impact of building constructions, Green concepts and environmental, social and economical benefits, Concept of embodied energy, carbon footprint, Green building ratings – GRIHA and LEED manuals – mandatory requirements, Principles of sustainable development in building design and their characteristics. •

UNIT II

9 Hours

Alternate Building Materials: • Alternate fuels for the production of cement, Pozzolana cements, Lime - properties and uses, eco-friendly binders and aggregates-GGBS, Silica fume aggregates, Gypsum board, artificial fibers for reinforced concrete (glass, carbon, steel) –properties and their sustainable benefits, Building materials from agro and industrial wastes, Rubber wood, PVC flush doors, interlocking blocks for walls. •

UNIT III

8 Hours

Alternate Building Technologies: • Use of arches in foundation, alternatives for wall construction methods – cavity walls, rat trap bond, composite masonry, confined masonry, Alternates for RCC lintels, Mivan Construction Techniques, Light weight beams, Composite fillers roof slabs, hallow core roof slabs, profile sheet roofing, Composite beam panel roofs, foam concrete floors •

UNIT IV

8 Hours

Site selection and planning: • Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting. • Indoor Environmental Quality: • Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. • Integrated Life cycle design of Materials and Structures: • Recycling/reuse of Construction and demolition wastes – wood, coarse aggregates, glass, steel, bitumen. •

UNIT V

8 Hours

Green Composites for Buildings: • Concepts of Green Composites. Water Utilisation in Buildings, Utility of solar energy in buildings –solar passive & cooling, Low Energy approaches to Water Management. Management of Sullage and Sewage, water efficient plumbing systems, Green Cover and Built Environment, Contribution of environmental awareness in building construction – contribution by Costford, Nirmithi Kendra, Habitat, Rainwater harvesting. •

TEXT BOOKS:		
1	HarharaIyer G,	Green Building Fundamentals, Notion Press
2	Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S	Alternative Building Materials and Technologies, New Age International pub.

REFERENCES:		
1	Harshul Savla	Green Building: Principles & Practices
2	Spence R J S and Cook D J	Building Materials in Developing Countries, Wiley pub.
3	Clarke Snell,	Building Green: A Complete How-To Guide to Alternative Building Methods, Sterling publishers, 2009, ISBN-10 1600595340, ISBN-103 978-1600595349

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Explain the concepts of principles of green building and their ratings.
CO2	Explain the selection of different building materials for the construction of green buildings.
CO3	Explain the alternate building technologies for sustainable construction practices.
CO4	Explain energy saving techniques in lighting and ventilation of buildings and reuse/ recycle of demolition waste
CO5	Explain utilization of solar passive energy, spent water and built environment for thermal comforts of buildings

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2					2						1		
CO2	2					2						1		
CO3	2					2						1		
CO4	2					2						1		
CO5	2					2						1		

Design of Reinforced Earth structures

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE22	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES: This course will enable students to:	
1	Create an understanding of the latest technique such as reinforcing the soil
2	Analyze the concept of RE so as to ascertain stability of RE structures
3	identify the different reinforcing materials that can be used efficiently in soils
4	comprehend the design concepts of different RE structures

UNIT I

9 Hours

Basics of Reinforced Earth Construction • Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantages of reinforced earth Construction, Sandwich technique for clayey soil. • Geosynthetics and Their Functions • Historical developments, Recent developments, manufacturing process woven & non-woven, Raw materials –Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Geosynthetics. • Properties and Tests on Materials Properties • Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Testing & Evaluation of properties. •

UNIT II

9 Hours

Design of Reinforced Earth Retaining Walls • Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problems • Soil Nailing Techniques • Concept, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken •

UNIT III

8 Hours

Design of Reinforced Earth Foundations • Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines. •

UNIT IV

8 Hours

Geosynthetics for Roads and Slopes • Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of subgrade, Design requirements Slopes – Causes for slope failure, Improvement of slope stability with Geosynthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes. •

UNIT V

8 Hours

Geosynthetics - filter, drain and landfills • Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soil retention, Geosynthetic permeability, anti clogging, survivability and durability (No Numerical Problems) Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps (No Numerical Problems). •

TEXT BOOKS:		
1	Swami Saran	"Reinforced Soil and its Engineering Applications", Dreamtech Press, 3 Edition (2019), ISBN-10: 9389307902, ISBN-13: 978-9389307900
2	Sivakumar Babu G. L	"An introduction to Soil Reinforcement and Geosynthetics", Universities Press; First Edition (2005), ISBN-10: 8173714819, ISBN-13: 978-8173714818

REFERENCES:		
1	Koerner. R.M	"Design with Geosynthetics", Prentice Hall; 2nd edition (1990), ISBN-10 : 0132023008, ISBN-13 : 978-0132023009
2	Venkattappa Rao, G., & Suryanarayana Raju., G. V.S,	"Engineering with Geosynthetics," Tata McGraw Hill Publishing Company Limited., New Delhi. (1990)
3	Jones	"Earth reinforcement and Soil structure", CJEP Butterworths, London
4	Sanjay Kumar Shukla and Jian-Hua Yin	"Fundamentals of Geosynthetic Engineering", CRC Press; 1st edition (2006), ISBN-10 : 0415394449, ISBN-13 : 978-0415394444

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Identify, formulate reinforced earth techniques that are suitable for different soils and in different structures
CO2	Comprehend the laboratory testing concepts of Geosynthetics
CO3	Design reinforced earth retaining structures and soil nailing concepts
CO4	Determine the load carrying capacity of foundations resting on the reinforced earth soil bed.
CO5	Assesses the use of Geosynthetics in drainage requirements and landfill designs

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2												
CO2		2												
CO3		2												
CO4		2												
CO5		2												

Urban Transportation & Planning

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	0
Sub. Code:	N7CVPE23	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:

This course will enable students to:

1	Understand the elements of urban transit system, planning process, transport studies, trip generation, trip distribution, mode choice and mass transit systems.

