B. M. S. COLLEGE OF ENGINEERING

(Autonomous Institute, Affiliated to VTU, Belgaum)
Bull Temple Road,
Bengaluru -560 019.

DEPARTMENT OF CIVIL ENGINEERING

SCHEME and SYLLABUS (III to VIII Semester)

(ADMISSION YEAR 2022 & onwards)
(160 CREDITS SCHEME)

FOR B.E CIVIL ENGINEERING

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

Vision

To be an excellent center for imparting quality higher education in Civil Engineering for a constantly changing societal needs with credibility, integrity and ethical standards.

Mission

Accomplish excellence in curricular, co-curricular activities with a committed faculty through teaching and research which creates technically competent and dedicated civil engineers to serve their surroundings with pride.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. Practice Civil Engineering in construction industry public sector undertaking and as an entrepreneur for successful professional career.
2. Pursue higher education for professional development.
3. Exhibit leadership qualities with demonstrable attributes in lifelong learning to contribute to societal needs.

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
Program Outcomes (up to July 2024)

The graduates will have an ability to	
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**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.
PO4	**Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analyze and interpret data and synthesis of the information to provide valid conclusions**.**
PO5	**Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	**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.
PO11	**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.
PO12	**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.

Program Specific Outcomes

PSO1	Analyze and design Civil Engineering systems.
PSO2	Become environmentally and socially responsible citizens with awareness of the use of sustainable material and technologies so as to provide alternate engineered solutions.

Program outcomes (wef Aug 2024)

PO1: **Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: **Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: **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)

PO4: **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).

PO5: **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)

PO6: **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).

PO7: **Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: **Individual and Collaborative Team work**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: **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

PO10: **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.

PO11: **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)

Knowledge and Attitude Profile

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Department of Civil Engineering Credit Distribution Table

(For Admission year 2022& onwards)

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course (BS)	8	8	4	-	-	-	2	-	22
Engineering Science Course (ES)	9	9	3	3	-	-	-	-	24
Professional Core Course (PC)	-	-	14	17	14	11	4	-	60
Professional Elective Course (PE)	-	-	-	-	3	3	3	3	12
Open Elective Course (OE)	-	-	-	-	-	3	3	3	09
Project/ Mini-Project (PW)	-	-	-	-	2	2+1	7	-	12
Internship	-	-	-	-	-	-	-	6	06
Humanities and Social Sciences,& Management Course (HS)	1	1	-	1 (UHV)	1 (EVS)	-	1 (IKL)	-	05
Ability Enhancement Course /SDC	2	2	1	1	2 (RM)	2 (PM)	-	-	10
Non-Credit Mandatory Course	-	-	NC	NC	NC	NC	-	-	-
Total Credits per semester	20	20	22	22	22	22	20	12	160

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
Scheme for III Sem B.E

(Admission year 2022-23 & onwards) **wef: AY 2023-24**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact Hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
BS	23MA3BSMCV	Mathematics for Civil Engineering-3	Maths	2	1	0	**3**	4	50	50	100	3
PC-1	23CV3PCBMC	Building Materials and Construction	civil	2	0	1	**3**	4	50	50	100	3
ES	23CV3ESENG	Engineering Geology	civil	2	0	1	**3**	4	50	50	100	3
PC-2	23CV3PCFME	Fluid Mechanics	civil	2	1	0	**3**	4	50	50	100	3
IPCC-1	23CV3PCGDY	Geodesy	civil	2	1	1	**4**	6	50	50	100	3
PC-3	23CV3PCSOM	Strength of Materials	civil	3	1	0	**4**	5	50	50	100	3
BS	23CV3BSBFE	Biology for Engineers	civil/ BT	1	0	0	**1**	1	50	50	50	1
AE/SDC	23CV3AEIME	Introduction to MS Excel	civil	0	0	1	**1**	1	50	50	100	2
NCMC	23NCMC3YG1	YOGA	PE	0	0	0	**P/NP**	1	50	-	-	
	23NCMC3NS1	NSS										
	23NCMC3PE1	Physical Education (Sports and Athletics)										
			TOTAL	14	4	4	**22**	**30 hrs**			**750**	

AICTE activity points

* *For 2023 admission batch onwards, few more NCMC options are introduced*

BMS COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Scheme for IV Sem B.E

(Admission year 2022 & onwards) **wef: AY 2023-24**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	contact Hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
ES	23CV4ESBDC	Building Drawing and CAD	Civil	1	1	1	**3**	5	50	50	100	4
IPCC-2	23CV4PCCON	Concrete Technology	Civil	2	0	1	**3**	4	50	50	100	3
PC-4	23CV4PCENV	Environmental Engineering -1	Civil	3	0	0	**3**	3	50	50	100	3
IPCC-3	23CV4PCGTE	Geotechnical Engineering-1	Civil	2	1	1	**4**	6	50	50	100	3
IPCC-4	23CV4PCHYE	Hydraulic Engineering	Civil	1	1	1	**3**	5	50	50	100	3
PC-5	23CV4PCSTA	Structural Analysis	Civil	3	1	0	**4**	5	50	50	100	3
HS	22MA4HSUHV	Universal Human Values	Civil	0	1	0	**1**	2	50	50	100	1
AE/SDC	23CV4AEBIM	Introduction to Building Information Modeling	Civil	1	0	0	**1**	1	50	50	50	1
NCMC	23NCMC4NS2	NSS	PE	0	0	0	**P/NP**	1	50	-	-	
	23NCMC4YG2	YOGA										
	23NCMC4PE2	Physical Edu. (Sports and Athletics)										
			TOTAL	**13**	**5**	**4**	**22**	32hrs			**750**	

AICTE activity points

BMS COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Scheme for V Sem B.E

(Admission year 2022& onwards) **wef: AY 2024-25**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	contact Hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PC-6	23CV5PCDRC	Design of RC Structural Elements	Civil	2	1	0	**3**	4	50	50	100	3
IPCC-5	23CV5PCENV	Environmental Engineering-II	Civil	2	0	1	**3**	4	50	50	100	3
PC-7	23CV5PCGTE	Geotechnical Engineering-II	Civil	2	1	0	**3**	4	50	50	100	3
IPCC-6	23CV5PCHEN	Highway Engineering	Civil	1	1	1	**3**	5	50	50	100	3
PC-8	23CV5PCSSA	Structural Systems Analysis	Civil	1	1	0	**2**	3	50	50	100	3
PE-1	23CV5PEXXX	Professional Elective -1	Civil	3	0	0	**3**	3	50	50	100	3
PW	23CV5PWMIP	Minor Project	Civil	0	0	2	**2**	4	50	50	100	1
AE	23CV5AERMY	Research Methodology	Civil	2	0	0	**2**	2	50	50	100	3
HS	23CV5HSEVS	Environmental Studies	Civil	1	0	0	**1**	1	50	50	50	1
NCMC	23NCMC5NS3	NSS	PE	0	0	0	**P/NP**	1	50	-	-	-
	23NCMC5YG3	YOGA										
	23NCMC5PE3	Physical Edu. (Sports and Athletics)										
			Total credits	**14**	**4**	**4**	**22**	31 Hours			850	

AICTE activity points

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

Scheme for V sem B.E

(Admission year 2022 & onwards) **Electives** **wef: AY 2024-25**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PE-1	23CV5PEACT	Advanced Concrete Technology	Civil	3	0	0	3	3	50	50	100	3
PE-1	23CV5PEAPC	Air Pollution and Control	Civil	3	0	0	3	3	50	50	100	3
PE-1	23CV5PEABM	Alternative Building Materials and Technology	Civil	3	0	0	3	3	50	50	100	3
PE-1	23CV6PEGSS	Geospatial Survey	Civil	3	0	0	3	3	50	50	100	3
PE-1	23CV5PEMAE	Marine Engineering	Civil	3	0	0	3	3	50	50	100	3
PE-1	23CV5PETRF	Traffic Engineering	Civil	3	0	0	3	3	50	50	100	3

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Scheme for VI sem B.E

(Admission year 2022 & onwards) **wef: AY 2024-25**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PC-9	23CV6PCDSS	Design of Steel Structural Elements and Software applications lab	Civil	1	1	1	**3**	5	50	50	100	3
PC-10	23CV6PCBFS	Bridge Engineering and Foundation systems	Civil	2	1	0	**3**	4	50	50	100	3
PC-11	23CV6PCHIE	Hydrology and Irrigation Engineering	Civil	1	1	0	**2**	3	50	50	100	3
PC-12	23CV6PCTSE	Transportation Systems Engineering	Civil	3	0	0	**3**	3	50	50	100	3
AE	23CV6AEPMF	Project Management and Finance	Civil	2	0	0	**2**	2	50	50	100	3
PE-2	23CV6PEXXX	Professional Elective -2	Civil	3	0	0	**3**	3	50	50	100	3
OE-1	23CV6OEXXX	Open Elective -1	Civil	3	0	0	**3**	3	50	50	100	3
PW	23CV6PWMP1	Major Project Phase 1	Civil	0	0	1	**1**	4	50	50	100	1
PW	23CV6PWESP	Extensive survey project	Civil	0	0	2	**2**	2	50	50	100	1
NCMC	23NCMC6NS4	NSS	PE	0	0	0	**P/NP**	1	50	-	-	-
	23NCMC6YG4	YOGA										
	23NCMC6PE4	Physical Edu. (Sports and Athletics)										
AICTE activity points			Total	**15**	**3**	**4**	**22**	**30hrs**			**900**	

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
Scheme for VI sem B.E

(Admission year 2022 & onwards) **Electives** **wef: AY 2024-25**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PE-2	23CV6PEBFA	Basics of flood analysis	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PECMA	Computational method of Structural Analysis	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PEDTS	Design of Tall structures	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PEGIT	Ground improvement Techniques	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CVC6PEPAD	Pavement Design	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PEPMC	Pavement Materials and construction	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PESMA	Structural Masonry	Civil	3	0	0	3	3	50	50	100	3
PE-2	23CV6PESWM	Solid waste management	Civil	3	0	0	3	3	50	50	100	3
		OPEN ELECTIVE-1										
OE-1	23CV6OECCC	Climate change and Carbon capture	Civil	3	0	0	3	3	50	50	100	3
OE-1	23CV6OEDMM	Disaster Management and Mitigation Techniques	Civil	3	0	0	3	3	50	50	100	3
OE-1	23CV6OEMFC	Mechanics of FRP composites	Civil	3	0	0	3	3	50	50	100	3

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

Scheme for VII sem B.E

(Admission year 2022 & onwards) **wef: AY 2025-26**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PC-13	23CV7PCQSC	Quantity survey and Estimation	Civil	2	1	0	**3**	4	50	50	100	3
PC-14	23CV7BSMLC	Machine learning for Civil Engineering Applications	Civil	2	0	0	**2**	2	50	50	100	3
PC-15	23CV7PCPPR	Professional Practice for civil Engineers	Civil	1	0	0	**1**	1	50	50	50	1.5
PE-3	23CV7PEXXX	Professional Elective -4	Civil	3	0	0	**3**	3	50	50	100	3
OE-2	23CV7OEXXX	Open Elective -2	Civil	3	0	0	**3**	3	50	50	100	3
PW	23CV7PWMP2	Major project phase 2	Civil	0	0	7	7	14	100	100	200	
HSS	25MA7HSIKL	Indian knowledge system	Civil/ Humanities	1	0	0	**1**	1	50	50	50	1
			Total credits	12	1	7	**20**	28 hrs.			**700**	

AICTE activity points

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
Scheme for VII sem B.E

(Admission year 2022 & onwards) **Electives** **wef: AY 2025-26**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PE-3	23CV7PEADR	Advanced Design of RC structures	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PEERS	Earth Retaining structures	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PEIWT	Industrial Wastewater Treatment	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PESDY	Structural Dynamics	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PEGDR	Geometric Design of Roads	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PEGWH	Ground Water Hydrology	Civil	3	0	0	3	3	50	50	100	3
PE-3	23CV7PEPSC	Prestressed concrete structures	Civil	3	0	0	3	3	50	50	100	3
		OPEN ELECTIVE-2										
OE-2	23CV7OEFEA	Finite Element Analysis	Civil	3	0	0	3	3	50	50	100	3
OE-2	23CV7OERSG	Remote Sensing and GIS	Civil	3	0	0	3	3	50	50	100	3

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

Scheme for VIII sem B.E

(Admission year 2022 & onwards) **wef: AY 2025-26**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
OE-3	23CV8OEXXX	Open Elective -3	Civil	**3**	**0**	**0**	**3**	**3**	50	50	100	3
PE-4	23CV8PEXXX	Program Elective-4	Civil	3	0	0	3	3	50	50	100	3
INT	23CV8SRINT	Seminar on Internship	Civil	**0**	**0**	**6**	**6**	1	50	50	100	1
			Total	**6**	**0**	**6**	**12**	**6hrs**			**300**	

AICTE activity Points

BMS COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

Scheme for VIII sem B.E

(Admission year 2022 & onwards) **Electives** **wef: AY 2025-26**

Course Type	Code	Course Title	Teaching Department	Credits			Total Credits	Contact hours/ week	Marks			SEE duration (Hours)
				L	T	P			CIE	SEE	Total	
PE-4	23CV8PEERD	Earthquake Resistant Design of structures	Civil	3	0	0	3	3	50	50	100	3
PE-4	23CV8PEEIA	Environmental Impact assessment	Civil	3	0	0	3	3	50	50	100	3
PE-4	23CV8PEGSR	Geosynthetics and Soil Reinforcement	Civil	3	0	0	3	3	50	50	100	3
PE-4	23CV8PEIWM	Integrated watershed Management	Civil	3	0	0	3	3	50	50	100	3
PE-4	23CV8PEUTP	Urban Transport Planning	Civil	3	0	0	3	3	50	50	100	3
		OPEN ELECTIVE-3										
OE-3	23CV8OEOSH	Occupational safety and Health Administration	Civil	3	0	0	3	3	50	50	100	3
OE-3	23CV8OESLA	Sustainability and Life cycle assessment	Civil	3	0	0	3	3	50	50	100	3

III SEMESTER B.E

SYLLABUS

(from AY 2022 admitted & onwards)

.

Mathematics for Civil Engineering – 3

Course	Mathematics for Civil Engineering – 3	Course Code	23MA3BSMCV	SEE Duration	3 Hours
Credits	03	L:T:P	2-1-0	SEE+ CIE Marks	50+50
Contact hours	39	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of Series, Transforms and Numerical Techniques in Engineering Problems.
- Acquire the knowledge of Series, Transforms and Numerical Techniques to apply them in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

- **Course outcomes**
- After successfully completing the course, the student will be able to understand the topics:

Course Code	CO	COURSE OUTCOME (CO)	PO	Strength
23MA3BSMCV	CO 1	Apply the concepts of Transform, Series and Finite Difference Methods to solve engineering problems.	1	3
	CO 2	Apply the concepts of Transform, Series and Finite Difference Methods in engineering using modern IT tools.	1 & 5	3

UNIT-1

STATISTICAL METHODS: **[08 hours]**

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = a\,x^b$) by the method of least squares.

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation. Lines of regression, angle between two regression lines.

UNIT-2

PROBABILITY DISTRIBUTIONS: **[08 hours]**

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

UNIT-3

LAPLACE TRANSFORMS: [08 hours]

Definition and Laplace transform of standard functions (statements only). Problems on Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems.

Inverse Laplace transforms: definition and problems. Solution of differential equations.

UNIT-4

FOURIER SERIES: [08 hours]

Introduction to trigonometric polynomial, trigonometric series. Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Practical harmonic analysis.

UNIT-5

NUMERICAL SOLUTION OF PDE: [07 hours]

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt and Bendre-Schmidt explicit formulae. Solution of one-dimensional wave equation using finite difference method.