UNIT I

9 Hours

Introduction: • Characteristics of different modes of transportation; Principles of co-ordination and operation control, Elements in urban transit system, NUTP Transportation Planning Process: Factors to be considered; land use transportation planning; Systems approach, integration of transport planning, traffic and land use planning. •

UNIT II

9 Hours

Transport studies: • Planning of different types of surveys and interpretation, travel demand and forecasting Traffic surveys for mass transit system planning. •

UNIT III

8 Hours

Trip Generation and Distribution: • Factors governing trip generation and attraction; Zonal models; Category analysis; Methods of trip distribution; Application of gravity model. •

UNIT IV

8 Hours

Modal Split and Assignment: • Factors affecting modal split; Modal split in transport planning; principles of traffic assignment; Assignment techniques, integration of multimodal transport systems. •

UNIT V

8 Hours

Mass Transit Systems: • Introduction to routing and scheduling, transit system's performance parameters. Corridor identification and corridor screen line analysis. Urban forms and structures: point, linear, radial, poly-nuclear developments and suitable transit systems, Urban goods movement. Preparation of comprehensive plan and transportation system management planning. •

TEXT BOOKS:

1	Papacostas, C. S., and Prevedouros, P. D.	Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt. Ltd., 2002.
2	Kadiyali, L.R.	Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2013.

REFERENCES:		
1	Hutchinson, B.G.	Principles of Urban Transport Systems Planning, McGraw Hill, London, 1974.
2	Khisty, C. Jotin and Lall, B.Kent	Transportation Engineering and Planning, 3rd Edition, Pearson India, 2001.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Explain planning process for an effective transportation system.
CO2	Describe the various methods of collecting traffic data to propose an effective transport facility.
CO3	Evaluate zonal trip generation and attraction for inter-zonal trip distribution methods.
CO4	Evaluate transport system for assigning travel trips to various routes for effective management and economic sustainability.
CO5	Elaborate on the urban mass transit system operation and urban goods movement.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2												1
CO2	3	2												1
CO3	3	2	2											2
CO4	3	2	2											2
CO5	3	2												1

Air Pollution & Control

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	0
Sub. Code:	N7CVPE24	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Learn History of air pollution; definition of air pollution and various types of sources and classification of air pollutants
2	Learn the effects of gaseous and particulate air pollutants on humans, plants and materials; principles of air pollution control and various control equipment at source.
3	Understand the techniques and instrumentation of ambient air sampling, stack monitoring and experimental analysis of air gaseous and particulate air pollutants.
4	Learn the meteorological components, stability of the atmosphere and corresponding plume shapes.
5	Gain knowledge of recent problems concerning global warming, ozone holes, acid rains and smog formation.
6	Learn the standards and legislation regarding environmental impact assessment in industrial plant locations and planning.

UNIT I

9 Hours

Introduction • composition of air, Definition of air pollution, Classification of pollutants-natural contaminants, aerosols (particulate matter), dust, smoke mist fog and fumes. Gases and vapours • Primary and secondary pollutants. Smog-photo chemical and coal induced smog. Behavior and fate of air pollutants. wet removal, dry removal and chemical reactions in the atmosphere • Effect of air pollution on human health. Mechanism of action of air pollutants. • Effect of air pollution on animals due to fluorine, arsenic and lead. • Effect of air pollution on plants. Effect of air pollution on properties. •

UNIT II

9 Hours

Meteorological factors affecting air pollution- atmospheric stability and temperature inversions. Wind rose diagram. • Ambient air sampling, collection of gaseous pollutants. Grab samples, absorption in liquids, adsorption on solids. • Freezeout sampling, collection of particulate pollutants. Dustfall jar, high-volume filtration. • Tape sampler, Impringement Electrostatic precipitation •

UNIT III

8 Hours

Control of gaseous contaminants-combustion, absorption and adsorption. • Control of air pollution by equipment-objectives of using control equipment, use of collector in series. Types of collecting equipment-settling chambers-advantages and applications • Inertial separators-principles, types-Baffle type, Louver type and dust traps. • Cyclone separator-advantages, disadvantages and applications Filters-Fabric or cloth filters- Reverse jet filter- Envelope type fabric filter and multiple compartment type bag house. • Electrostatic precipitators. Scrubbers or wet collectors-spray towers, venture, cyclone, packed and mechanical scrubbers •

UNIT IV

8 Hours

Air pollution due to automobiles-Introduction, Exhaust emission, crank case emission and evaporative emission. • Control of exhaust emission-modification in engines, treatment of exhaust gas. Catalytic converters. • Control of evaporative emission and crank case emission. Alternate methods. • Acid rain, Acid rain formation, Effects of acid rain on soil, surface waters, human health, materials, plants and animals •

Green house effect- Effects of global warming on Climate, sea level, Water resources, Vegetation, Human health, Human settlement and society, Energy, Clouds and water vapour. Reduction of green house gases •

UNIT V

8 Hours

Major air pollution episodes-Bhopal gas episode (1984), London smog (1952), Meuse valley (Belgium 1930), Donora(USA 1948),Poza Rica(Mexico 1950), Tokyo(1967) • Standards and legislation-The air (prevention and control of pollution) act 1981. Constitution of the board, functions of central and state board. Ambient air quality standards, emission standards, penal provision act Air pollution indices-Determination of index. Diaplay Dissemination technique • Legislation to control air pollution and industrial plant location - City planning-factors to be considered. •

TEXT BOOKS:

1	Rao M.N. & Rao H.V.N	Air Pollution, Tata Mc Graw Hill Publishing Company Ltd., 2007, ISBN-13:9780074518717

REFERENCES:

1	Anjaneyalu Y	Air Pollution and control Technologies, Allied Publishers (P) Ltd., 2012., ISBN 9789387593435
2	Noel De Nevers	Air Pollution Control Engineering, Waveland Press, Inc., 2017.

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Explain the effect of air pollution on humans, animals, plants and Property.
CO2	Explain the methods of collecting air samples
CO3	Explain the methods of controlling gaseous contaminants
CO4	Describe the method of controlling air pollution due to automobiles, effect of acid rains and global warming.
CO5	Describe the major air pollution episodes, legislation to control air pollution and industrial plant location.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						3						1		
CO2						3						1		
CO3						3						1		
CO4						3						1		
CO5						3						1		

Watershed Management

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	0
Sub. Code:	N7CVPE25	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Enable the students to learn the basics of Water Resources and Watershed Management.
2	Students will gain the knowledge of water resources planning, governance and water policy issues.
3	The course also helps in understanding the techniques of Watershed management for managing floods and drought.

UNIT I

9 Hours

Water Resources Planning: • Introduction, India's water resources, scenario of water use, purposes of water resources development, classification of water resources development projects, functional requirements in multi-purpose projects, process of project formulation, project evaluation, strategies for the future-planning and management strategies. • Surface and Ground water Resources: • Hydrologic Cycle, Global water resources and Indian water resources, Surface Water Resources, Water Balance, Available Renewable Water Resources, Water Scarcity, The water Balance as a result of Human Interference, Groundwater Resources, Types of Aquifers, Groundwater as a Storage Medium. •

UNIT II

9 Hours

Water Governance and water Policy: • Legal Framework of water – Substance of National Water Laws – other Key issues – Changing incentives through Regulation – National Water Policy – National Level Commissions – Irrigation Management Transfer Policies and Activities – Legal Registration of Water use as – Legal Changes in Water Allocation, - Role of Local Institutions – Community Based Organizations – Water Policy Reforms:India •

UNIT III

8 Hours

Watershed Management: • Concept of watershed, introduction to watershed management, stakeholders, watershed management policies. Characteristics of watershed • Integrated water resources management: • Natural resources management, agricultural practices, integrated farming, soil conservation, rainwater harvesting, water conservation and recycling, watershed management practices in arid and semi-arid regions, case studies. •

UNIT IV

8 Hours

Watershed Modeling: • Standard modeling approaches and classifications, system concept of watershed modeling, hydrologic processes, modeling of rainfall-runoff process, subsurface flow and groundwater flow. •

UNIT V

8 Hours

Flood Management and Modern Techniques in Watershed Management: • Storm water management, drainage system design, routing of floods, through channels and reservoirs, flood control, case studies and flood damage. Application of GIS and remote sensing in Watershed Management, Decision support system in Watershed Management. •

TEXT BOOKS:		
1	Peter P. Mollinga	Integrated Water Resources Management, Water in South Asia Volume I, Sage Publications,2009, ISBN-10 : 9353280397 , ISBN-13 : 978-9353280390
2	Vir Singh Raj	Watershed Planning and Management, Yash Publishing House, Bikaner, 2000, ISBN:8186882022, ISBN:9788186882023

REFERENCES:		
1	Allam, Gamal Ibrahim Y	Decision support system for integrated Watershed Management, Colorado University, 1994 ISBN:9781552093306 ISBN:1552093301
2	Murthy, J.V.S.	Watershed Management in India, Wiley Eastern, New Delhi, 2013, 2nd Edition ISBN: 9788122435184

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Describe the planning and management strategies of water resources for multipurpose development projects.
CO2	Describe the water laws policies related to water allocation, reforms and irrigation management as per the national water policy.
CO3	Explain the fundamental concepts of Watershed Behavior and water management and explain the application of modern techniques in watershed management.
CO4	Apply the standard techniques to model the rainfall runoff, subsurface & ground water flow including computation of quantity of useful water available in watersheds.
CO5	Describe the flood management measures and the modern techniques such as GIS & Remote sensing for watershed management and decision support system.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1											2
CO2	3	2	1											2
CO3	3	2	2											2
CO4	3	3	3											2
CO5	3	2	3											2

Industrial Waste Treatment

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE26	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	This course introduces the students to the characterization of industrial wastewater and their effects on environment, type and characteristics of pollutants in streams and municipal wastes, treatment of wastes using physical, chemical, and biological methods, the standards and permissible limits for the discharge of treated waste, air pollutants and their quantification and treatment.
2	Understand Air pollutants and their quantification and treatment.

UNIT I

9 Hours

Introduction • Characteristics of industrial wastewater, pollutants in industrial wastewater and their effects, population equivalent. Difference between domestic and industrial wastewater, Effect of waste on streams and on municipal treatment plants. Stream quality, standards of stream quality for public water supply, industrial water supply and for aquatic life. Disposal by dilution and numerical examples using Streeter Phelps's equation, Industrial effluent standards for disposal into streams, on land and into sewers. Stream sampling. Economics of wastewater treatment. Legislation to control water pollution. •

UNIT II

9 Hours

Treatment Methods: • Volume, strength reduction, neutralization, equalization and proportioning. Removal of suspended solids by sedimentation, flotation and screening. Removal of colloidal solids by chemical coagulation and adsorption. Removal of organic solids by lagooning in oxidation ponds, activated sludge treatment, modified aeration, dispersed growth aeration, contact stabilization, high-rate aerobic treatment, trickling filtration, spray irrigation, wet combustion, anaerobic digestion, mechanical aeration system, well injection and foam separation. Numerical example on design of: sedimentation tanks, aeration tanks and trickling filters. •

UNIT III

8 Hours

Combined Treatment: • Treatment and disposal of sludge solids by anaerobic and aerobic digestion, vacuum filtration, drying beds, sludge lagooning, incineration, centrifuging and sanitary land filling. Feasibility of treatment of raw industrial wastes with domestic wastes and partially treated industrial wastes with domestic wastes. Discharge of completely treated waste to municipal sewer systems Discharge of partially treated industrial wastes directly to streams Discharge of completely treated wastes to streams or on land. Low cost waste water treatment methods- oxidation ponds, oxidation ditch and aerated lagoons. •