Assessment Pattern CIE and SEE:

Component	Type of assessment	Max. Marks	Total	50 % Weightage	Total
CIE – Theory	Quiz	10	100	5	50
	AAT	10		5	
	Test 1	40		20	
	Test 2	40		20	
SEE	End Exam	100		50	

SEMESTER END EXAMINATION:

- Each unit consists of one full question.
- Five full questions to be answered.
- To set one question each from Units 2, 4 & 5 and two questions each from Unit 1 and Unit 3.

SUGGESTED LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", McGraw-Hill Education, 11th Ed.

2. S. Pal & S. C. Bhunia, "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. N. P. Bali and M. Goyal, "A textbook of Engineering Mathematics", Laxmi Publications.
4. D. G. Zill, "Advanced Engineering Mathematics", Jones and Bartlett learning, 6th Ed, 2018.
5. C. R. Wylie, L. C. Barrett, "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
6. H. K. Dass and R. Verma, "Higher Engineering Mathematics", S. Chand Publication (2014).

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. http://www.class-central.com/subject/math(MOOCs)
2. http://academicearth.org/
3. http://www.bookstreet.in.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

BUILDING MATERIALS & CONSTRUCTION

Course	Building Materials & Construction	Course Code	23CV3PCBMC	SEE Duration	3 Hours
Credits	03	L:T:P	2:0:1	SEE+ CIE Marks	50+50
Contact hours	Theory 26 Hours Lab 10-12 classes	CIE (Theory)	25 marks	Lab	25 Marks

COURSE OBJECTIVES: The course enables the students to

Enable students to gain knowledge on the wide range of building materials and processes/techniques involved in building construction. This will enable the students to apply the knowledge for building planning, design and estimation.

COURSE OUTCOMES: An ability to demonstrate knowledge to	
CO1	Develop a matrix of material properties related to building construction, for a various types of materials.
CO2	Recognize and Sketch the functional components of a building and design a staircase.
CO3	Describe the techniques of constructing various building components.
CO4	Conduct experiments to evaluate properties of building materials.

UNIT-1

Introduction To Building Materials:

Evaluation of parameters of building materials - Physical, mechanical and other parameters to define strength, durability and performance for different construction materials. Manufacturing process, Properties, Types, Uses, defects of the following materials:

Building units - Stone, Bricks, Solid Concrete Blocks, Hollow Clay blocks, Wire-cut bricks, Aerated Concrete blocks, Engineered blocks

Binding materials -Lime, cement and bitumen Metals -

Reinforcement Steel and structural steel. Non-metals - timber

Finishing materials - plasters and paints

Introduction To Building Construction

Common building construction systems - load-bearing and framed systems Foundations, walls, frames, beams, slabs, staircases, lintels, roofs, floors and others, fenestration components - doors, windows and ventilators

7Hours

UNIT-2

Foundation:

Function and requirements of a good foundation, Types of foundations, Preliminary investigation of soil, Safe Bearing Capacity of Soil, Introduction to spread, combined, strap, mat and pile foundations

Damp Proofing, Water Proofing And Anti termite Treatment

Definition of technical terms, Defects, causes and sources of dampness, damp proofing and terrace water proofing methods, Pre and post constructional anti termite treatment.

5 Hours

UNIT-3

Masonry:

Definition of terms used in Masonry, Classification of Masonry, Bonds in Brick work, Reinforced Masonry, Joints in stone masonry, Introduction to load bearing and partition walls, openings in masonry - lintels, chejja and arches Definition, classification, functions & uses

5 Hours

UNIT-4

Roofs And Floors:

Types of Roofs & Roofing materials, Flat roof (RC), Types of pitched roofs. Types of flooring, Factors affecting selection of flooring materials.

Stairs:

Definition of technical terms, Requirements of good stair, Types of Stairs, Geometricaldesign of RCC Dog legged & open well stairs (Plan and sectional elevation)

5 Hours

UNIT-5

Building Construction Sequence:

Stake holders - roles and responsibilities: planners/architects, structural engineers, geotechnical engineers, contractors/PMCs, Regulatory authorities, financers, NBC guidelines, on-site safety protocols

4 Hours

List of Laboratory Experiments:

Building materials need to be introduced and tested

1. Tests on bricks and concrete blocks (water absorption, dimension analysis, compressivestrength)
2. Crushing strength - timber, MS and Cast iron
3. Tensile strength – MS
4. Flexural strength -MS and Timber
5. Shear test – MS
6. SEM, XRD and EDAX - Brick and Cement
7. Hardness test: Brinnells and Rockwells hardness test (Demo)
8. Charpy and Izod Impact test (Demo)

Text book/Codes:

1. P.G. Varghese, " **A Text Book Building Materials**", Prentice-Hall of India Pvt. Ltd., Publication., 2nd Edition,.2015.

2. Sushil Kumar**, "Building Construction,",** Standard Publication and Distributors, New Delhi, 19thEdition, 2001.

Reference books:

1. Mohan Rai and M.P. Jain Singh, "**Advances in Building Materials and Construction**", publication by CBRI, Roorkee.
2. S.K. Duggal, "**Building Materials (3rd revised edition)**", New Age International publishers, India.
3. Dr. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, "**Building Construction**", Laxmi PublicationsPvt Ltd..

CIE pattern:

1. Theory CIE: 20 marks, and Quizzes / AAT/ seminars /assignments for 5 marks.
2. Lab CIE: 25 marks.
3. All CIE in theory conducted for 40 marks and reduced to 20.

SEE paper pattern:

1. A total of 6 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in unit 1.
2. The maximum number of sub division in a question is restricted to 4.

SEE paper pattern : *2023 batch onwards***:**

Each unit to have choice . Total 10 questions to be set. Students shall answer 5 full questions.

Quizzes / AAT/ or seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

Faculty to map any additional POs if required based on delivery of course content.

	23CV3PCBMC													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3	-											-	2
CO2	2	-											-	-
CO3	3	-											-	-
CO4	-	-	-	3	-	-	-	-	3	3	-	-	2	-

ENGINEERING GEOLOGY

Course	Engineering Geology	Course Code	23CV3ESENG	SEE Duration	3 Hours
Credits	03	L:T:P	2:0:1	SEE+ CIE Marks	50+50
Contact hours	26 hrs +10 to12 lab classes	CIE (Theory)	25 marks	Lab	25 Marks

COURSE OBJECTIVES: The course enables the students to

Understand the importance of earth's interior in Civil Engineering. To analyse the physical characteristics of the rock and minerals for its suitable application in Engineering. To provide insight into hydrogeology and subsurface exploration for assessing a safe and suitable site condition and earth resources for Re-engineering activities. To apply modern tools, and techniques in Earth resource management, and Sustainability.

COURSE OUTCOMES: An ability to	
CO1	Summarize properties of various minerals, classify types of rocks and discuss its applications.
CO2	Describe dynamic activities of earth and its causes.
CO3	Calculate dip and strike in rocks, identify various rock formations and discuss methods of ground water exploration.
CO4	Conduct experiments on rocks and minerals and interpret geological maps and toposheets.

UNIT-1

Introduction:

Introduction to Geology and its importance in Civil Engineering practices. Internal structure and composition of the earth.

Earth's Resources:

Study of rock forming and economically important minerals. Physical properties, chemical composition, uses and contribution of the industrial minerals in preparation of construction materials: Quartz and its varieties: Feldspar group: Mica Group: Carbonate group: Calcite, Asbestos, Kaolin and Garnet. Ore minerals: Hematite, Magnetite, Limonite, Pyrite, Chalcopyrite, Pyrolusite, Chromite, Galena and Bauxite

4 Hours

UNIT-2

Rocks:

Rock as a construction material, index properties, composition, Types of rocks.

Igneous rocks:

Definition, origin, classification, and forms of Igneous Rocks. Texture structure, Petrological description and Engineering importance of the following rocks: Granite, Pegmatite, Dolerite and Basalt.

Sedimentary rocks:
Definition, origin, classification of Sedimentary rocks. Primary structures Petrological description and engineering importance of the following Rocks. Conglomerate, Sand Stone, Shale, Limestone and Laterite.

Metamorphic rocks:
Definition, types of Metamorphism, Metamorphic structures. Petrological description and Engineering importance of the following rocks. Quartzite, Gneiss, Schist, and Marble.

Application as:
An aggregate, decorative material (facing, and polishing), as railway ballast, in masonry work, monumental architecture. Selection of rocks for foundation, construction, cladding, flooring, concrete aggregate, road metal, and railway ballast with examples
Water bearing properties of igneous, sedimentary, and metamorphic rocks. Rock cycle., weathering and deterioration of rocks. Types and agents of weathering. Site selection for Dams, Reservoirs, and Tunnels. Silting up of reservoir and remedial measures.

7 Hours

UNIT-3

Geodynamics:
Dynamic activities of the Earth, Plate tectonics. Geological and Engineering considerations of Land slide, (mass movements) Avalanches causes and precautions. Earthquakes - seismic waves, seismic zones and seismic studies, causes and effects.

5 Hours

UNIT-4

Mechanical Behaviour of Rocks:
Introduction, Stress and Strain in rocks, Outcrop, Dip and Strike (numerical problems, geometrical/ simple trigonometry-based) and Compass clinometers. Study of structural features of rocks. Description of Folds, Faults and Joints, their identification in the field. Importance in various Civil Engineering projects

5Hours

UNIT-5

Hydrogeology:
Introduction, Study of Groundwater and its importance, Occurrence of groundwater in different Geological rock formation, Water table, Water level fluctuation. Types of Aquifers- Confined and unconfined Aquifers, Artificial recharge of ground water. Selection of well sites, Geological and Geophysical Methods of Groundwater exploration, depth of water table, and Applications of Electric resistivity method. Topo sheets, GPS, GPR (Ground Penetrating Radars), and their applications.

5 Hours

List of Laboratory Experiments:

EXPERIMENTS/EXERCISES: MINEROLOGY:
Study of Physical Properties of the mineral and their contribution in preparation of construction materials.

Practical no. 1: Study of the Physical Properties of the following minerals. • Quartz group of Minerals:- Rock crystal, Rose Quartz, Jasper banded Agate/Jasper, Smoky Quartz • Feldspar Group: Orthoclase, Plagioclase, Microcline. • Mica Group: Biotite Mica, Muscovite mica.

Practical no. 2: Study of the Physical Properties of the following minerals. • Carbonate Group: Calcite, Magnesite, Dolomite. • Ferro-Magnesium Minerals: Hornblende, Augite, Olivine, Asbestos, Talc, Garnet, Gypsum

Practical no.3: Study of the Physical Properties of the following minerals • Ore Minerals: Hematite, Magnetite, Limonite, Iron Pyrite, Chalcopyrite, Pyrolusite, Chromite, Galena, Bauxite. • PETROLOGY: Identification of Rocks Based on their Index Properties

Practical no.4: • Igneous Rocks: Granite, Diorite, Gabbro, Dunite, Porphyries, Pegmatite, Dolerite and Basalt.

Practical no. 5: • Sedimentary Rocks: Conglomerate, Breccia, Sandstone, Shale, Limestone and Laterite.

Practical no. 6: • Metamorphic Rocks: Slate, Schist, Gneiss, Quartzite, and Marble.):

Practical no. 7: Analysis and understanding of the Lithological Character of sub surface by Vertical Electrical Sounding (VES) resistivity method.

Practical no. 8: Dip and Strike Problems (Three types).

Practical no. 9: Bore well Problems on level Ground (Three types).

Practical no. 10: Study and Interpretation of Standard Structural Geological Maps.

TEXT BOOKS:

1. A Text of Engineering and General Geology, By Parbin Singh, 2009
2. A Text of Geology, by P.K. Mukherjee, 2006

REFERENCES:

1. A Text of Engineering and Geology, by B.S. Sathya Narayanaswamy
2. Physical Geology, By Arthur Homes
3. Principle of Engineering Geology, by KVGK Gokhale
4. Principle of Engineering Geology, by K.M. Bangar
5. Physical and Engineering Geology, by S.K. Garg
6. Geology for Engineers, By D.S. Arora
7. Engg Geology by S K, Duggalet. Al
8. Engineering Geology by D.Venkatareddy
9 . Ground water Geology by Todd D.K. Jhon Willey and Sons, New York LEARNING

RESOURCES:

1. www.geoscienceworld.org
2. www.springer.com
3. http://en.wikipedia.org
4. www.gle.wisc.edu
5. www.geoexpro.com
6. http://freevideolectures.com/Course/87/Engineering-Geology

CIE pattern:

Theory CIE: 20 marks, and Quizzes / AAT/ seminars /assignments for 5 marks.
Lab CIE: 25 marks.
All CIE in theory conducted for 40 marks.

SEE Pattern : *2022 batch*

- Units 1, 4 and 5 will have one main question with a maximum of 3 sub-questions.
- Internal choice for Unit 2 and Unit 3 with maximum of 3 subdivisions.
- Student shall answer one FULL question from each unit.

SEE paper pattern : *2023 batch onwards*

Each unit to have choice . Total 10 questions to be set. Students to answer five full questions selecting one from each unit.

	ENGG GEOLOGY				**23CV3ESENG**							**2023-24**		
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	2	-											2	
CO2	2	-											2	
CO3	2	-											2	
CO4	-	2	-	3	-	-	-	-	3	3	-	-	2	

GEODESY

Course	Geodesy	Course Code	23CV3PCGDY	SEE Duration	3 Hours
Credits	04	L:T:P	2:1:1	SEE+ CIE Marks	50+50
Contact hours	40hrs + 11 lab classes	CIE Theory	25 marks	Lab	25 marks

COURSE OBJECTIVES: The course enables the students to

Gain knowledge and skill about conventional as well as latest methods and instruments used for measuring distances, angles, and elevation of objects.

COURSE OUTCOMES: An ability to	
CO1	Apply the principles of surveying for linear, angular and elevation measurements and calculations.
CO2	Compute the elements required to set out simple and compound curves in the field.
CO3	Apply the principles of photogrammetry and advances techniques in surveying.
CO4	Use various instruments for measurements, record and interpret data, and set out horizontal curves on the ground.

UNIT-1

Introduction:

Definition, Historical perspective of surveying, comparison between geometry & surveying. Necessity of surveying, plans and maps, principles of surveying, coordinate system, scale, plane and geodetic surveying, topo sheets of Survey of India and their numbering, Errors in measurements: sources, types and their adjustments, precision and accuracy.

Horizontal control (Linear measurements):

Direct and indirect measurements, chaining, principles of chaining, accessories for chaining, ranging a survey line, offsets, corrections to length measured with a tape, chaining across obstacles.

7 Hours

UNIT-2

Vertical control:

Levelling: Concepts of levelling, instruments used, terms and definitions, booking of levels, reductions of level, classification of levelling, curvature and refraction, reciprocal levelling. Contouring: Characteristics and applications, interpolation of contours by arithmetic calculation. Earth work computation Trapezoidal formula, prismoidal formula, volume from contour map. Digital elevation model: definition, characteristics, applications, sources of DEM.

9 Hours

UNIT-3

Direction and angle measurements:
Meridians, azimuths and bearings, calculation of included angles from bearing, errors in compass surveying, correction for local attraction, adjusting a traverse, magnetic declination.
Measurement of angles using theodolite, temporary and permanent adjustment, fundamental lines and desired relations, digital theodolite, measurement of horizontal and vertical angles using theodolite, trigonometric levelling.

8 Hours

UNIT-4

Route surveying:
Curves- introduction, types- simple, circular, transition, reverse curve. Simple circular curve: elements, setting out using angular method.
Plane table survey:
Accessories, principle, advantages and limitations of plane table surveying, orientation. Methods of plotting: radiation, intersection, traversing and resection method. Three point problem, solution to three-point problem, triangle of error, Lehman's rule, Bessel's graphical method.

8 Hours

UNIT-5

Advanced techniques in surveying:
Aerial photogrammetry: definition and principle, definition of terminologies, type of aerial photographs, vertical photograph- scale, flying height. Relief displacement, parallax. Electromagnetic distance measurement: principle, types, errors and correction.
Total station:
Functions and characteristics, Lidar scanner for topographical survey. Satellite based positioning system: basic principles, functions, GPS, GALILEO, GLONASS, IRNSS..