UNIT IV

8 Hours

Treatment of some industrial wastewater: • Characteristics, treatment and disposal of industrial wastewater form Dairy industry, Paper and pulp industry, Sugar industry, Tannery industry, cotton textile industry, woollen textile industry and Pharmaceutical industries •

UNIT V	
	8 Hours
Air pollution: • Introduction, Definition of air pollution composition of air. Ambient air sampling, collection of gaseous pollutants. Grab samples, absorption in liquids, and adsorption on solids. Freezeout sampling, collection of particulate pollutants. Dust fall jar, high-volume filtration. Tape sampler, Impingement Electrostatic precipitation, Thermal precipitation. Treatment of gaseous pollutants by Cyclone separator, Filters-Fabric or cloth filters, Reverse jet filter, Envelope type fabric filter and multiple compartment type bag house, Electrostatic precipitators-principles. Pipe type and plate type precipitators. Dry and wet precipitators. Industrial applications of electrostatic precipitators, Scrubbers-spray towers, ventury, cyclone, packed and mechanical scrubbers. •	

TEXT BOOKS:		
1	Patwardhan A. D	Industrial wastewater treatment (2017). PHI Learning Pvt. Ltd. ISBN-13: 978-8120333505
2	Rao C. S.	. Environmental pollution control engineering (2007), New Age International. ISBN-13:978-9386649898

REFERENCES:		
1	Nemerow, N. L., & Agardy,F. J.	Strategies of industrial and hazardous waste management (1998), JohnWiley & Sons.
2	Nelson L. Nemerow	Industrial waste water treatment, Wesley Publishing co. ISBN:9780123724939

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Compute pollution levels in streams before and after the disposal of the industrial waste and apply legislation standards
CO2	Decide the pre-treatment methods required for different type of industrial waste
CO3	Design various wastewater treatment units
CO4	Identify the characteristics of industrial wastes and recommend suitable sequence of treatment units
CO5	Identify air pollutants and their treatment

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2					2								
CO2	2					2								
CO3	2					2								
CO4	2					2								
CO5	2					2								

Prestressed concrete structures

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	0
Sub. Code:	N7CVPE31	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Introduce to the basic concepts of PSC, stress analysis.
2	Analyze the loss of prestress
3	Analyze the importance of Deflection of prestress members.
4	Analyze Flexural Strength of PSC members
5	Analyze Shear and Torsional resistance of PSC members

UNIT I

9 Hours

Introduction to PSC structures: Introduction to Prestressed concrete structures- Basic concepts of Pre-stressing. Historical development, Advantages of pre-stressed concrete. Applications of pre-Stressed concrete, Need for High strength concrete and steel. Basic Principles of Prestressing. Tensioning Devices. Pre-tensioning and Post Tensioning Systems. Thermo-Electric Pre-stressing. Chemical Pre-stressing and shear stress. Analysis of Pre-stress and Bending Stresses Basic assumptions, Analysis of Pre-stress. Resultant stresses at a section. Pressure line or Thrust line and internal Resisting couple. Stresses in Tendons. Cracking Moment •

UNIT II

9 Hours

Losses of Prestress: Losses of Pre stress. Loss due to elastic deformation of concrete, due to shrinkage of concrete, Creep of concrete, Relaxation of stress in steel, Due to anchorage slip. Total losses allowed for in the design. Determination of jacking force •

UNIT III

8 Hours

Deflection of Prestressed concrete members. Importance of control of deflections. Factors influencing deflections. Short- and long-term Deflection. Elastic Deflections under transfer loads and due to different cable profile. Deflection limits as per IS 1343. Effect of creep on deflection. Load verses deflection curve •

UNIT IV

8 Hours

Flexural Strength of PSC members: Flexural Strength of Prestressed concrete members. Types of Flexural Failure. Strain compatibility method. Simplified code procedures. •

UNIT V

8 Hours

Shear and Torsional resistance of PSC members: Shear and Torsional resistance of pre-stressed concrete. Shear and principal stresses. Pre-stressed concrete members in torsion. Ultimate shear resistance of pre-stressed concrete sections. Design of shear reinforcement • Maintenance and repair of PSC members •

TEXT BOOKS:		
1	Krishnaraju, N.	Prestressed Concrete, McGraw Hill Education, Sixth edition, 2018
2	James R., Modern	Prestressed concrete, Springer Publishers, 1st Edition,1990.
3	T.Y. Lin and N.H.Burns	Design of Pre-stressed Concrete Structures, John Willey & Sons, 3rd Ed., 1981
4	Dayaratnam, P., Sarah,P.	Prestressed Concrete Structures, Oxford & IBH Publishing Co Pvt.Ltd, 6thEdition, 2018

REFERENCES:		
1	Y.C. Loo and Cornfreig	Reinforced and prestressed concrete, University Press, 2nd Ed., London,2012.
2	Dennis Mitchel Edward G Nawy	Prestressed Concrete Structures, Prentice Hall,5th Edition 2002.
3	M. Collins and D. Mitchell	Prestressed Concrete Structures, Prentice Hall, 1991.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Describe the basic concept and principles of PSC. Calculate the stress conditions in PSC members due to pre-stress, dead load, and live loads
CO2	Calculate the losses of pre-stress in pretension and post tension members
CO3	Calculate the deflection of pre-stress in pretension and post tension members
CO4	Analyze and design of PSC members for flexure, as per IS1343 Code
CO5	Analyze and design of PSC members for shear and torsion, as per IS1343 Code.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1			3											
CO2			3											1
CO3			3											1
CO4			3											1
CO5			3											1

Bridge Engineering

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE32	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Understand the different types of bridges, their components, design principles, selection of bridge site, loads coming on bridges.
2	Apply the concept of moving loads to analyse different components of culverts, slab bridges, T-beam bridges, steel bridges and foundations
3	Apply the concepts of RCC design and steel design for designing different components of culverts, slab bridges, T-beam bridges, steel bridges and foundations

UNIT I

8 Hours

Introduction: • Components of a bridge, classification of bridges, Historical development, Types of bridge superstructures- Design principles (No problems), selection of bridge site. • Loads on Bridges: Dead loads, Vehicle live load, Impact effect, Wind loading, Longitudinal forces, centrifugal forces, Buoyancy, water current forces, Thermal forces, seismic forces. •

UNIT II

10 Hours

Design concepts of pipe and Box culvert • Introduction to slab bridges, Effective length of dispersion, effective width of dispersion. Design of deck slab bridges for IRC AA (Tracked vehicle), IRC class A vehicle. •

UNIT III

8 Hours

Design of T-beam Reinforced Concrete Bridges: • Introduction to T-beam bridges, Pigeaud's curves for deck slab analysis, Analysis using Courbon’s method, Design of T-beam bridge deck and girders for different IRC AA (Tracked vehicle), IRC class A vehicle •

UNIT IV

8 Hours

Design of plate girder and truss bridges for IRC Loading: • Plate girder bridge: General features, Structural elements of plate girder, design principles, design example • Trussed bridges: General features, types of trusses, design features, Design example of steel truss bridge • Basic features of cable-stayed bridges and cable-suspension bridges •

UNIT V

8 Hours

Substructures and Foundations: • Bearings and types, Types of abutments, piers and wing walls, forces to be considered for the design, Design of Pier. Design of Abutment. Types of foundations and forces to be considered for the design •

TEXT BOOKS:		
1	N Krishna Raju	“Design of Bridges”, Oxford & IBH Publishing Co., New Delhi, 1998.
2	Johnson Victor	“Essentials of Bridge Engineering”, Oxford & IBH publishing Co. Pvt. Ltd. New Delhi, 6th edition, 2009.
3	Jagadish T.R. & Jayaram M.A	Design of Bridge Structures – 2nd Edition, 2009, PHI, New Delhi.

REFERENCES:		
1	S.Ponnaswamy	Bridge Engineering, 2nd Edition, 2007
2	N.Rajagopalan	Bridge Superstructure", Alpha Science International- Technology & Engineering Series, 2006
3	Libby	Modern Pre-Stressed Concrete Bridges. 4th Edition, 1990

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Select the type of bridge based on the site investigation and compute the design discharge, linear waterway, economic span and depth of scour.
CO2	Design different types of culvert and slab bridges, for different IRC loadings.
CO3	Design of RCC T-beam bridges for IRC loading
CO4	Design of plate girder and truss bridges for IRC Loading
CO5	Design of bridge sub-structures and foundations

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3													1
CO2	2	3	2											1
CO3	2	3	2											1
CO4	2	3	2											1
CO5	2	3												1

Advanced Geotechnical Engineering

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE33	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Understand the concepts of site exploration and sampling techniques.
2	Understand the stresses in soils due to different types of loading.
3	Understand the lateral earth pressure behind retaining walls and seepage analysis through earth dams.
4	Understand the determination of stability of earth slopes and design of foundations.

UNIT I

9 Hours

Soil Exploration and Sampling Techniques: Introduction, methods of exploration (disturbed & undisturbed samples), planning exploration program, Soil boring (primary boreholes and secondary boreholes), soil sampling (cohesionless soil sampling, disturbed sampling, undisturbed cohesive soil sampling, underwater sampling). Extraction of samples of rock. Standard Penetration Test (SPT), corrections to SPT, SPT correlations. Cone Penetration Test (CPT), CPT correlations for cohesive soil, CPT correlations for cohesionless soils. Geophysical tests (Seismic refraction & electrical resistivity). Ground water table location, number and depth of borings, bore log, soil report. Numerical Problems. • Stresses in soils: Boussinesq's method of stress distribution for point loads, strip loading, loading on circular area. Pressure distribution Diagrams, Isobars, vertical stress distribution on a horizontal plane, vertical stress distribution on a vertical line. Westergaard's method of stress distribution for point loads and loading on circular area. Numerical Problems. •

UNIT II

9 Hours

Lateral earth pressure: Lateral earth pressure at rest, Rankine's active earth pressure, Rankine's passive pressure, Coulomb's active earth pressure, Coulomb's passive earth pressure. Graphical solutions for active and passive earth pressure for cohesionless soils. Numerical Problems. Types of retaining structures, Stability of gravity and RCC concrete cantilever retaining walls, Drainage requirements, Numerical Problems. •

UNIT III

8 Hours

Seepage Analysis: Laplace's equation for flow through soils, characteristics of flow nets, Construction of flow nets for earth dams, sheet pile walls, Phreatic line in earth dams (graphical method), Estimation of quantity of seepage & exit gradient. Numerical Problems. •

UNIT IV

8 Hours

Stability of earth slopes: Types of slopes, types of failure and their causes, Stability of infinite slopes, Stability of finite slopes – Swedish circle method (total stress analysis for cohesive and c-Φ soils), Stability of slopes of earth dams, Taylor's stability number. Numerical Problems. •

UNIT V

8 Hours

General Principles of Foundation Design Introduction, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts. Combined

footings (rectangular & trapezoidal), strap footings & wall footings. • Deep Foundations Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles. •

TEXT BOOKS:

1	Gopal Ranjan & ASRRao	"Basic and Applied Soil Mechanics", New Age International publishers, 5thEdition, 2023.

REFERENCES:

1	VNS Murthy	"Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CRC Press, 2016.
2	B C Punmia, Ashok Kumar Jain and Arun Kumar Jain	"Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 16th Edition, 2017.
3	Muni Budhu	"Soil Mechanics and Foundations", Wiley India Pvt. Ltd., 3rd Edition, 2011.