8 Hours

LABORATORY:

1. To find the distance between two points shown in the field by pacing, and by chaining.
2. To set regular geometric figures (Hexagon or Pentagon) using chain tape and accessories.
3. To determine the different in elevation between two points by differential levelling
4. To find the RL of a given point by fly levelling.
5. To find the true difference in elevation between two points situated far apart by using reciprocal leveling.
6. To set a regular geometric figure (Hexagon or Pentagon) using a prismatic compass, giventhe bearing of one line.
7. Measurement of horizontal angle using digital theodolite by repetition and reiteration methods.
8. Trigonometric leveling: Single plane method.
9. Setting simple circular curve-Instrumental method.
10. To prepare a plan of a given boundary by method of radiation.
11. Demonstration of Total station and GPS

Text book/Codes:

1. R. Subrahmanian, "**Surveying and Levelling (Second Edition, 2007**)", Oxford UniversityPress.
2. B.C. Punmia, Ashok K Jain and Arun K Jain, "**Surveying Vol I (Seventeenth Edition, 2022) and II (Sixteenth Edition, 2019)**", Lakshmi Publications (P) Ltd.

Reference books:

1. S.K. Duggal, "**Surveying Vol I and II (Fifth Edition)**", Tata McGraw-Hill
2. W. Schofield and Mark Breach, "**Engineering Surveying (Sixth Edition)**", CRC Press.
3. A. Bannister, S. Raymond, R. Baker, "**Surveying (Seventh Edition)**", Pearson, New Delhi

E-learning resources:

https://nptel.ac.in/courses/105107122
https://nptel.ac.in/courses/105104101

CIE pattern:

- Theory CIE: 20 marks, and Quizzes / AAT/ seminars /assignments for 5 marks.
- Lab CIE: 25 marks.
- All CIE in theory conducted for 40 marks and reduced.
- Activity based learning: Quizzes / AAT/ / seminars /assignments

SEE pattern:

1. Totally 7 question are to be framed (20 marks each) and students have to answer 5 full questions. The choice of questions is to be given in unit 2 and unit 3 only.
2. The maximum number of sub division in a question is restricted to 4

SEE paper pattern : *wef Aug 2024*

Each unit to have internal choice . Total 10 questions to be set. Students to answer five full questions selecting one from each unit.

CO-PO MAPPING SCALE 1 TO 3

AY 2023-24	**Geodesy 23CV3PCGDY**													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3												2	
CO2	3													
CO3	3												2	
CO4	-	-	-		2	-	-	-	3	3	-	-		

FLUID MECHANICS

Course	Fluid Mechanics	Course Code	23CV3PCFME	SEE Duration	3 Hours
Credits	03	L:T:P	2:1:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE (Theory)	50 marks	Lab	-

COURSE OBJECTIVES: The course enables the students to

Gain knowledge on fluid mechanics and their applications to CivilEngineering.

COURSE OUTCOMES: An ability to	
CO1	Estimate the fluid properties, fluid pressure and force.
CO2	Apply the equations of motion and energy equations to identify the flow characteristics and to estimate the fluid flow.
CO3	Analyse the losses in pipes and discharge through pipe network.
CO4	Demonstrate the Fluid Mechanics principles in practical applications.

UNIT-1

Introduction:

Fluid Properties- Mass density, specific volume, specific weight, specific gravity- Definitions, Viscosity, Newton's law of viscosity, Newtonian & non- Newtonian fluids, ideal & real fluids, Compressibility, Vapor Pressure, Surface tension,and Capillary. Units and dimensions.

Fluid pressure & its measurement:

Definition of pressure, types of pressures, pressure at a point in a static fluid, Hydrostatic pressure law, Pascal's law, Measurement of fluid pressure- Simple & Differential manometers, Mechanical gauge.

9 Hours

UNIT-2

Hydrostatics:

Definition of total pressure, center of pressure, total pressure and center of pressure on vertical plane surface and inclined surfaces, pressure diagram, practical applications- tanks, dams, sluice gates

8 Hours

UNIT-3

Kinematics of fluid:

Introduction, velocity, classification of fluid flow, description of the flow pattern, continuity equation in cartesian coordinate system, acceleration, velocity potential, stream function.

7Hours

UNIT-4

Dynamics of fluid flow: Concept of inertia force and other forces causing motion, derivation of Euler's & Bernoulli's Equation, kinetic energy correction factor, applications of Bernoulli's Equation in flow measurement: Venturi Meter, Pitot Tube, Flow through orifices and mouthpieces for constant head, Flow over notches and weirs (rectangular and triangular)**.**

8Hours

UNIT-5

Pipe flow systems: Energy losses in pipes-major and minor losses. HGL and TEL for pipe flow, variation of friction factor for laminar and turbulent flows, pipes in seriesand parallel, equivalent pipe, pipe networks, water hammer

7 Hours

Self-Study:

- Total pressure and center of pressure on curved surface and lock gates etc.
- Flow through orifices and mouthpieces under varying head, time to empty the tank, Flow over trapezoidal and Cipolletti weir.
- Analysis of discharge in branches of pipe network.

Self-study shall be evaluated through alternate assessment tools.

Text books:

1. P.N. Modi & S.M. Seth, "**Fluid Mechanics including Fluid Machines**", Standard Book House, New Delhi, 21st Edition, 2017.

Reference books:

1. Victor L Streeter & E. Benjamin Wylie, "**Fluid Mechanics**", McGraw Hill Publications.
2. Frank M White, "**Fluid Mechanics**", Sixth Edition, the McGraw Hill Companies.
3. Yunus Cengel & John Cimbala, "**Fluid Mechanics**", Third edition, McGraw Hill Education.
4. K. Subramanya, "**Fluid Mechanics and Hydraulic Machines**", McGraw Hill Education.
5. C.S.P. Ojha, R. Berndtsson & P.N. Chandramouli, "**Fluid Mechanics & Machinery**", Oxford University Press.
6. Dr. A.K. Jain, "**Fluid Mechanics Including Hydraulic Machines**", Khanna Publishers.

E-learning resources:

http://nptel.ac.in/courses/105101082/
https://nptel.ac.in/courses/105103192

CIE pattern:

Theory CIE: Each CIE to be conducted for 40 marks and reduced to 20, and Quizzes / AAT/ seminars /assignments for 10 marks.

SEE pattern:

1. Totally 7 question are to be framed (20 marks each) and students have to answer 5 full questions. The choice of questions is to be given in unit 1 and unit 4 only.

SEE paper pattern : *wef Aug 2024*

Each unit to have choice. Total 10 questions to be set. Students to answer five full questions selecting one from each unit. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	FME	23CV3PCFME											
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3	-										-	-	-
CO2	3	-										-	--	-
CO3	2	3										-	3	-
CO4	-	-	-	3	-	-	-	-	-	-	-	2	-	-

STRENGTH OF MATERIALS

Course	Strength of Materials	Course Code	23CV3PCSOM	SEE Duration	3 Hours
Credits	04	L:T:P	3:1:0	SEE+ CIE Marks	50+50
Contact hours	50 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Identify different materials physical and mechanical properties and their response to loadings in terms of stresses, strains, bending moment and shear force.

COURSE OUTCOMES: An ability to	
CO1	**Analyse** stress and strain at a point and their relations in a deformable material
CO2	**Apply** force equilibrium conditions and concept of free body diagrams to **determine** internal forces, stresses and responses under different loading conditions

UNIT-1

Simple Stresses and Strains:

Introduction, Properties of Materials, Concept of Stress and Strain, Types of Stresses, Types of Strains, Hooke's law, St. Venant's principle, Stress–Strain Diagram for Structural Steel and Nonferrous Materials, Principles of Superposition, Elongation of Bars with Uniform and uniformly Varying Cross Sections. Elongation due to Self- weight, Composite section. Temperature stresses – temperature stresses in Composite Sections.

Elastic Constants: Poisson's ratio, Elastic Constants and their relationship, Volumetric strain.

14 Hours

UNIT-2

Analysis of Determinate Beams:

Definition-Shear force & Bending moment, sign conventions, Relationship between loading, shear force and bending moment. Shear Force Diagrams and Bending Moment Diagrams for determinate beams for various loading cases.

12 Hours

UNIT-3

Stresses in Beams:

Introduction – Bending stress in beam, Assumptions in simple bending theory, Pure bending Derivation of Bernoulli's equation for simple bending, Modulus of rupture, Section Modulus, Flexural rigidity and relevant numerical problems.

Expression for horizontal shear stress in beam - Shear stress distribution for rectangular, circular, Flanged and Built up sections

.

8 Hours

UNIT-4

Transformation of Stresses:
Introduction, Stress components on inclined planes, Analysis of generalized two dimensional stress system – Normal and shear stresses on any inclined plane; Principal stresses and Principal planes, Mohr's circle of stresses, Relevant numerical problems. Failure Theories.

8 Hours

UNIT-5

Elastic Stability of Columns:

Introduction - Short and long columns - Euler's theory on columns - Effective length slenderness ratio - radius of gyration, buckling load - Assumptions, derivations of Euler's Buckling load for Column with both the ends hinged and both the ends fixed - Limitations of Euler's theory - Rankine's formula and problems.

Torsion of Shafts:
Pure Torsion, Torsion equation, Strength and Stiffness of Solid and Hallow Circular Shafts (Uniform cross sections), Torsional Rigidity and Polar modulus, Power transmitted by shaft of solid and hollow circular sections; Relevant numerical problems.

8 Hours

Text books:

1. Ferdinand P. Beer and E. Russel Johnston(jr), "**Mechanics of Materials**", Publisher, 6thEdition, 2013
2. L.S.Srinath, Prakash Desai and Ananth, "**Strength of materials**", Ramu Publisher, 2nd Edition, 2009.
3. Basavarajaiah and Mahadevappa, "**Strength of materials**", CRC Press, 3rd Edition – 2018.

Reference books:

1. Timoshenko and Young, "Elements of Strength of Materials", Affiliated East-West Press..
2. James M. Gere, "**Mechanics of Materials (FifthEdition)**", Thomson Learning.
3. A S Arunkumar, Sreekeshava, B V Ravishankar, "**Mechanics of Materials**", IK Publishers.
4. I.B.Prasad, "**Strength of Materials**", Khanna Publisher.
5. P N Chandramouli, "**Fundamentals of Strength of Materials**", PHI Learning Pvt. Ltd.
6. Subramanian R, "**Strength of Materials**", Oxford University Press.

CIE Pattern: Theory CIE: Each CIE to be conducted for 40 marks and reduced to 20, and Quizzes / AAT/ seminars /assignments for 10 marks.

SEE paper pattern:

1. Totally 7 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in unit 1 and unit 5 only.
2. The maximum number of sub division in a question is restricted to 4.

SEE paper pattern : wef aug 2024

Each unit to have choice. Total 10 questions to be set.

The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3											3	
CO2	3	3											3	

BIOLOGY FOR ENGINEERS					
Course	**Biology for Engineers**	**Course Code**	**23CV3BSBFE**	**SEE Duration**	**1.5 hours**
Credits	**01**	**L:T:P**	**1-0-0**	**SEE+ CIE Marks**	**25+25**
Contact hours	**15hrs**	**CIE**	**25 marks**	**Lab**	**Nil**

COURSE OBJECTIVES: To impart basic knowledge about biology and its relation and application to Engineering.

COURSE OUTCOMES: An ability to	
CO1	Explain the cellular make up, structure and functions of biomolecules and outline the basic concepts of enzymes and its functions.
CO2	Comprehend structural and functional concepts of enzymology and immunological science and its application.
CO3	Discuss the advances biological science and its application .

INTRODUCTION TO LIFE:
Cell and its Characteristics, Classifications, Structure and Functions of Organic and Inorganic Molecules; Carbohydrates, Lipids, Proteins, Nucleic Acid and Vitamins.

CONCEPTS OF ENZYMOLOGY
Structural and Functional Importance of Enzyme and its Application.

IMMUNOLOGICAL SCIENCE:
Structural and Functional properties of Antibodies and its Classification, Microbiology and its Applications.

IMPLEMENTATION OF BIO-NANO SCIENCE:
Nano technology and its Applications, Biosensors and its Application, Biochips and its Application.

ADVANCES IN BIOLOGICAL SCIENCE:
Bio mechanics, Neural Network Application, Genetic Engineering and its Application.

15hours

Text Books:

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Dr. Sohini Singh and Dr. Tanu Allen, "Biology for Engineers", Vayu Education of India, New Delhi, 2014
3. Biology for Engineers, Wiley Precise Textbook series, reprint 2023.
4. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox, 7th Edition, W. H. Freeman and Company, New York.

Reference books:

1. Molecular Biology of the cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Garland Science; 5 edition.
2. Simon O. Haykin, Neural Networks and Learning Machines (3rd Edition), Prentice Hall; 3 edition (November 28, 2008).

CIE : Minimum Two tests for 20 marks each.
Quiz/ AAT/ Assignment for 5 marks.
Total CIE =25 marks . 45 minutes duration. CIE graded for 50 marks.

SEE paper pattern: *2022 batch*

1. SEE is for 50 marks for duration of one hour.
2. **Part-A** is MCQ based or objective based for 20 marks
3. Totally 5 question are to be framed in **Part- B** (10 marks each) and students has to answer 3 full questions. The maximum number of sub division in a question is restricted to 4.

SEE paper pattern: *2023 batch onwards*
SEE for 50 marks. MCQs/ true or false/ match the following pattern. SEE graded for 50 marks. Duration: one hour

CO-PO MAPPING SCALE 1 TO 3

	Biology for engineers 23CV3BSBFE													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	2					2								
CO2	2					3								
CO3	2					3								

Introduction to MS Excel					
Course	**Introduction to MS Excel**	**Course Code**	**23CV3AEIME**	**SEE Duration**	**2 hours**
Credits	**01**	**L:T:P**	**0-0-1**	**SEE+ CIE Marks**	**50+50**
Contact hours/ classes	**2hrs/ week Lab: 10-12 classes**	**CIE**	**25 marks**	**Lab**	**Nil**

COURSE OBJECTIVES: To be enable students to use MS EXCEL with familiarization with basic functions and to apply it to various civil engineering verticals. This is an ability enhancement course.

COURSE OUTCOMES: An ability to	
CO1	Apply excel functions to estimate centroid and moment of inertia of different geometrical cross sectional shapes.
CO2	Create plots for S.F.D., B.M.D. and Simple Curve for Surveying
CO3	Create spread sheet for applications in various Civil Engineering Numerical Problems.

Syllabus Content:

1	**Functions:** sum, average, count, Countif, max and min,: simple multivariate regression of data , V lookup, convert;
2	**Charts and Plots**: types: XY scatter, linear plot, curve fit – determining R^2 of plots, combination plot /chart, semi log plot, error bars in plots
3	**Matrix operations** : Addition, subtraction, multiplication of two matrices, determinant and inverse of a matrix.
4	To determine position of centroid for a given plane lamina.
5	To determine moment of inertia of given plane lamina.
6	To plot S.F.D. and B.M.D. for – a) Simply supported beam. b) Cantilever beam; subjected to concentrated load, uniformly distributed load , uniformly varying load and point moment
7	To generate a gradation curve for given soil sample using a semi-log plot.
8	Create spread sheet : Survey/ Geodesy - problem on setting up of Simple Curve
9	Use of MS Excel to calculate quantities for a brick wall - mortar and bricks.
10	Use of MS Excel to determine flow rate and pressure for an example pipe network using Hardy Cross Method.

CIE: One CIE conducted for 50 marks by the faculty along with an internal faculty as co-examiner. Practical records valued for 20 marks and CIE for 30 marks.

SEE: SEE to be conducted for 100 marks with an external examiner and an internal faculty as co-examiner.