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Evaluate general suitability of the site for the proposed civil project using soil exploration techniques.
CO2	Determine the stresses in soils due to various types of loadings using Boussinesq's and Westergaard's solution.
CO3	Determine the lateral earth pressures on earth retaining structures applying using static equilibrium based on Rankine's and Coulomb's theory.
CO4	Determine the seepage loss and stability in various hydraulic structures.
CO5	Analyze the stability of slopes of simple geometry, including the effect of pore water pressure.
CO6	Identify the type of foundation and design them by using the loads acting over the foundation.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2														
CO3														
CO4														

Earthquake Resistant Design of Structures

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE34	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Fundamentals of structural dynamics and engineering seismology
2	Irregularities in building which are detrimental to its earthquake performance
3	Different methods of computation seismic lateral forces for framed and masonry structures
4	Earthquake resistant design requirements for RCC and Masonry structures and Relevant clauses of IS codes of practice pertinent to earthquake resistant design of structures

UNIT I

9 Hours

Principles of Engineering Seismology • Causes of Earthquakes, Classification of Earthquakes, Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration • Dynamics of SDOF systems • Basic Definitions, Concept of degrees of freedom, dynamic properties of a system, D'Alembert's principle, free and forced vibrations, types of damping, types of dynamic loads • Analytical Model of dynamic system, Free vibration of damped and undamped system having single degree of freedom •

UNIT II

9 Hours

Response of SDOF to dynamic forces: • Response of damped SDOF to impulse, Duhamel's integral for general loading • Topics without numerical evaluation: Direct integration method, response of SDOF to ground excitation, response spectrum •

UNIT III

8 Hours

Response of MDOF to dynamic loading: • Formulation of MDOF to obtain mass, stiffness and damping, Natural vibration of MDOF systems, natural frequencies and mode shapes, orthogonality of mode shapes, Natural vibration of MDOF systems, natural frequencies and mode shapes, orthogonality of mode shapes, Mode superposition method for response of MDOF to dynamic loading, Response spectrum method for response of MDOF to seismic excitation •

UNIT IV

8 Hours

Seismic Analysis of multi-storied framed structures as per IS:1893 (Part-1)-2016 • Mathematical modelling of multi-storied buildings, Design Lateral forces, seismic analysis using equivalent static lateral force method and response spectrum method for 3- and 2-storied shear buildings •

UNIT V

8 Hours

Earthquake-resistant design and detailing of RC framed structures: • Ductile detailing considerations as per IS13920 for flexural members and for frame members, Design and detailing (sketching) of critical sections of flexural and frame elements for given design forces • Self-study topics for assignment: Tips for earthquake resistant design of framed structures and masonry buildings. •

TEXT BOOKS:		
1	Agarwal, P. and Shrikhande, M.	"Earthquake resistant design of structures", PHI India, First Edition, 2006
2	Duggal, S. K.	"Earthquake Resistant Design of Structures", Oxford University Press, 3rd Edition, 2016

REFERENCES:		
1	Datta, T.K.	Seismic Analysis of Structures", John Wiley & Sons (Asia) Ltd, First Edition, 2010.
2	Chopra, A. K.	Dynamics of Structures: Theory and Applications to Earthquake Engineering, PearsonEducation, Inc., 6th Edition, 2023

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Describe basic principles of engineering seismology and structural dynamics
CO2	Evaluate the response for SDOF systems under free and forced vibrations
CO3	Evaluate the response of MDOF to seismic excitation using response spectrum method
CO4	Perform seismic analysis of multi-storied buildings
CO5	Design earthquake-resistant RC framed structures

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1													1
CO2	3													2
CO3	3													3
CO4	2	3												3
CO5	1	2	3											3

Traffic Engineering

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE35	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	understand the importance of traffic engineering, its performance on road network, knowledge of basic laws relating to regulation, planning, designing and operating to achieve safe and efficient movements of person and goods.

UNIT I

9 Hours

Vehicle and Human Characteristics • Road user – Visual characteristics of the drivers, fields of vision, perception – reaction time, pedestrian characteristics, impact of drugs and alcohol, impact of aging, psychological, personality and related factors. • Vehicle Characteristics – Concept of vehicle, types, concept of design vehicle, turning characteristics of the vehicle, breaking characteristics, acceleration characteristics, stopping distance and application, roadway characteristics. • Traffic Studies: • Traffic volume measurement, data analysis, concept of ADT, AADT, critical hourly volume and its significance, prediction of the traffic growth, importance of peak hour effect. •

UNIT II

9 Hours

Speed Studies: • Spot speed, speed measurements, interpretation of the data – frequency distribution, cumulative frequency distribution curve, relevant applications. • Speed and Delay Studies: • Measurement along the length of the road, assessing the causes of delay, estimation of travel time, computing journey speed, running speed. • Parking Studies: • Inventory, characteristics, on and off-street parking, numerical problems • O & D Studies: • Objectives, methods, presentation of the data and relevant applications. •

UNIT III

8 Hours

Toll Operation Studies: • Fuel, emission and consumption models, air quality models. • Accident Studies: • Factors influencing accidents, data collection, analysis and remedial measures. • Road safety Audit: • Key elements of a road safety audit, stages of audit, work zone, vulnerable zone, school zone, methods for identifying other hazardous road locations, case studies. •

UNIT IV

8 Hours

Traffic Regulation: • Regulation on vehicles, driver, parking, traffic signs (regulatory, warning, informatory), design of traffic signals – cycle length, green phase, red phase, different types of signals – fixed signals, traffic actuator signals, designing the cycle length by Webster method. • Traffic Management: • Restrictions on turning movements, one-way streets, tidal flows, exclusive bus lanes, closing side street, rotary intersection. •

UNIT V

8 Hours

Statistics in Traffic Engineering: • Elements of probability, probability distribution – binomial distribution, normal distribution, Poisson's distribution, sampling, standard deviation, mean, sampling, significance testing, regression analysis, numerical problems. •

TEXT BOOKS:		
1	Khanna SK, Justo C.E.G ,Veeraragavan A.	Highway Engineering, Nem Chand & Bro., Revised 10th Edition, 2023, ISBN 978-81-85240-72-5
2	Kadiyali, L.R.	Traffic Engineering and Transportation Engineering, Khanna publishers, 9th edition,2023. ISBN 81-7409-220-x

REFERENCES:		
1	C.Jotin Khisty, B.KentLall	Transportation Engineering, Prentice Hall India, 3rd Edition, 2002. ISBN978-81-203-2212-7
2	Bureau of Indian Standards	Relevant IRC codes

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Analyze the road user and vehicle factors in overall scope of traffic Engineering
CO2	Collect the traffic data, analyse and interpret the results.
CO3	Explain the causes of accidents and propose the remedial measures.
CO4	Explain the traffic regulations measures and suggest suitable traffic control devices.
CO5	Apply statistical tools to conceptualize and identify real word events as a function of discrete/continuous distributions.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1											2
CO2	3	2												1
CO3	3	2												1
CO4	3	2												1
CO5	3	2	2											2

Construction Automation and robotics

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	N7CVPE36	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:	
This course will enable students to:	
1	Understand the automation and robotics in construction
2	Explore construction robotics technologies
3	Classify types of construction robots and their applications
4	Know the benefits and challenges of implementation of automation and robotics in construction
5	Develop analytical and problem-solving skills to address challenges in construction automation

UNIT I

9 Hours

Introduction to Construction Automation and Fundamentals of Robotics • Introduction to Construction Automation: • Overview of construction industry challenges and the role of automation. • Importance • Application • Historical development and recent trends in construction robotics. Fundamentals of Robotics: • Basics of robotics: components, actuators, sensors, and control systems. • Kinematics and dynamics of robot manipulators. • Robot programming: teach pendant programming, offline programming, and simulation. •

UNIT II

9 Hours

Types of Construction Robots • • Autonomous construction vehicles: drones, driverless bulldozers, and excavators. • Robotic arms for tasks like bricklaying, welding, and 3D printing. • Inspection robots, exoskeletons, and wearable robotics. • Automation in prefabrication and modular construction. • Autonomous construction equipment and vehicles. • Intelligent construction materials and structures. • Computer vision and machine learning for construction site sensing. •

UNIT III

8 Hours

Applications of Automation and Robotics in Construction • Applications of Automation and Robotics in Construction • Automation and robotics in steel component production • Automation of excavation operations, excavation force analysis, process analysis • Precast component storage and transportation automation • Building construction: robotic bricklaying, concrete placement, and assembly. • Infrastructure construction: drones for surveying, robotic bridge inspectors, and road construction vehicles. • Maintenance and inspection: robots for routine inspections and repairs. • Multi-robot systems and collaboration. • Hybrid robotic systems: combining aerial and ground robots. • Soft robotics and bio-inspired design for construction. •

UNIT IV

8 Hours

Integration with Building Information Modelling (BIM) • Integration with Building Information Modelling (BIM) • Virtual reality systems, sensory data acquisition and processing • Utilizing BIM data for planning and controlling robotic operations. • Simulation and virtual reality tools for optimizing robot deployment. • Collaborative robots (cobots) working alongside human workers. • Integration of BIM with robotic simulation and visualization. • Case studies of BIM-integrated robotic construction projects. Challenges and Considerations: • Safety considerations for working with construction robots. • Regulatory and legal challenges. • Cost-benefit analysis and return on investment considerations. •

UNIT V	
	8 Hours
Future Trends and Ethical Considerations • • Emerging technologies shaping the future of construction automation and robotics. • Robotics for sustainable construction practices. • Additive manufacturing (3D printing) in construction. • Nanotechnology and advanced materials for construction robotics. • Ethical considerations regarding the use of robots in construction. • Value addition to construction through simulation, Introduction, life cycle management, life design management, importance of design management, proactive design selection and project performance. Case Studies and Best Practices: • Real-world examples of successful implementation of construction automation and robotics. • Lessons learned, challenges faced, and best practices. • Group presentations on selected case studies. •	

TEXT BOOKS:		
1	B. Gambao-Araya and M. A. AbouRizk	Handbook of Robotics and Automation in Construction, Wiley, 2002
2	H. Asadi and A. C. Scott	Advanced Construction Robotics, Springer, 2020
3	Carlous Balguer, Mohammed Abderriahim	Robotics and Automation in Construction, Edited Volume, IntechOpen, 2008. ISBN 978-953-7619-13-8
4	Thomas Bock and Linner	Construction Robots, Cambridge Universities Press, 2016. ISBN 978-1-107-07599-3

REFERENCES:		
1	G. N. Walker and R. J. Schmitz	Automation in Construction, Wiley-Blackwell, 1992
2	C. T. Haas and J. C. Kunz	Robotics and Automation in Construction, MIT Press,1987
3	V. Kumar and R. Issa	Robotics in Construction, Springer, 2016
4	Thomas Bock, Thomas Linner, and BrunoNinaber	Construction Robotics, Springer, 2008
5	Karl T. Ulrich and Clayton M. Christensen	Robotics in Construction
6	Noah W. D. Rapp and Anthony S. Perlinski	Autonomous Robots for Construction
7	Houtan Jebelli, Mahmoud Habibnezhad,Shayan Shayesteh, Somayeh Asadi, SangHyun Lee	Automation and Robotics in the Architecture, Engineering, and Construction Industry, Springer Nature,3 Jan 2022
8	Web link videos	https://www.youtube.com/watch?v=NUeJFscrnPc https://www.youtube.com/watch?v=aBHc2GsPU5E https://www.youtube.com/watch?v=O3al52UWoc0 https://www.youtube.com/watch?v=2fmRejSRkss https://www.youtube.com/watch?v=zBvvbOLq3t0 https://www.youtube.com/watch?v=vL2KoMNzGTo