Books:

1. An Introduction to: Excel for Civil Engineers, by Gunthar Panganiban, Publisher: CreateSpace, Independent Publishing Platform7290 Investment Drive # B,North Charleston, SC, United States , ISBN:978-1-5371-3771-1, Published on:16 August 2016, Pages -386
2. Excel for Scientists and Engineers: Numerical Methods, by E. Joseph Billo, Publisher : Wiley, ISBN: 978-0-471-38734-3, April 2007, Pages – 480.
3. Excel for Beginners (Volume 1 of Excel Essentials), by M.L. Humphrey, ISBN 1976489369, 2017, Pages – 80.

E-Learning

1. https://youtu.be/wbJcJCkBcMg - Excel for Beginners - The Complete Course
2. https://www.youtube.com/watch?v=QnPC5UYy9ys – hardy cross method in excel
3. https://www.youtube.com/watch?v=CMoZmYUyHOM&pp=ygUoaW50cm9kdWN0aW9uIHRvIGV4Y2VsIHRvIGNpdmlsIGVuZ2luZWVycw%3D%3D - Excel for Civil Engineering Applications

CO – PO MAPPING

	23CV3AEIME MS EXCEL													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	**PSO1**	**PSO2**
CO1	2				3									
CO2	2				3					2				
CO3	2				3				2	2			2	

IV SEMESTER

Syllabus

For 2022 admitted & onwards

Building Drawing and CAD

Course	Building Drawing and CAD	Course Code	23CV4ESBDC	SEE Duration	4 Hours
Credits	03	L:T:P	1:1:1	SEE+ CIE Marks	50+50
Contact hours/ classes	12hrs L + 12 drawing classes + 12 lab classes	CIE Theory	25 marks	CIE Lab	25 marks

COURSE OBJECTIVES: The course enables the students to

Gain drafting knowledge, visualize the various components of a building and design a building. This will enable students to design and draw the various types of buildings based on the given functional requirements. The students will learn manual drawing as well as to prepare drawings using AUTOCAD.

COURSE OUTCOMES: An ability to	
CO1	Develop drawings from given line diagram manually.
CO2	Design and Develop drawings of building components and service layouts manually.
CO3	Generate drawings of various building components and buildings using AUTOCAD.

Unit-1

Introduction:

Scales (Usage of Paper Scales & T Square only), Definition of various terms used in building drawings.

Design: Functional design of buildings using inter connectivity diagrams (bubble diagram), development of line diagram of residential buildings, public buildings such as Primary Health Centre, office buildings and school buildings.

5 Hours

UNIT-2

Building Components:

To prepare geometrical drawing of various component of buildings such as

i. Stepped wall footings,
ii. Isolated RCC column footings
iii. RCC dog legged Staircase
iv. Fully paneled wooden Doors & fully glazed wooden windows
v. Steel truss

20 Hours

UNIT-3

Drawings:

Development of plan, elevation, section and schedule of openings for the given line diagram of residential buildings incorporating necessary specifications for;

i. Two bed room single storyed residential buildings (2 Nos)
ii. Two storyed residential building (Only for submission)

Specifications for residential, office and public buildings. Building bye-laws as per Local regulatory bodies. The setback distances, calculation of carpet area, plinth area and floor area ratio.

Services (Only for submission) :

Preparation of water supply, sanitary and electrical layouts for a given single line diagram

11 Hours

Students shall submit manual drawings for evaluation.

CAD Laboratory:

List of Experiments

Class	Topics
1	Introduction to AUTOCAD, introduction to usage of drafting, modifying and other AUTOCAD tools.
2	
3	Prepare drawings for SSM foundation.
4	Prepare drawings for isolated RCC footing and column.
5	Prepare drawings for fully paneled doors.
6	Prepare drawings for fully glazed windows
7	Prepare drawings for dog – legged staircase
8	Prepare drawings for plan, section, elevation of single bedroom house including schedule of openings and area statement
9	
10	Prepare drawings for plan, section, elevation of double bedroom house including schedule of openings and area statement
11	
12	Lab CIE

Text books:

1. Shah M. H. And Kale C. M, "**Building Drawing**", Tata McGraw Hill Publishing Co. 2002.

Reference books:

1. V. B. Sikka, "**A Course in Civil Engineering Drawing**", S. K.Kataria & Sons, 11th Edition, 2022
2. Gurucharan Sing, "**Building Construction**". Standard Book House publication, 17th Edition, 2019
3. IS: 962 - 1989 "**Code of practice for architecture and building drawing",** BIS, New

Delhi.

CIE Pattern

Two CIE will be conducted for 40 marks each and reduced to 5 marks each. (Total marks for CIE=10); Manual Drawing submissions for 15 marks. Drawing sheets shall be evaluated by respective batch faculty.

For CAD lab, one lab CIE will be conducted for 25 marks.

SEE pattern:

1. The question paper shall have Three QUESTIONS from three UNITS. Maximum number of sub divisions in each main question is Two.
2. One question of 20 marks from UNIT-1
3. One question of 20 marks with internal choice from UNIT-2
4. One compulsory question of 60 marks from UNIT-3.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	BPD 23CV4ESBDC													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	-	2											2	
CO2	-		3										2	
CO3	-		3		3								2	

CONCRETE TECHNOLOGY

Course	Concrete Technology	Course Code	23CV4PCCON	SEE Duration	3 Hours
Credits	03	L:T:P	2:0:1	SEE+ CIE Marks	50+50
CONTACT hour/ Classess	Theory -26 Hours Lab: 10-12 classes	CIE	25 marks	Lab	25 marks

COURSE OBJECTIVES: The course enables the students to

Provide fundamental knowledge of the ingredients for concrete design and preparation, properties of concrete and the testing of concrete properties in accordance with the IS codes.

COURSE OUTCOMES: An ability to

CO1	Identify and ascertain the characteristics of the ingredients and the quality of concrete based on its properties specified for field application.
CO2	Proportion the concrete mix for various field applications and predict the service life of the structure based on the durability indicators using IS codal provisions.
CO3	Conduct experiments to evaluate the properties of concrete.

UNIT-1

Introduction:

Basic Concrete Ingredients: Hydraulic Cements: Physical Properties, Manufacturing process, Chemical composition, hydration of cement, interfacial transition zone. w/c ratio, micro structural development of Portland cement, testing of cement. Aggregates: Properties, types of aggregates, classification of aggregates, importance of grading, testing of aggregates (IS:383:2019), deleterious materials, Water: qualities of water, use of sea water, Admixtures (Mineral and Chemical Admixtures).

6 Hours

UNIT-2

Fresh Concrete:

Properties of fresh concrete; Workability, Factor affecting workability, measurement of workability, slump, compacting factor, Vee-Bee consistometer and flow tests, SCC tests, Segregation and bleeding, Plastic shrinkage, Process of manufacture of concrete: Batching, mixing, transportation, placing and compaction and curing by different methods, Ready Mix Concrete.

7 Hours

UNIT-3

Mix Proportioning of Concrete:

Concrete mix design: Concept of mix design, role of water to cement ratio, water content, other variables and exposure conditions, mixproportioning using IS-10262-2019 guidelines

5 Hours

UNIT-4

Hardened Properties:

Engineering properties of concrete; Compressive strength and the factors affecting the strength, tensile strength, Flexural strength, bond strength, modulus of Elasticity, factors affecting modulus of elasticity, poissons ratio, creep, Drying and Autogenous shrinkage, non–destructive testing; rebound hammer, ultrasonic pulse velocity, Intro to other test methods of NDT, In-situ testing of concrete as per IS- Provisions.

5 Hours

UNIT-5

Durability:

Significance of durability, Factors affecting durability, carbonation, Aggressive environments - Chloride ions and Sulphate ions, Acid, Corrosion, Freezing and thawing, Alkali Silica reaction, Testing methods for durability.

3 Hours

LABORATORY :

Tests on Cement:

1. Specific gravity test
2. Fineness of cement
3. Consistency test on cement
4. Setting time test on cement
5. Compressive strength of cement

Tests on Fine Aggregate:

1. Specific Gravity Test
2. Sieve analysis
3. Bulking of fine aggregate
4. Unit weight % Voids
5. Water Absorption test

Tests on Coarse Aggregate:

1. Specific Gravity
2. Sieve analysis
3. Unit weight % Voids
4. Water absorption test

Tests on fresh concrete:

1. Slump test
2. Compaction factor test
3. Vee-Bee Consistometer test
4. Flow table test

Tests on hardened concrete

1. Compressive strength of concrete cube
2. Compressive strength of Cylinder
3. Split tensile strength
4. Flexural strength of concrete beam

Demo Experiments - NDT tests

1. Pulse ultrasonic test
2. Rebound Hammer test

Activity Based Experiments

1. To ascertain the compatibility of the admixtures with different cements.
2. Concrete Mix design with different mineral admixtures along with their fresh properties.
3. Simple durability tests.

Text book/Codes:

1. MS Shetty, "**Concrete Technology Theory and practice**", S Chand and Company, 2006.
2. A M Neville, "**Properties of Concrete**", Fifth Edition, Pearson Education Asia Pvt ltd, 2014.
3. **IS: 383-2016**. "**Indian standard specification for coarse and fine aggregates from natural sources for concrete (Third revision**)". Bureau of Indian Standards, New Delhi, India.
4. **IS: 456-2000**, Reaffirmed 2005. "**Plain and Reinforced Concrete - Code of Practice**". Bureau of Indian Standards, New Delhi, India.
5. **IS: 10262-2019**. "**Indian standard concrete mix proportioning (Second revision)**". Bureau of Indian Standards, New Delhi, India.

Reference books:

1. P K Mehta and Paulo JM Monteiro, "**Concrete – microstructure, properties and materials**", 4th Edition, McGrawHill Education, 2017.
2. A R Santhakumar, "**Concrete Technology**", 2nd Edition, Oxford University Press – New Delhi, 2018.
3. Gambhir ML, "**Concrete Technology**", Tata McGraw-Hill Publishing Company, 5th Edition, New Delhi,2017.
4. Current literatures.

E-learning resources:

https://nptel.ac.in/courses/105102012/
http://elearning.vtu.ac.in/

CIE:

CIE theory to be for 20 marks and Quizzes / AAT/ / seminars /assignment is for 5 marks.
Lab CIE for 25 marks.

SEE paper pattern:

1. Totally 7 questions are to be framed (20 marks each) and student to answer 5 full questions. The choice of questions is to be given in **unit 1 and unit 4** only.
2. The maximum number of subdivision in a question is restricted to 4.

SEE paper pattern : wef Aug 2024

1. Totally 10 questions are to be framed (20 marks each) and student to answer 5 full questions. The choice of questions is to be given in **all units.**
2. The maximum number of subdivision in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

Faculty to map any additional POs if required based on delivery of course content.

CO-PO Mapping

	CONCRETE TECHNOLOGY 23CV4PCCON													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3		-	-					-	-			-	2
CO2	2	-	3	-					-	-			3	-
CO3	-		-	2	-	-	-	-	3	3	-	-	2	-

ENVIRONMENTAL ENGINEERING-I

Course	Environmental Engineering-I	Course Code	23CV4PCENV	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Analyse the variation of water demand and to estimate water requirement for acommunity
Evaluate the sources and conveyance systems for raw and treated water
Study drinking water quality standards and to illustrate qualitative analysis of water
Design physical, chemical and biological treatment methods to ensure safe and potablewater Supply

COURSE OUTCOMES: An ability to	
CO1	Estimate water demand and forecast population for a community.
CO2	Evaluate available sources of water, its quality and design suitable treatment unit.
CO3	Identify Specific pollutants removal techniques, and analyse distribution and plumbing systems to distribute water to the required quality standards.

Unit-1

Estimation of water demand and population forecasting:

Water demand: Different water demands, fire demand, per-capita consumption- factors affecting per capita demand, variations in rate of water demand, peak factor and design period.
Population forecasting: Various methods of forecast, fire demand.
Concepts of safe water, wholesome water and palatable water, NBC guidelines for water requirement.

7 Hours

UNIT-2

Water supply systems and water quality analysis:

Sources and supply of water: Surface and sub-surface sources, Intake structures- river and reservoir intake; factors for selection and location of intakes. Pumps- necessity, types, power of pumps, factors for the selection of pumps and design of the economical diameter of

the rising mains.

Water sampling and characteristics: Concepts of safe water, wholesome water and palatable water, physical, chemical and bacteriological analysis of water, water quality standards – BIS and WHO Standards, health significance of water parameters, water borne diseases, Sampling- objectives, methods, preservation techniques, bacterial examination of water-multiple fermentation tube and membrane filter test –MPN.

8 **Hours**

UNIT-3

Design of water treatment units:

Conventional treatment plant: Mechanism, design, construction, operation and maintenanceof screens, aeration-types of aerators, sedimentation, Clarifloculator, types of coagulants; flash mixer, filtration (Slow, rapid and Pressure filters).

8 Hours

UNIT-4

Disinfection and removal of specific pollutants:

Disinfection: Methods of disinfection, chlorination, chlorine demand, residual chlorine, use of bleaching powder.

Removal of Specific pollutants: Water softening - lime soda, Zeolite process, adsorption and membrane technology (Microfiltration, ultrafiltration, Nano filtration and reverse osmosis).

8 Hours

UNIT-5

Distribution and water conservation:

Water storage and distribution: Storage reservoirs, different distribution network systems. Plumbing system in building: Supply systems within the building, Pipe fittings and pipe joints in building.

Water conservation: Importance and Techniques.

8Hours

Activity:

1. Site visit: Water treatment plant.
2. Design of complete water treatment systems for a community.

Text books:

1. Santosh Kumar Garg, "**Water Supply Engineering: Environmental Engineering - Vol. I**", Khanna Publisher, 2017
2. B.C. Punmia and Ashok Jain, "**Environmental Engineering, I-Water Supply Engineering**", Laxmi Publications (P)Ltd., New Delhi, 2010.

Reference books:

1. Howard S. Peavy, Donald R. Rowe, George T, "**Environmental Engineering**", McGraw HillInternational Edition, New York, 2017.
2. Bendat and Piersol, "**Water & Waste Water Technology**". John Wiley & Sons Inc., New York, 2008.
3. Ministry of Urban Development, Government of India, New Delhi, "**CPHEEO Manual on**

water supply and treatment engineering", Akalank Publications, 2018.

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 7 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in unit 2 and unit 3 only.
2. The maximum number of sub division in a question is restricted to 4.
3.

SEE paper pattern : wef Aug 2024

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	Environmental Engg-I 23CV4PCENV													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3												2	
CO2	3	2	2										2	
CO3	2												2	

GEOTECHNICAL ENGINEERING-I

Course	Geotechnical Engineering- I	Course Code	23CV4PCGTE	SEE Duration	3 Hours
Credits	04	L:T:P	2:1:1	SEE+ CIE Marks	50+50
Contact hours	39 hrs Lab : 10-12 classes	CIE Theory	25 marks	CIE Lab	25 marks

COURSE OBJECTIVES: The course enables the students to

Provide fundamental knowledge and skill about Index properties, Engineering properties of soil, their importance and methods to determine them experimentally. This course provides an insight to mechanics of soil as a foundation and construction material.

COURSE OUTCOMES: An ability to	
CO1	Apply Fundamental concepts to evaluate soil **index properties** so as to identify and classify them.
CO2	Compute and discuss various **Engineering properties** of soils and describe different types of soil structures and clay minerology.
CO3	Conduct experiments on soil, analyze, interpret data, comprehend and write reports.

UNIT-1

Soil Phases and Interrelationships

Definition, List of different soil types. Definition of mass, weight. Relation between mass and weight. Units of mass and weight in SI units. Phase Diagram, basic definitions and various weight volume interrelationships, Numerical problems on inter-relationships, borrow area-embankment.

7Hours

UNIT-2

Index Properties Of Soils And Their Determination:

Index Properties of soils, its significance and Laboratory determination, -Water content, Specific Gravity, in-situ density, Particle size distribution (Sieve analysis and Hydrometer analysis), Relative density, Consistency limits and their indices, Activity of Clay, Thixotropy of clay. Soil Classification methods, IS classification; - Plasticity chart and its importance, Field identification of soils. Numerical problems.

10 Hours

UNIT-3

Clay Mineralogy and Soil Structure:

Introduction, Types-Single grained honey-combed, flocculent and dispersed structures,Types of soil-Water, base-exchange capacity, Common clay minerals in soil and their structures-Kaolinite, Illite and Montmorillonite.

Effective Stress: Effective stress concept-Total pressure and Pore pressure, effect of water table, Numerical problems- with and without capillary water **7 Hours**.

UNIT-4

Engineering properties

Permeability of Soils:

Introduction, Importance, Definition, Types-pervious, semi, impervious soils, Darcy's law-Assumption and validity, coefficient of permeability and its Laboratory determination, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, quick sand condition Numerical problems.

Compaction of soils: Definition, Principle of compaction. Standard and Modified Proctor's tests and their compactive energy. Factors affecting compaction, Field compaction control, Numerical problems.

8 Hours

UNIT-5

Engineering properties

Shear Strength of Soils:

Introduction, Shear parameters, Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional failure envelope. Total and effective shear strength parameters, Sensitivity of clay. Measurement of shear parameters-Direct shear test, unconfined compression test, and Triaxial shear test., Types of drainage conditions, Numericals.

7 Hours

Laboratory:

Determination of index and engineering properties of soil.

1. Specific gravity by density bottle and pycnometer method
2. Water content by oven drying and pycnometer method
3. Particle size analysis by mechanical sieve analysis and hydrometer analysis
4. Field density by core cutter method, sand replacement method
5. Liquid limit by cone penetrometer method and shrinkage limit.
6. Liquid limit by Casagrande method and plastic limit by rolling thread method
7. Hydraulic conductivity by constant head and falling head permeameter method
8. Compaction characteristics by standard proctor method
9. Shear parameters by Direct shear test
10. Unconfined compressive strength test
11. Shear parameters by Triaxial shear test –UU test

Text books:

1. Punmia B.C., Ashok kumar jain, Arun kumar Jain, " **Soil Mechanics and Foundation Engg**.", 17th Edition, Laxmi Publications Co. , New Delhi,2017.

Reference books:

1. Arora.K.R, "**Soil Mechanics & Foundation Engineering**", Standard Publishers,2009.
2. Braja, M. Das, "**Principles of Geotechnical Engineering**", Cengage India Private Limited; Ninth edition, 2017.
3. Gopal Ranjan and Rao A.S.R., "**Basic and Applied Soil Mechanics**", 3rd edition, New Age International (P) Ltd., New Delhi, 2016.
4. Murthy VNS, "**Textbook of Soil Mechanics and Foundation Engineering: Geotechnical Engineering series**", CBS publishers, 2015.
5. Craig R.F, "**Soil Mechanics**", 7th edition, Spon press, New York, 2004.
6. Head K.H, "**Manual of Soil Laboratory Testing**", Vol. I, II, III, Princeton Press, London, 1986.

E-learning resources:

1. http://www.myopencourses.com/subject/e-book-on-concepts-andtechniques-in-geotechnical-and-foundation-engineering
2. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv104Page1.htm
3. nptel.ac.in/courses/105101084/
4. https://ay14-15.moodle.wisc.edu/prod/course/view.php?id=499

CIE: CIE in theory component is for 20 marks and Quiz/Assignments/Seminar /AAT is for 5 marks. CIE for Lab component is for 25 marks.

SEE paper pattern:

1. A total of 7 questions are to be framed (20 marks each) and student has to answer 5 full questions. The choice of questions is to be given in **Unit 2 and Unit 4** only.
2. No questions on derivation of interrelationships in Unit 1.
3. The maximum number of subdivisions in a question is restricted to 4.

SEE paper pattern: wef aug 2024

1. A total of 10 questions are to be framed (20 marks each) and student has to answer 5 full questions. The choice of questions is to be given in **all units**.
2. No questions on derivation of interrelationships in Unit 1.
3. The maximum number of subdivisions in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	GTE-1				23CV4PCGTE									
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3	-											2	
CO2	3	2											2	
CO3	3	-							3	3	-	-	2	

Course	Hydraulic Engineering	Course Code	23CV4PCHYE	SEE Duration	3 Hours
Credits	03	L:T:P	1:1:1	SEE+ CIE Marks	50+50
Contact hours	Theory -26 Hours Lab – 24 Hours	CIE Theory	25 marks	CIE Lab	25 marks

COURSE OBJECTIVES: The course enables the students to

To gain knowledge and skills necessary to analyse uniform and non-uniform flows in open channels, perform dimensional analysis.

COURSE OUTCOMES: An ability to	
CO1	Analyse the characteristics of uniform flow, critical flow and non-uniform flow in open channels.
CO2	Apply the concepts of CFD and modelling to open channel flow simulation.
CO3	Apply the principles of dimensional analysis to fluid flow phenomena.
CO4	Conduct investigations, interpret data, and arrive at conclusions related to fluid flow phenomena.

Unit-1

Flow in open channels:

Definition of channel, difference between pipe and open channel flow, types of flows, geometric properties of open channels, velocity distribution.

Uniform flow in open channels:

Chezy's & Manning's formula, channel conveyance, most economical channel sections-rectangular and trapezoidal sections.

5 Hours

UNIT-2

Energy equation, Specific energy, Specific Energy curve, Momentum equation,Specific force, Energy and momentum correction factors

Critical flow: Characteristics, critical flow in rectangular sections.

Metering flumes: Venturi flume, Parshall flume. **5 Hours**

UNIT-3

Non-uniform flow in open channel: Definition, Types of non- uniform flows.

Gradually Varied Flow: Differential equation of GVF, Classification of channelbottom slopes and flow profiles in wide rectangular channel. Identification of GVF profile in Mild slope channel.

Rapidly varied flow: Hydraulic jump: definition, types & applications, momentum equation formulation for the hydraulic jump, Hydraulic jump in a horizontal rectangular channel: sequent depth, energy loss and length of the jump, Stilling basin.

7 Hours

UNIT-4

Computational hydraulics:

Introduction to CFD, numerical, analytical and experimental models, general steps of model development

Modeling fluid flow in an open channel - Case study:

Basic conservation equations in differential forms, Navier-Stoke equation, boundary conditions: Dirichlet and Neumann boundary conditions, space and time discretization, comparison of numerical and analytical models.

5 Hours

UNIT-5

Similitude:

Dimensional Analysis Introduction, Dimension, Dimensional homogeneity, Methods- Rayleigh method, Buckingham Pi method, Similitude- Geometric, Kinematic & Dynamic Similarity, Model laws.

4 Hours

Laboratory:

1. Study of fluid properties (Demonstrations)
2. Performance analysis of various flow measuring structures.
   a. Venturimeter
   b. Orifice & Mouth Piece
   c. V- Notch
   d. Ogee weir
3. Study the type and characteristic of hydraulic jump
4. Study the GVF profiles in open channel
5. Study on major and minor losses in pipes
6. Investigations on pipe network (open ended)

Text books:

1. P.N. Modi & S.M. Seth, "**Fluid Mechanics including Fluid Machines**", Standard Book House, New Delhi, 21st Edition, 2017
2. Popesku I, "**Computational Hydraulics. Numerical Methods and Modelling**", IWA Publishing, UK, 2014.

Reference books:

1. V.T. Chow, "**Open Channel Hydraulics**", The Blackburn Press, 2009.
2. Subramanya K, "**Flow in Open Channels**", 5th Edition, McGraw-Hill, 2019
3. R.K. Bansal, "**Fluid Mechanics**", 10th Editions, Laxmi Publications, New Delhi,2019
4. Ranga Raju, K.G, "**Flow through open channels**", 1st Edition, T.M.H. 2nd edition,2001
5. Tapan Sen Gupta, "**Computational Fluid Dynamics**, Universities Press, 2004.

E-learning resources:

1. http://nptel.ac.in/courses/105103096
2. http://nptel.ac.in/courses/105107059/
3. https://nptel.ac.in/courses/105105161

CIE: CIE theory component for 20 marks and Quiz /AAT for 5 marks. CIE for Lab component for 25 marks. All theory CIE to be conducted for 40 marks.

SEE paper pattern:

1. Totally 7 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in unit 3 and unit 5 only.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignments

SEE paper pattern: wef 2024 odd sem

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	HYDRAULIC ENGINEERING							**23CV4PCHYE**						
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3	3											2	
CO2	3												2	
CO3	3												2	
CO4				3						3		2	2	

STRUCTURAL ANALYSIS

Course	Structural Analysis	Course Code	23CV4PCSTA	SEE Duration	3 Hours
Credits	04	L:T:P	3:1:0	SEE+ CIE Marks	50+50
Contact hours	50 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Enable the students to gain knowledge on the fundamentals of structural analysis by applying the knowledge gained through Engineering Mechanics and Strength of Materials. It enables to get the prerequisite for advanced analysis and design of structures.

COURSE OUTCOMES: An ability to	
CO1	Apply the force equilibrium conditions and compatibility conditions to analyze simple structures including arches, cables, frames and evaluate structural response.
CO2	Apply energy principles to analyze determinate structures.

UNIT-1

Introduction to Structural Systems:

Historical perspective of structures, Classification of structures, Forms of Structures, Loads, Conditions of equilibrium, Compatibility conditions, Statically Determinate and Indeterminate Structures, Concept of Indeterminacy, Degree of Static and Kinematic indeterminacy.

Deflection of beams - Importance of deflection, Governing differential equation of elastic curve. Evaluation of deflection by Macaulay's double integration method.

10Hours

UNIT-2

Slope and deflection by Geometrical Methods:

Computing slopes and deflections in statically determinate beams by moment area method and conjugate beam method.

10 Hours

UNIT-3

Analysis of Cables & Arches:

Cables – Analysis of cables under point loads and UDL for supports at same and at different levels.

Arches - Distinction between arch and beam action, Analysis of three hinged parabolic arches with supports both at same and different levels, Determination for Bending Moment, Radial shear and Normal Thrust.

10Hours

UNIT-4

Introduction to Indeterminate Structures:

Consistent Deformation method: Analysis of Structure with 1 Degree of StaticIndeterminacy. Clayperons' theorem of three moments: Analysis of Fixed Beams and Continuous beam without and with sinking of supports.

10 Hours

UNIT-5

Energy Method:

Strain Energy Principle-Strain energy and complimentary strain energy. Strain energy due to axial load, bending. Theorem of minimum potential energy, principle of virtual work. Castigliano's 1st theorem and their applications in the analysis of determinate beams, frames.
Unit Load method: Deflection of determinate beams, rigid frames and pin jointed plane trusses by Unit load method.

10 Hours

Text book/Codes:

1. Pandit and Gupta. "**Theory of Structures Vol-1**", Tata McGraw Hill, New Delhi, First Edition, 2017

2. C S Reddy, "**Basic Structural Analysis**", Tata McGraw Hill, New Delhi, Third Edition, 2017

Reference books:

1. Norris and Wilbur, "**Elementary Structural analysis**", International student edition, Tata McGraw Hill book Co, New York, 3rd Edition, 1976.

2. R C Hibbeler, "**Structural Analysis**", 10th edition, Pearson Education, 2022.

E-learning resources:

NPTEL

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 7 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in unit 2 and unit 5 only.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ seminars /assignments/model submissions

SEE paper pattern: wef odd sem 2024

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	23CV4PCSTA												
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**	**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3											3	

Universal Human Values

Course	Universal Human Values	Course Code	22MA4HSUHV	SEE Duration	1 hours
Credits	01	L:T:P	0-1-0	SEE+ CIE Marks	50+50
Contact hours	30 hrs	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES:

To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

COURSE OUTCOMES: An ability to	
CO1	Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual
CO2	Analyze the value of harmonious relationship based on trust and respect in personal and professional life
CO3	Examine the role of a human being in ensuring harmony in society and nature
CO4	Apply the understanding of ethics in life and profession

UNIT-1

Course Introduction:

Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

06 hours

UNIT-2

Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'

11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease 06 hours

UNIT-3

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship:

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

06 hours

UNIT-4

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence:

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

06 hours

UNIT-5

Implications of the above Holistic Understanding of Harmony on Professional Ethics:

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for

augmenting universal human order b. Ability to identify the scope and characteristics of

people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

27. **Sum up .Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.**

06 hours

Text book/Codes:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books:

1. A Nagaraj, "**Jeevan Vidya: Ek Parichaya**", , Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, **"Human Values"** , New Age Intl. Publishers, New Delhi, 2004.
3. Annie Leonard, "**The Story of Stuff**", Free Press, 2011
4. Mohandas Karamchand Gandhi, **"The Story of My Experiments with Truth",** Fingerprint Publishing; First Edition, 2009.
5. E. F Schumacher, **"Small is Beautiful",** HarperCollins, 2010
6. Cecile Andrew, **"Slow is Beautiful"**, New Society Publishers, 2006
7. J C Kumarappa, "**Economy of Permanence**", Sarva Seva Sangh Prakashan, 2017
8. PanditSunderlal**, "Bharat Mein Angreji Raj**" , Prabhat Prakashan, 2018
9. Dharampal, "**Rediscovering India**", Bloomsbury Academic, 2011
10. Mohandas K. Gandhi " **Hind Swaraj or Indian Home Rule**", Pilgrims Publishing, 2013
11. Maulana Abdul Kalam Azad, **"India Wins Freedom",** Orient BlackSwan, 1988
12. Romain Rolland (English), "**Vivekananda**", Advaita Ashrama, Indian, 2010

E-learning resources:

https://www.youtube.com/c/UniversalHumanValues

CIE pattern (50 marks) : Only one CIE (MCQ) to be conducted for 10 marks. AAT to be conducted for 30 marks. Attendance >95% will be awarded 5 marks, 85-95% will be awarded 3 marks, 75-85% will be awarded no marks. Report submission carries 5 marks.

SEE paper pattern:

Marks for SEE shall be graded for 50 marks. SEE shall have 25 MCQs and a duration of 1 hour.

CO-PO MAPPING SCALE 1 TO 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										2		3		
CO2										2		3		
CO3									3	2				
CO4								3	2					

Course	23CV4AEBIM	Course Code	Introduction to Building Information Modeling	SEE Duration	1.5 hours
Credits	01	**L:T:P**	1:0:0	**SEE+ CIE Marks**	25+25
Contact hours	**15**	**CIE**	**25 marks**	**Lab**	**Nil**

COURSE OBJECTIVES : To introduce the students to

- Understand the Foundations of BIM
- Familiarize with BIM Tools and Workflow
- Explore Real-world Applications and Future Trends

COURSE OUTCOMES: An ability to	
CO1	Demonstrate Understanding of BIM Fundamentals
CO2	Utilize BIM Software Tools Effectively
CO3	Analyze Real-world Applications and Future Trends

Module 1: Fundamentals of BIM (3 hours)

- Definition and history of BIM
- Importance and benefits of BIM in civil engineering
- Key concepts and terminology in BIM

Module 2: BIM Software Tools (3 hours)

- Overview of popular BIM software platforms (e.g., Revit, AutoCAD Civil 3D)
- Basic navigation between different roles
- Understanding the role of BIM software in project lifecycle

Module 3: BIM Workflow and Collaboration (2 hours)

- Understanding the BIM workflow process
- Role of BIM in project planning, design, construction, and maintenance
- Collaborative aspects of BIM in interdisciplinary project teams

Module 4: Data Management and Integration (3 hours)

- Managing and integrating various data types within a BIM environment
- Understanding data exchange formats (e.g., IFC)
- Importance of data management in BIM projects

Module 5: Real-world Applications and Future Trends (2 hours)

- Case studies and examples of BIM implementation in civil engineering projects

- Future trends and advancements in BIM technology
- Ethical considerations and challenges in BIM implementation

Scheme of Continuous Internal Evaluation (CIE):

CIE Pattern: CIE final marks is for 25 and graded for 50 marks.

2 written tests to be conducted for 20 Marks each reduced to 10 marks.

AAT component shall have 05 marks. AAT's include Assignments / Quizzes / Seminars / Course projects / Field surveys / Case studies / Hands-on practice (experiments) / Group Discussions / others.