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Understand the fundamentals of automation and robotics in construction.
CO2	Explore state-of-the-art construction robotics technologies and their applications.
CO3	Identify different types of construction robots and their applications.
CO4	Analyse the benefits and challenges of implementing automation and robotics in construction projects.
CO5	Evaluate real-world case studies of construction automation and robotics projects. Apply advanced analytical and problem-solving skills to address challenges in construction automation.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2				1									
CO2	1				1									
CO3	1				1									
CO4	1				1					2				
CO5	1				1					2				

Research Methodology & Intellectual Property Rights

Contact Hours/ week: (L-T-P-S)	2-0-0-2	**Credits:**	2
Total Lecture Hours:	60 = 28 (L)+0(T)+0(P)+32(S)	**CIE Marks:**	50
Sub. Code:	NSH09	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

UNIT I

6 Hours

Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations •

UNIT II

6 Hours

Research Problem: Effective literature studies approaches, analysis Plagiarism, and Research ethics. •

UNIT III

6 Hours

Technical Writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee •

UNIT IV

5 Hours

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. •

UNIT V

5 Hours

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. •

TEXT BOOKS:

1	Wayne Goddard and Stuart Melville	Research methodology: an introduction, 2nd Edition, 2014, Juta Academic Lt.D. ISBN 9780702156601.
2	Stuart Melville and Wayne Goddard	Research methodology: an introduction for science & engineering students, 2nd Edition, Juta Academic
3	Ranjit Kumar	Research Methodology: A Step by Step Guide for beginners, SAGE Publications India Pvt Ltd, 4th Edition, 2023, ISBN: 9789351501336

REFERENCES:		
1	T. Ramapp	Intellectual Property Rights Under WTO", S. Chand, 2008
2	Robert P. Merges, Peter S. Menell, Mark A. Lemley	Intellectual Property in New Technological Age", 2016.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Identify based on the knowledge the basics of research and its types
CO2	Apply knowledge to write Literature Review, Technical Reading, Attributions and Citations.
CO3	Practice the knowledge of Ethics in Engineering Research
CO4	Apply the concepts of Intellectual Property Rights in engineering
CO5	Apply IPR knowledge for the granting patents and its procedure for new innovative product for grants

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		2									
CO2	3	3	3		2									
CO3	3	3	3		2									
CO4	3	3	3		2									
CO5	3	3	3		2									

Project Work

Contact Hours/ week: (L-T-P-S)	0-0-14-6	**Credits:**	10
Total Lecture Hours:	300 = 0 (L)+0(T)+196(P)+104(S)	**CIE Marks:**	0
Sub. Code:	N7CVP	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES: This course will enable students to:	
1	Encourage independent learning and the innovative attitude of the students
2	Develop interactive attitude, communication skills, organization, time management, and presentation skills
3	Impart flexibility and adaptability
4	Inspire team working
5	Expand intellectual capacity, credibility, judgment and intuition
6	Adhere to punctuality, setting and meeting deadlines
7	Install responsibilities to oneself and others
8	Present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas

NOTES:	
CIE procedure for Project Work:	For Single discipline projects: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates For Interdisciplinary project: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates
SEE procedure for Project Work:	SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Identify a problem through literature survey and knowledge of contemporary engineering technology
CO2	To consolidate the literature search to identify issues/gaps and formulate the engineering problem
CO3	To prepare project schedule for the identified design methodology and engage in budget analysis, and share responsibility for every member in the team.
CO4	To provide sustainable engineering solution considering health, safety, legal, cultural issues and also demonstrate concern for environment
CO5	To identify and apply the mathematical concepts, science concepts, engineering and management concepts necessary to implement the identified engineering problem
CO6	To select the engineering tools/components required to implement the proposed solution for the identified engineering problem.
CO7	To analyze, design, and implement optimal design solution, interpret results of experiments and draw valid conclusion
CO8	To demonstrate effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE/Springer/ paper format of the work

CO9	To engage in effective oral communication through power point presentation and demonstration of the project work.
CO10	To demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics.
CO11	To perform in the team, contribute to the team and mentor/lead the team

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										3			
CO2		3												
CO3										3				
CO4						3								
CO5	3	3												
CO6					3						3			
CO7			3	3										
CO8									3					
CO9									3					
CO10							3							

Technical Seminar

Contact Hours/ week: (L-T-P-S)	1-0-0-1	**Credits:**	1
Total Lecture Hours:	30 = 14 (L)+0(T)+0(P)+16(S)	**CIE Marks:**	100
Sub. Code:	CVTS	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2														
CO3														
CO4														

INTERNSHIP – III

Contact Hours/ week: (L-T-P-S)	2-0-0-28	**Credits:**	15
Total Lecture Hours:	450 = 28 (L)+0(T)+0(P)+422(S)	**CIE Marks:**	100
Sub. Code:	CVINT3	**SEE Marks:**	100

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES: This course will enable students to:

NOTES:

General	Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.
Duration and eligibility	The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.
Research internship:	A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Rural Internship:	Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.
Role of the faculty coordinator or mentor:	The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.
Place of Internship	The students are permitted to carry out the internship anywhere in India or abroad. With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (within or outside the state or abroad), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide.
Internship expenses	Institute shall not bear any cost involved in carrying out the internship by students. However, students can receive any financial assistance extended by the organization.
Industry internship:	Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2														
CO3														
CO4														