SEE paper pattern:

SEE includes ***CAPSTONE PROJECT SUBMISSION*** and presentation of the same.

35 Marks for the submission and 15 Marks for the presentation.

CIE +SEE = 25+25 = 50.

Suggested Learning Resources:

1. ISO 19650 - Building Information Modelling (BIM)
2. BIM Handbook – Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston
3. "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors" by Chuck Eastman, Paul Teicholz, Rafael Sacks, and Kathleen Liston
4. "Building Information Modeling: Framework for Structural Design" by Nawari O. Nawari
5. "BIM for Construction Health and Safety" by Stefan Mordue and Roland Finch
6. Coursera: "Building Information Modeling (BIM) Fundamentals" by Autodesk
7. LinkedIn Learning: "BIM: Essential Training" by Eric Wing
8. Autodesk BIM 360 Blog: Offers insights, tips, and best practices on BIM implementation and software usage.
9. National Institute of Building Sciences (NIBS): Provides resources, publications, and research related to BIM in the construction industry.
10. Building SMART International: Offers resources, standards, and events related to BIM and open BIM initiatives.

COURSE: Building Information Modeling												CODE: 23CV4AEBIM	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		2											
CO2	3	3			3									
CO3	2			3			2					3	3	

V semester

Syllabus

For 2022 admitted batch

(*V semester syllabus : wef Aug 2024*)

DESIGN OF RC STRUCTURAL ELEMENTS V sem

Course	Design of RC Structural Elements	Course Code	23CV5PCDRC	SEE Duration	3 Hours
Credits	03	L:T:P	2:1:0	SEE+ CIE Marks	50+50
CONTAC Thours	39	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire fundamental knowledge of reinforced concrete and design the RC structural elements

COURSE OUTCOMES: An ability to	
CO1	Comprehend basic design concepts and explain philosophies of design pertaining to RC members as per Indian codal provisions
CO2	Design of RC components conforming to IS Code of Practice.

UNIT-1

Introduction to Basic Design Concepts:

Introduction, Objectives of the Design of Reinforced Concrete Structures, Methods of Design, Design Loads, IS Code provisions for concrete and reinforcements

Philosophies of Design:

Introduction, Basic principles of working stress method, Moment of resistance of singly reinforced rectangular section – Balanced, under reinforced and over reinforced sections by working stress method (No numerical examples) Principles of limit state method, Partial safety factors, Characteristic and design loads, Characteristic and design strength, Stress block parameters for limit state of collapse by flexure Flexural strength of singly reinforced rectangular sections, Doubly reinforced rectangular sections, Flanged sections, Shear strength of RC sections, Torsional strength of RC sections, Concepts of anchorage/development length. General aspects of serviceability, Deflection limit as per IS code of practice. Examples on analysis of singly reinforced, Doubly reinforced, flanged sections, shear strength and development length.

10 Hours

UNIT-2

Design of Beams:

General specification for flexural design of prismatic beams-Practical requirements, Size of beam, cover to reinforcement, spacing of bars, Design procedures for critical sections for bending moment, shear and torsion, Anchorage of bars, check for development length and deflection. Design examples of rectangular and Flanged sections. **8 Hours**

UNIT-3

Design of Slabs:

General considerations of design of slabs, Design of rectangular slabs spanning one direction. Design of rectangular slabs spanning in two orthogonal directions for various boundary conditions

conforming to IS code provisions.

8 Hours

UNIT-4

Design of Columns:

General aspects, Effective length of column, Loads on columns, Short and slender columns, Minimum eccentricity, Design of short columns under axial compression (Rectangular and circular sections only), Design of columns under axial compression together with uniaxial bending, Design of columns under axial compression together with biaxial bending. using SP – 16 charts (both short and long columns).

7Hours

UNIT-5

Design of Stair cases:

General features, Types of stair case, loads on stair case, Effective span as per IS code provisions, Distribution of loading on stairs, Design of dog legged staircase

Design of Footings:

Introduction, load for footings. Design of isolated rectangular footing for axially loaded column.

.

6 **Hours**

Text book/Codes:

1. PC Verghese, "**Limit State design of reinforced concrete**", PHI-Learning Pvt. Ltd, New Delhi, 2nd edition (2012)
2. S. Unnikrishnan Pillai and Devadas Menon, "**Reinforced Concrete Design**", Tata McGraw-Hill Publishing Company Limited, New Delhi., 3rd edition 2009
3. S. Ramamrutham and R Narayan, "**Design of Reinforced Concrete structures**", Dhanpat Rai publishing Company (2000).

Reference books:

1. BC Punmia, Ashok Kumar Jain and Arun Kumar Jain, "**Limit State design of reinforced concrete**", Laxmi Publications, New Delhi, 2016.
2. Park and Paulay, "**Reinforced concrete structures**", John Wiley and sons, Singapore, 1975.
3. P Dayaratnam, "**Limit state design of reinforced concrete structures**", Oxford and IBH Publishing company Pvt ltd., New Delhi, 2017
4. N. Krishna Raju, "**Design of Reinforced concrete structures**", CBS Publishers, New Delhi., 3rd Edition. 2015
5. IS: 456-2000, "**Plain and Reinforced Concrete- Code of Practice**", BIS, New Delhi
6. SP-16, "**Design aids for Reinforced Concrete to IS :456 -1978**", BIS, New Delhi

E-learning resources:

https://nptel.ac.in/courses/105106117

https://archive.nptel.ac.in/courses/105/106/105106118/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern: w.e.f sept 2024

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.
   Quizzes/AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3 : wef Aug 2024

	Design of RC Structural Elements												**23CV5PCDRC**	
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	2	3										3	

GEOTECHNICAL ENGINEERING-II					
Course	**Geotechnical Engineering-II**	**Course Code**	**23CV5PCGTE**	**SEE Duration**	**3 Hours**
Credits	**03**	**L:T:P**	**2:1:0**	**SEE+ CIE Marks**	**50+50**
Contact hours	**39**	**CIE**	**50 marks**	**Lab**	**Nil**

COURSE OBJECTIVES: The course enables the students to

Apply basic concepts of soil mechanics for evaluating Consolidation characteristics, slope stability, bearing capacity of soils, stresses, lateral earth pressure, methods of exploring the subsoil and carry out detailed geotechnical investigation in the field.

COURSE OUTCOMES: An ability to	
CO1	Compute consolidation characteristics of soils and lateral earth pressure on retaining walls.
CO2	Estimate stresses below any type of loaded area and discuss Soil exploration techniques.
CO3	Perform slope stability analysis and Calculate bearing capacity of soil.

UNIT-1

Consolidation Of Soils:

Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations. Consolidation characteristics of soil (Cc, av, mv and Cv), Time rate of consolidation, Numerical problems. Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by: Casagrande's method and log e–log p-method. Laboratory one dimensional consolidation test, determination of consolidation characteristics of soils: compression index, and coefficient of consolidation. Determination of coefficient of consolidation by Taylor's square root of time (δ-$\sqrt{t}$) fitting method, Casagrande's logarithmic of time (δ-log t) fitting method, consolidation settlement, numerical problems.

8 Hours

UNIT-2

Lateral Earth Pressure:

Introduction, retaining walls and its importance. Active and passive earth pressures, Earth pressure at rest, Earth pressure coefficient and their range. Safe depth of excavation without lateral support, Numerical problems. Earth pressure theories - Rankine's and Coulomb's –concepts, assumptions and limitations, Rankine's Lateral earth pressure in cohesive and Cohesionless soils, Numericals, Earth pressure distribution.

8 Hours

UNIT-3

Stability Of Earth Slopes:

Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of finite and infinite slopes- Method of slices. -, Fellenius method of locating centre of critical slip circle, Taylor's stability number, Numerical problems.

7 Hours

UNIT-4

Subsurface Exploration:

Importance of exploration program, Methods of exploration: Trial pits, Boring. Number and depth of borings for buildings and dams, Types of samples- undisturbed, disturbed and representative samples, Types of samplers, sample disturbance, Design features of a good sampler: area ratio, Recovery ratio, inside and outside clearance,– Typical boring log. Sounding tests – Standard penetration test and Cone penetration test, Geophysical methods-Electrical resistivity and Seismic refraction methods, Numerical problems. Typical soil exploration report. Modern Instruments and techniques.

4 **Hours**

Stresses In Soils:

Boussinesq's theory for concentrated, line loads, strip loads, circular and rectangular loading (No derivation of equations to be asked in the examination) Newmark's chart – concept and usage, concept of pressure bulb, significant depth. **Approximate methods**: Equivalent point load method and 2:1 distribution method, numerical problems. Westergaard's theory..

4 Hours

UNIT-5

Bearing Capacity Of Soils:

Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's bearing capacity equation-assumptions and limitations bearing capacity of footing subjected to vertical loading. Meyerhof's bearing capacity analysis, assumptions and limitations, determination of bearing capacity of footings of different shapes (no eccentric loads), Effect of ground water table on bearing capacity, Correlation of Standard penetration test N-values and cone penetration resistance with bearing capacity of soil.

8 Hours

Text book/Codes:

1. Punmia B.C, Jain A.K, and Jain A.K, " **Soil Mechanics and Foundation Engineering**", 17th Edition, Laxmi Publications Co., New Delhi. (2019).
2. **IS 2131 (1981), IS 6403 (1981), IS 2720:Part XV.**

Reference books:

1. Bowles J.E, "**Foundation Analysis and Design**", 5th Edition, McGraw Hill Pub. Co. New York. (2001).
2. Braja M. Das, "**Principles of Geotechnical Engineering**", 7th Edition, Cengage Learning. (2018).
3. J.A. Knappett and Craig R.F, "**Craig's Soil Mechanics**", 8th edition, CRC press, New York. (2012).

4. Gopal Ranjan and Rao A.S.R, "**Basic and Applied Soil Mechanics**", New Age International (P) Ltd., New Delhi. (2000).
5. Terzaghi, K., Peck, R. B., & Mesri, G. "**Soil mechanics in engineering practice**", 3RD Edition. John Wiley & Sons. (2009).
6. Arora.K.R, "**Soil Mechanics and Foundation Engineering**", Standard Publishers, New Delhi. (2017 reprint).
7. V.N.S Murthy, "**Textbook of Soil Mechanics and Foundation Engineering: Geotechnical Engineering**", CBS Publishers and distributors. (2009).

E-learning resources:

https://nptel.ac.in/courses/105/103/105103097/
https://nptel.ac.in/courses/105/105/105105176/
https://ocw.mit.edu/courses/civil-and-environmental-engineering/
http://www.myopencourses.com/subject/e-book-on-concepts-and-techniques-in-geotechnical-and-foundation-engineering

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and student to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.
3. Quizzes/AAT/seminars/Assignments.

CO-PO MAPPING SCALE 1 TO 3

	23CV5PCGTE				GTE-II									
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	

ENVIRONMENTAL ENGINEERING – II

Course	Environmental Engineering – II	Course Code	23CV5PCENV	SEE Duration	3 Hours
Credits	03	L:T:P	2:0:1	SEE+ CIE Marks	50+50
Contact hours	26 Hours Lab : 10-12 classes	CIE (Theory)	25 marks	Lab	25 Marks

COURSE OBJECTIVES: The course enables the students to

Acquire knowledge about wastewater characteristics, their disposal, treatment methods and to design sewers.

COURSE OUTCOMES: An ability to	
CO1	Assess the characteristics and properties of wastewater which aids selection of appropriate treatment and disposal methods.
CO2	Select suitable sewer material and sewer appurtenance for the design and laying of sewers.
CO3	Design various components of wastewater treatment units.
CO4	Conduct experiments to determine water and waste water characteristics.

UNIT-1

Introduction:

Definitions of waste water engineering, methods of domestic waste water disposal, types of sewage systems and their suitability and its applications

Design of Sewers:

Hydraulic formulae for velocity, effects of flow variations on velocity, self- cleansing and non-scouring velocities, design of hydraulic elements for circular sewers flowing full and flowing partially full. (No derivations) **4 Hours**

UNIT-2

Materials of Sewers:

Sewer materials and Types, shapes of sewers, laying of sewers, testing of sewers, ventilation & cleaning of sewers.

Sewer Appurtenance:

Catch basins, manholes, oil and grease traps, drainage traps. Basic principles of house drainage (Single and Dual stack). Typical layout plan showing house drainage connections.

3Hours

UNIT-3

Wastewater Characteristics:

Sampling, significance, techniques and frequency. Physical, chemical and biological characteristics, Aerobic and anaerobic activity. BOD and COD. Numerical on BOD and COD. Effluent disposal standards for land, surface water & ocean.

Disposal of Effluents:
Disposal of effluents by dilution, self-purification phenomenon. Oxygen sag curve, Zones of purification, sewage farming sewage sickness, Numerical problems on disposal of effluents. Streeter Phelps equation (No derivation)

8 Hours

UNIT-4

Treatment of Waste Water:
Flow diagram of municipal waste water treatment plant.
Preliminary & primary treatment: Screening, grit chambers, skimming tanks, and primary sedimentation tanks, design criteria & design examples and its applications.

Secondary Treatment:
Suspended growth and fixed film bioprocess. Tricking filter–theory and operation, types and designs. Activated sludge process – principle and flow diagram, F/M ratio. Design of ASP and its applications

Solid Waste management: Introduction to solid waste management **8 Hours**

UNIT-5

Tertiary Treatment of Wastewater:
Advance wastewater Treatment - SBR, MBBR, MBR. Nitrogen and phosphorus removal and its applications.

Study of In-House Treatment plant/ Site visit to sewage Treatment plant

3 Hours

List of Laboratory Experiments:

1. Determination of pH, Alkalinity and Acidity.
2. Determination of Turbidity and Jar Test for Optimum Dose of alum
3. Determination of Total hardness, Calcium and Magnesium hardness
4. Determination of chlorides.
5. Determination of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD).
6. Determination of Chemical Oxygen Demand (COD)
7. Determination of Nitrates
8. Determination of Solids in Sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile solids, Fixed Solids and Settleable Solids.

Text Books:

1. S.K. Garg, "**Sewage Disposal and Air Pollution Engineering**", Khanna publishers. (2015)
2. B.C. Punmia , "**Sewage Disposal and Engineering**", Arihant publications. (2016)

Reference Books:

1. Fair, Geyer and Okun , "**Water and waste water engineering vol-II**", John Willey Publishers, New York, 3rd edition 2010
2. Metcalf and Eddy Inc , "**Waste water treatment, disposal and reuse**", Tata McGraw Hill Publication, 4th edition 2002
3. CPHEEO , "**Manual on waste water treatment**", Ministry of urban development, Delhi. 2009
4. **BIS code for Plumbing**: https://law.resource.org/pub/in/bis/S03/is.sp.35.1987.pdf
5. **BIS code for sewer materials** https://law.resource.org/pub/in/bis/S03/is.1742.1983.pdf

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 questions are to be framed (20 marks each) and student to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.
3. Quizzes / AAT/ / seminars /assignments.

CO-PO MAPPING SCALE 1 TO 3

	Environmental Engineering-II 23CV5PCENV													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												2	
CO2	3	2	2										2	
CO3	3	2	2										2	
CO4				3									1	

STRUCTURAL SYSTEMS ANALYSIS

Course	Structural Systems Analysis	Course Code	23CV5PCSSA	SEE Duration	3 Hours
Credits	02	L:T:P	1:1:0	SEE+ CIE Marks	50+50
Contact hours	26	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Analyze statically indeterminate structures from the knowledge of fundamentals and basic concepts of structural analysis.

COURSE OUTCOMES: An ability to	
CO1	Develop relevant equations for Displacement and Moment distribution to perform non-sway and sway analysis of structural systems
CO2	Formulate relevant stiffness matrices and analyze different structural systems using direct stiffness method
CO3	Generate influence line diagram for moving loads and construct SFD and BMD.

UNIT-1

Slope Deflection Method:

Fixed beam, Fixed end moment for point load, UDL, UVL and support sinking. Introduction, sign convention, development of slope-deflection equations, analysis of continuous beams including support settlements, analysis of orthogonal rigid plane frames with kinematic redundancy ≤ 3 (only non-sway).

5 Hours

UNIT-2

Moment Distribution Method:

Introduction, Distribution factor, Carry over factor, development of method, Analysis of continuous beams including support settlements, analysis of orthogonal rigid plane frames.

5 Hours

UNIT-3

Analysis of Structural Frames with Sway:

Concept of sway analysis, difference between sway and non-sway analysis, analysis of orthogonal rigid plane frames (only sway) using slope deflection and Moment distribution methods.

5 **Hours**

UNIT-4

Direct Stiffness Method:

Introduction, degrees of freedom, static and kinematic indeterminacy, equilibrium and compatibility conditions, local and Global coordinate systems, concepts of stiffness and flexibility, analysis of continuous beams and rigid plane frames using direct stiffness method with kinematic redundancy ≤ 3**.**

6 Hours

UNIT-5

Moving Loads and Influence Lines:

Load and Influence Lines: moving load analysis for simply supported beams for several point loads and UDL. Influence line diagram for reaction, SF and BM at a given section for the cases mentioned above, use of influence line diagrams for analysis of plane trusses.

5 Hours

Text book/Codes:

1. C.S Reddy, "**Basic Structural Analysis**", 3rd Edition, Tata McGraw Hill Publication Company Ltd. (2017).
2. R. Vaidyanathan, P. Perumal, "**Structural Analysis - Vol. 1**", 4th Edition, Laxmi Publications. (2019)
3. M. Vijayanand, Dr. K.U. Muthu, Dr. H. Narendra, "**Indeterminate Structural Analysis**", Dreamtech Press. (2019)
4. V.N Vazirani & M.M Ratwani, "**Analysis of Structures Volume- II**", Khanna Publishers, Delhi.

Reference books:

1. J. Sterling, Kinney "**Indeterminate Structural Analysis**", Addison – Wesley publishers Shiyekar M.R, 1957
2. Noris C.H., Wilbur J.B. Utku S, "**Elementary Structural Analysis**", Mc Graw Hill International Book Edition, 1991.
3. C.K.Wang, "**Intermediate Structural Analysis**", Mc Graw Hill Publications, 2017
4. Ashok k Jain, "**Advanced Structural Analysis**", Nem Chand & Bros, Roorkee, India, 4th Edition, 2015
5. Manikaselvam, "**Elements of Matrix Analysis and Stability of Structures**", Khanna Publishers, New Delhi, 7th edition, 1998.

E-learning resources:

https://nptel.ac.in/courses/105105109
https://nptel.ac.in/courses/105101086
https://nptel.ac.in/courses/105106050

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4

Activity based learning / Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	SSA 23CV5PCSSA													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3											3	
CO3	3	3											3	

HIGHWAY ENGINEERING

Course	Highway Engineering	Course Code	23CV5PCHEN	SEE Duration	3 Hours
Credits	03	L:T:P	1:1:1	SEE+ CIE Marks	50+50
Contact hours	26 Hours Lab 10-12 classes	CIE (Theory)	25 marks	Lab	25 Marks

COURSE OBJECTIVES: The course enables the students to

Acquire knowledge of highway materials and methods for design and construction of highways.

COURSE OUTCOMES: An ability to	
CO1	Identify and prioritize highway proposals for road development based on user benefits.
CO2	Design horizontal and vertical alignments for roads.
CO3	Evaluate the properties of Pavement materials.
CO4	Design, construct and carry out maintenance operation for flexible and rigid pavements.

UNIT-1

Introduction:

Role of Transportation Engineering, Characteristics of Road Transport, Scope of highway engineering.

Highway Planning:

Necessity of highway planning, Classification of Roads, Road patterns, Planning Surveys-Interpretation of Plans-Preparation of Master Plans-Phasing of plan, Lucknow Road Development Plan-Problems, Road Development Plan: Vision, Rural Road Development Plan: Vision.

Highway Alignment Surveys:

Requirements and factors controlling alignment of roads - Engineering surveys for highway location.

5 Hours

UNIT-2

Highway Geometrics:

Pavement surface characteristics - Camber and width requirements - Sight distances - stopping and overtaking sight distances, overtaking zone requirements - Design of horizontal alignment -speed, radius, super elevation, methods of providing super elevation, extra widening at curves, transition curves.

Design of Vertical Alignment:

Gradient, grade compensation, summit curves and valley curves – No derivations, Numerical problems.

5 Hours

UNIT-3

Pavement Materials And Design:

Desirable properties and testing of highway materials: road aggregates, bituminous materials and subgrade soil; Factors influencing the design of pavements - Design of flexible and rigid pavements - IRC guidelines; Introduction to Mechanistic Empirical Pavement Design. Numerical Problems on design of flexible and rigid pavements, Composite pavements and White topping.

6 Hours

UNIT-4

Highway Construction:

Historical development of road construction - Construction of earth roads, WBM roads, WMM roads, stabilized roads (CTB & CTSB), bituminous pavements, cement concrete roads and joints in cement concrete roads**,** calculation of quantity and cost of construction of pavement, Full Depth Reclamation (FDR) pavement. **5 Hours**

UNIT-5

Highway Maintenance:

Types and causes of distresses in flexible & rigid pavements – Remedial measures. Highway drainage – Object & Requirements - Surface and Sub-Surface Drainage - Design of Surface Drainage System- Numerical Problems

Highway Economics And Finance:

Introduction to Highway user benefits, Economic Analysis and Highway Finance in India.

5 Hours

LABORATORY EXPERIMENTS/ EXERCISES

1. Tests on Sub grade Soil:
a. Compaction Test
b. California Bearing Ratio Test
2. Tests on Road Aggregates:
a. Aggregate Impact Test
b. Los Angeles Abrasion Test
c. Aggregate Crushing Value Test
d. Specific Gravity Test and Water Absorption Test
e. Shape Tests i. Flakiness Index ii. Elongation Index iii. Angularity Number
3. Tests on Bituminous Materials:
a. Penetration Test
b. Ductility Test
c. Softening Point Test
d. Specific Gravity Test

e. Viscosity Test
f. Flash and Fire Point Test
4. Tests on Bituminous Mixes
a. Marshall Stability Test

Text books:

1. Khanna, S.K.,and Justo, C.E.G., "**Highway Engineering**", Nemchandand Bros, (2015).
2. Kadiyali, L.R.,andLal, N.B., "**Principles and Practices of Highway Engineering**", Khanna Publishers, (2013).
3. S. K. Khanna, C. E. G. Justo and A. Veeraragavan, "**Highway Materials and Pavement Testing**", Revised 5th Edition, Nem Chand and Bros, Roorkee, (2013).

Reference books:

1. O' Flaherty, C.A., "**Highway-Traffic Planning and Engineering**", Edward Arnold, (1986).
2. Yoder and Witczak, "**Principles of Pavement Design**", John Wiley and Sons, (1975).
3. IRC: 37, "**Guidelines for the Design of Flexible Pavements**".
4. IRC: 58, "**Guidelines for the Design of Rigid Pavements**".
5. IRC:15, "**Standard Specifications and Code of Practice for Construction of Concrete Roads**".
6. Ministry of Road Transport and Highways "**Specifications for Roads and Bridges**", IRC, NewDelhi, 2013.
7. David Croney, "**The Design and Performance of Road Pavements**", McGraw Hill, (1997).
8. Paul H. Wright and Karen Dixon, "**Highway Engineering**", Wiley, (2003).

E-learning resources:
https://nptel.ac.in/courses

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students have to answer 5 full questions. The choice of questions is to be given in all units
2. The maximum number of subdivision in a question is restricted to 4.
3 Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Highway Engineering													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	2	2				2						3	
CO3	3	3				2							3	
CO4	3	2	3				2						3	

ELECTIVES : ADVANCED CONCRETE TECHNOLOGY

Course	AdvancedConcrete Technology	Course Code	23CV5PEACT	SEE Duration	3 Hours
Credits	3	L-T-P	3:0:0	SEE + CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire the fundamental knowledge of different advanced materials and special concrete along with their mix design, their related testing of concrete properties in accordance with the related standard codes and procedures

COURSE OUTCOMES: An ability to	
CO1	Identify the various advanced new materials and its related characteristics.
CO2	Proportion concrete mix for different types of special concretes for various field applications.
CO3	Conduct experiments and prepare a comprehensive report on new knowledge in any one of the topics related to advanced concrete technology.

UNIT-1

Advanced Materials:

Cement (OPC, Blended and Composite), characterization, Limestone Calcined Clay (LC_2), Limestone Calcined Clay Cement (LC_3), Alternative binders, Chemical Admixtures, Introduction to Nano-materials. Developments in aggregates, alternative fine aggregates. Light Weight and High-Density aggregates, Microstructural characterization.

8 Hours

UNIT-2

High Performance Concretes:

Concept, materials selection, mineral and chemical admixture, mix proportioning for Self-Compacting concrete as per relevant codal provisions. Evaluation of fresh and hardened properties and durability aspects, Microstructural characterization, Applications, Construction & economic Aspects along with carbon units and embodied energy.

8Hours

UNIT-3

Ultra-High-Performance Concrete:

Concept, materials selection, mineral and chemical admixture, fibers, types of fibers, characteristics and distribution, mix design procedure as per relevant codal provisions, Hardened properties of UPHC, durability characteristics, Microstructural characterization, Applications, Construction & economic Aspects along with carbon units and embodied energy.

8Hours

UNIT-4

Alkali activated Concrete:

Brief history of development, Definition, Reaction chemistry, material characterization, mixes proportioning, properties, Microstructural characterization and its applications.

8Hours

UNIT-5

Rheology of Concrete:

Introduction, Factors affecting the rheology of fresh concrete, rheological properties and the measuring instruments, rheology of Normal concrete, SCC, HPC, UHPC and 3D Printable concrete.

7 Hours

Text Books:

1. A.M Neville (2012) "**Properties of Concrete**, 5th Edition, Pearson Education (Singapore) Pvt. Ltd.,
2. John Newman and Ban Seng Choo (2003) "**Advanced Concrete Technology–Processes**" Elsevier.Ltd.
3. P. K. Mehta and Paulo J. M. Monteiro (2014) "**Concrete: Microstructure, Properties, and Materials**" 4th Edition, McGraw-Hill Education.

Reference Books:

1. S.P. Shah and P.N. Balaguru (1992) "**Fiber Reinforced cement composites**" McGraw Hill International edition, Civil Engineering series.
2. J.Gibbs, P.Domone, G.D. Schutter and P.J.M.Bartos (2009)"**Self-Compacting Concrete**" Whittles Publishing.
3. G.F.Huseien, N.Hafizah, A.Khalid and N.Hafizah (2022) **"Nanotechnology for Smart Concrete**" CRS Press, Taylor and Francis.
4. N.Roussel (2011) "**Understanding the Rheology of Concrete**" Woodhead Publishing Series in Civil and Structural Engineering, Elsevier.
5. J.Davidovits (2020) "**Geopolymer - Chemistry and Applications**, Geopolymer Institute.
6. A. Perrot (2019) "**3D Printing of Concrete: State of the Art and Challenges of the Digital Construction Revolution"**, Wiley.

E-learning resources:

http://nptel.ac.in/courses

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 questions are to be framed (20 marks each) and students have to answer 5 full questions. The choice of questions is to be given in all units
2. The maximum number of sub division in a question is restricted to 4.

   Quizzes / AAT/ seminars /assignments/model submissions

CO-PO MAPPING SCALE 1 TO 3

	23CV5PEACT													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												3	
CO2			3										3	
CO3				3					3		3		3	

Elective : AIR POLLUTION AND CONTROL

Course	Air Pollution and Control	Course Code	23CV5PEAPC	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire fundamental knowledge of the sources, effects, dispersion of air pollutants, it's mitigation and quality management, and basics of noise pollution

COURSE OUTCOMES: An ability to	
CO1	Identify the characteristics and effects of air pollutant and noise pollutants.
CO2	Design the control mechanism.
CO3	Explain the Air quality standards and its management

UNIT-1

Sources And Effects Of Air Pollutants:

Classification of air pollutants – Particulates and gaseous pollutants –Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling–Analysis of pollutants – Principles, numerical problems.

8 Hours

UNIT-2

Dispersion Of Pollutants:

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate- Atmospheric stability and turbulence–Plume rise– Dispersion models –Applications.

8 Hours

UNIT-3

Air Pollution Control:

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment – gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries, Numerical problem

10 Hours

UNIT-4

Air Quality Management:

Air quality standards – Air quality monitoring – Preventive measures – Air pollution control efforts–Zoning–Town planning regulation of new industries–Legislation and enforcement – Environmental Impact Assessment and Air quality .

8 Hours

UNIT-5

Indoor Air Pollution And Noise Pollution:

Indoor air pollution- causes, effects, control guidelines

Noise Pollution-causes effects, control, legal aspects and standards.

5 Hours

Text book/Codes:

1. Anjaneyulu, D, "**Air Pollution and Control Technologies**", Allied Publishers, Mumbai, 2015.
2. Rao, C.S, "**Environmental Pollution Control Engineering**", Wiley Eastern Ltd., New Delhi, 2015.
3. Rao M.N., and Rao H.V.N, "**Air Pollution Control**", Tata-McGraw-Hill, New Delhi, 2015.

Reference books:

1. W.L. Heumann, "**Industrial Air Pollution Control Systems**", McGraw-Hill, New York, 2015.
2. Peavy S.W., Rowe D.R. and Tchobanoglous G, "**Environmental Engineering**", McGraw-Hill, New Delhi, 2015.
3. Mahajan S.P, "**Pollution Control in Process Industries**", Tata McGraw-Hill Publishing Company, New Delhi, 2015.
4. Garg, S.K, "**Environmental Engineering Vol. II**", Khanna Publishers, New Delhi, 1979.

E-learning resources:

https://archive.nptel.ac.in/courses/105/107/105107213/

https://archive.nptel.ac.in/courses/105/104/105104099/

https://web.iitd.ac.in/~arunku/files/CEL795_Y13/Air%20Pollution1.pdf

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 questions are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignment

CO-PO MAPPING SCALE 1 TO 3

	APC													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											1	
CO2	3	2	3										1	
CO3	3	2											1	

Elective : ALTERNATIVE BUILDING MATERIALS AND TECHNOLOGIES

Course	Alternative Building Materials and Technologies	Course Code	23CV5PEABM	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the concept of sustainable buildings using alternative building materials and technologies

COURSE OUTCOMES: An ability to	
CO1	Evaluate the engineering properties of various alternative building materials
CO2	Propose sustainable materials and technologies for different components of a building
CO3	Quantify embodied energy of various building components

UNIT-1

Alternative Materials – Aggregates, Binders And Mortars:

Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Different materials used as alternatives such as C&D waste, Crumb Rubber, Crushed stone aggregates (manufactured aggregates).

Lime-pozzolana cements- Raw materials, Manufacturing process, Properties and uses.

8 Hours

UNIT-2

Alternative Materials and Technologies for Walls:

Characteristics of building blocks for walls, Stones and Laterite blocks, Bricks , hollow clay blocks, Concrete blocks, Stabilized blocks: mud blocks, steam cured blocks, Fal-G Blocks, stone masonry block, Equipment used for production of stabilized blocks, monolithic walls, composite masonry, confined masonry, cavity walls, rammed earth.

8 Hours

UNIT-3

Alternative Materials and Technology for Roofing:

Alternatives to sloped roof and pitched roofs, flat roofs - concepts of composite T-beam roof, Jack-arch roof, filler slabs, ribbed and channeled roof, corrugated roof, pre-cast technologies.

Construction of domes, vaults and shell roofs; Centering for arches, vaults and domes

8 Hours

UNIT-4

Fiber Reinforced Concrete and Ferro Cement/ Ferro Concrete:

Ferro cement and ferro concrete building components: Materials and specifications, Properties, Construction methods, Applications.

Fibre Reinforced Concrete - Matrix materials, Fibers: metal and synthetic, Properties and applications, Fibre reinforced plastics, Matrix materials, Fibers: organic and synthetic, Properties and applications. **8 Hours**

UNIT-5

Materials, Energy and Cost:

Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Concepts of Sustainable materials and building technologies- Case studies. **7 Hours**

Text book/Codes:

1. KS Jagadish, BV Venkatarama Reddy and KS Nanjunda Rao , "**Alternative Building Materials and Technologies**", New Age International publications. Second Edition 2017, New Delhi, India

Reference books:

1. Jagadish KS, " **Sustainable Building Technologies**", IK International Publishing and BMTPC, New Delhi, 2019
2. RJS Spence and DJ Cook, "**Building materials in Developing Countries**", Wiley publishers, London U.K, 1983
3. **"National Building Code of India"**, BIS, New Delhi, 2016

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ seminars /assignments/model submissions

CO-PO MAPPING SCALE 1 TO 3

	ABMT 23CV5PEABM													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3													
CO2		2				3			2					3
CO3		3												2

Elective : GEOSPATIAL SURVEYING

Course	Geospatial Surveying	Course Code	23CV5PEGSS	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire fundamental knowledge of remote sensing, image processing concepts and spatial analysis in GIS.

COURSE OUTCOMES: An ability to	
CO1	Select the characteristics of a remote sensing system, image enhancement and processing techniques required for geospatial applications
CO2	Identify appropriate GIS operations for different types of data
CO3	Use remote sensing data and GIS tools to arrive at possible solutions to the real world problem

UNIT-1

Remote Sensing:

Introduction, basic radiation laws, electromagnetic spectrum, different bands and their applications in remote sensing, source of EMR, stages / components of remote sensing.

Basic principle of remote sensing, energy interaction with the atmosphere and the surface features, spectral reflectance curve

Types of remote sensing: ideal and real remote sensing system, classification of remote sensing systems

Types of satellite orbits, orbit characteristics, Image format, resolutions in remote sensing, remote sensing applications, characteristics of Indian Remote Sensing Satellites, sources of remote sensing data.

9 Hours

UNIT-2

Image Rectification And Enhancement :

Image geometric corrections, Ground control points, atmospheric corrections, color composites, Digital Image analysis, Image enhancement

7 Hours

UNIT-3

Image Classification:

Classification methods, vegetation indices, band combinations, Users accuracy, producer accuracy and overall accuracy.

7 Hours

UNIT-4

Geographic Information System:

Definitions, components, functions of GIS, Spatial and attribute data, data models: raster and vector data, advantages and drawbacks, topology, data structures, metadata, errors in GIS, GIS applications, link with remote sensing, introduction to webGIS, free and open source GIS tools.

9 Hours

UNIT-5

Maps:

Introduction to maps, components of maps, map projections and coordinate reference system.

Drone Survey:

Introduction to drone survey, applications

Spatial Analysis:

Introduction to spatial analysis, raster and vector operations, neighborhood analysis, spatial interpolation, DEM, generation of contours.

7 Hours

Text books:

1. Lillesand TM, Keifer RW, Chipman JW, " **Remote sensing and image interpretation**", John Wiley and Sons (2015, 7th Edition)
2. B Bhatta, "**Remote Sensing and GIS**", Oxford Publications (2021, 3rd Edition)

Reference books:

1. M Anji Reddy, "**Remote Sensing and GIS**", BSP Publication (2012, 4th Edtition)
2. Paul R Wolf, "**Elements of Photogrammetry**", McGraw International (2014, 4th Edition)
3. Peter A Burrough, "**Principles of GIS**", Oxford Publications (2015, 3rd Edition)
4. Bemhardsen, "**GIS**", Wiley Publications (2007, 3rd Edition)
5. Gibson P.J, "**Introductory Remote Sensing- Principles and Concepts**", Gibson P.J, Routledge, London.(2000, 1st edition)
6.

E-learning resources:

1. Prof. Onkar Dikshit, " **NPTEL Lectures: Modern Surveying Techniques**", IIT Kanpur

http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/ModernSurveyingTech/ui/TOC1 .htm

2. Prof. D Nagesh Kumar, "**NPTEL Lectures: Remote Sensing**", IISc Bangalore

http://www.nptel.ac.in/syllabus/105108077/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Self-study component: In the self-study component students need to work with satellite remote sensing data and maps to demonstrate the process of data acquisition and image processing.

Self-study component shall be evaluated through alternate assessment tools

CO-PO MAPPING SCALE 1 TO 3

	GSS				**Geospatial survey**									
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3					3						3			

Elective : MARINE ENGINEERING

Course	Marine Engineering	Course Code	23CV5PEMAE	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand oceanography, hydrography, wave dynamics theory, wind wave generation and prediction, marine exploration and design of marine structures

COURSE OUTCOMES: An ability to	
CO1	Apply principles of Mechanics of Fluids in wave generation, propagation and forecasting.
CO2	Analyze marine geo-technical characteristics
CO3	Design marine structures such as breakwaters.

Unit-1

General Oceanography:

Introduction to physical and chemical properties of ocean waters, Oceanographic instruments, Ocean currents, tides and its force. **3 Hours**

Hydrography

Survey methods in ocean waters, regional oceanography – Arabian Sea and Bay of Bengal, Estuary and its characteristics, sedimentation in estuaries. **4 Hours**

UNIT-2

Wave Dynamics Theories:

Introduction to Small Amplitude wave theory, Basic hydrodynamic equations, formulation and solution of boundary value problems**.**

Finite amplitude wave theories- Stokes' theory and shallow water wave theories and method of characteristics. Wave-structure interaction- Introduction to wave forces on piles and pile groups for breaking and non-breaking waves. **12 Hours**

UNIT-3

Wind Wave Generation, Analysis and Prediction:

Introduction to general meteorology, weather maps and its analysis. Wave Theories of wind wave generation, wave heights and wave periods distribution, design wave and wave spectra. Wave forecasting and storm surge.

7 Hours

UNIT-4

Marine Geotechnical Characteristics Exploration:

Introduction to subsurface and submarine explorations for onshore and offshore structure - Boring and sampling in marine deposits, Morphology and genesis of marine sediments, engineering properties of marine sediments.

Laboratory investigations on classification of marine soils, strength and consolidation properties of soils, A case study on studies on field investigation.

7 Hours

UNIT-5

Design of Marine Structures:

Introduction- design principles, functional design and safety factors, risk criteria and economy, general code provisions for design of marine structures such as conventional breakwaters and its typical design.

7 Hours

Text books:

1. Ippen, A. T, "**Estuary and Coastline Hydrodynamics**", Engineering Societies Monographs Series, First Edition, McGraw-Hill Inc., New York, (1966).
2. PerBruun, "**Port Engineering**", Vol. I ,II, III.31 March (1989).

Reference books:

1. Gross HG and E. Gross, "**Ocenography on View of the Earth**", Prentice Hall, New Jersey, USA,. Komar P.D., Beach processes and sedimentation. (1990)
2. Bendat and Piersol, "**Random Data Analysis and Measurement Procedures**". John Wiley & Sons Inc, 4th Edition, 2010
3. Robert G. Dean Robert A. Dalrymple, " **Water Wave Mechanics for Scientists and Engineers**", World Scientific, 2018
4. Horikawa. K , "**Introduction to Coastal Engineering**", University of Tokyo press, 1978.
5. Pinet, PR, "**Invitation to Oceanography**", Jones and Bartlett Pub., Boston, USA, Silvestor R, Coastal Engineering. Weigel. Oceanography, 8th Edition, 2019.
6. Pierre Le Tirant, "**Sea Bed Reconnaissance and Offshore Soil Mechanics for Installation of Petroleum Structures**", Technip Editions, 1979.
7. Pilarczyk and & Zeidler, " **Offshore Breakwaters and Shoreline Control**", A A Balkema Publishers, 1st Edition, 1996.
8. John Herbich, "**Hand Book of Coastal & Ocean Engg**.,". Vol. I, II, III. **UNKNO Publishers,**
9. Goda Yoshimi, "**Random Seas & Design of Marine Structures**", World Scientific Publishing Company, 2000

E-learning resources:

https://archive.nptel.ac.in/courses/114/106/114106025/
https://archive.nptel.ac.in/courses/114/106/114106032/
https://archive.nptel.ac.in/courses/114/106/114106037/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Marine structures						**MAE**						
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2		3											3	
CO3			3										2	

Elective : TRAFFIC ENGINEERING

Course	Traffic Engineering	Course Code	23CV5PETRF	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the fundamentals of Traffic Engineering, problems associated with movement and parking of vehicles and conduct surveys, data analysis for the purpose of improvements/ solutions to Traffic Engineering problems.

COURSE OUTCOMES: An ability to	
CO1	Characterize traffic behaviour and provide sustainable solutions to cater traffic demand
CO2	Conduct different traffic surveys and analyze data using statistical concepts.
CO3	Design a Signal for Urban Intersections
CO4	Analyze the societal and environmental impacts of traffic

UNIT-1

Traffic Engineering and Characteristics:

Road Characteristics-Road user characteristics, PIEV theory, Vehicle Performance characteristics, Fundamentals of Traffic Flow, Design speed, Urban Traffic problems in India, Accidents and reasons, Sustainable approach to mitigate the problems.

8 Hours

UNIT-2

Traffic Surveys:

Traffic Surveys- Speed, journey time and delay surveys, Classified Vehicle Volume Count, Method, Origin Destination Survey, Parking Survey - Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Passenger Car Unit (PCU) and Level of service Concept - applications and significance.

8Hours

UNIT-3

Traffic Signs and Signal Design:

Intersection Design - channelization, Signal design, Coordination of signals, Grade separated Intersection, Rotary Intersection.

8 Hours

UNIT-4

Traffic Safety and Environment:

Road accidents, Causes, effect, prevention, and cost – Analysis; Street lighting, Traffic and environment hazards, Air and Noise Pollution, causes, abatement measures, Promotion and integration of public transportation, Promotion of non-motorized transport - pedestrian facilities & cycle tracks.

8Hours

UNIT-5

Traffic Management:

Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, Segregation methods to cater to Traffic Demand; Integrated Transport Systems; Intelligent Transport Systems for traffic management.

7 Hours

Text book/Codes:

1. Kadiyali. L.R. "**Traffic Engineering and Transport Planning**", Khanna Publishers, Delhi, (2013).
2. S. K. Khanna and C.E.G Justo and A.Veeraragavan, "**Highway Engineering**", Nem Chand and Bros, Tenth Edition, (2015).
3. Salter. R.I and Hounsell N.B, "**Highway Traffic Analysis And Design**", Macmillan Press Ltd. (1996).
4. Indian Roads Congress (IRC) Specifications: "**Guidelines and Special Publications on Traffic Engineering, Planning and Management**". IRC, New Delhi

Reference books:

1. Fred L. Mannering, Scott S. Washburn and Walter P. Kilareski, "**Principles of Highway Engineering and Traffic Analysis",** Wiley India Pvt. Ltd., New Delhi, (2011).
2. Papacostas, C. S., and P. D. Prevedouros, "**Transportation Engineering and Planning**", PHI Learning, (2012).
3. Garber and Hoel, "**Principles of Traffic and Highway Engineering**", Cengage Learning, New Delhi, (2010).
4. John E Tyworth, "**Traffic Management Planning, Operations and control**", Addison Wesly Publishing Company, (1996).

E-learning resources:

https://onlinecourses.nptel.ac.in/noc22_ce41/preview
https://ocw.mit.edu/collections/transportation/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ seminars /assignments/model submissions

CO-PO MAPPING SCALE 1 TO 3

	Traffic Engineering					**TRF**								
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3					2							2	
CO2		3			2			2					2	
CO3		2	3			3								
CO4		3												

DEPARTMENT OF CIVIL ENGINEERING, BMSCE

MINOR PROJECT

Course	Minor Project	Course Code	23CV5PWMIP	SEE Duration	2 Hours
Credits	02	L:T:P	0:0:2	SEE+ CIE Marks	50+50
Contact hours	26	CIE	50 marks	Lab	4hrs/week

COURSE OBJECTIVES: The course enables the students to

Gain insights on the subject matter with practical knowledge. Project creation helps evolve the student's creative thinking, analytical skills, and reasoning ability.

COURSE OUTCOMES: An ability to	
CO1	Carry out the given mini project work in a team on the given topic
CO2	Comprehend, present and prepare the reports on the project work

- Students shall take up mini project work mandatorily in V semester as a team work.
- Few recommended areas that may be selected are:
  1. Design and drawing of various types of buildings (Drafting)
  2. Geotechnical engineering related projects.
  3. Hydraulics related projects.
  4. Environmental Engg related projects.
  5. Highway engg related projects
  5. Any other related projects apart from those mentioned above.
- The Minor project topic is to be decided in consultation with the concerned faculty .The topics shall be related to courses of earlier semesters or related to current V semester.
- **Evaluation**: Students are expected to prepare a project report in prescribed format and attend evaluation by viva voce.

Students will work together in a team for the mini project and will submit their Project work report in line with their identified problem statement.

Evaluation pattern of MINOR PROJECT:

CIE: Report submission and viva. Students are assessed by their project guides with an internal faculty as co examiner for 50 marks.

SEE: . Report submission and viva voce. One report per team is to be submitted. Internal with an external examiner will assess and evaluate 100 marks.

Project Report submission consists of the following; SEE Evaluation is carried out by external examiner along with internal guides.

CO-PO MAPPING SCALE 1 TO 3

	Minor project													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**
CO1	2	2	3		3							3	3	
CO2	2	2	3		3							3	3	
CO3									3	3		3		

ENVIRONMENTAL STUDIES

Course	Environmental studies	Course Code	23CV5HSEVS	SEE Duration	1 hour
Credits	1	L:T:P	1:0:0	SEE+ CIE Marks	25+25
Contact hours	15 Hours	CIE	50 Marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Develop a sense of responsibility about the environment, natural resources, their conservation, awareness about ill effects of pollution and understand the concept, structure and function of different ecosystems.

COURSE OUTCOMES: An ability to	
CO1	Identify and discuss the components and impacts of human activities on environment, conservation and on protection of natural resources
CO2	Identify and establish relationship between social, economic and ethical values from environmental perspectives.

Unit 1: Introduction to Environment:

Definition, about Earth. Atmosphere, Hydrosphere, Lithosphere and Biosphere, Structure of Atmosphere, Internal structure of the Earth Ecosystem, Balanced ecosystem, types of Ecosystem Effects of Human activities on Environment. Environmental Impact Assessment (E I A)

Unit –II : Natural Resources:

Water resources its availability, Mineral resources, Forest resources**.**

Unit -III Energy resources:

Conventional and Non-conventional energy resources. Hydroelectric, Wind power, solar, Biogas, Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power, Hydrogen as an alternate future sources of energy.

Unit-IV Environmental pollution:

Effects and control of pollutions i). Water pollution, ii). Land pollution, iii).Noise pollution.

Unit-V Current environmental issues & importance:

Population growth effects & Control, Climatic changes, Global warming. Acid rain Ozone layer depletion & effects, Environmental protection; Role of Government,. initiatives by Non-Govt. Organizations **15 hours**

Text book/Codes:

1. Dr. Geetha Balakrishanan, K G Lakshminarayana Bhatta, "**Environmental studies",** S M Publications, 5th Edition, 2017
2. N S Subramanyam, AV S S Sambamurthy, "**Ecology**", Alpha Science International Ltd, 2nd Edition, 2006
3. Dr. J.P.Sharma, "**Environmental studies**". Laxmi Publications, Third Edition, 2009
4. Smriti Srivastava, "**Environment and Ecology",** S K Kataria & Sons, 2023

Reference books:

1. Benny Joseph, "**Environmental Studies**", Mc Graw Hill Education, 3rd Edition, 2017
2. Dr. D.L.Manjunath, "**Environmental Studies**", Pearson Education India, 3rd Impression, 2009

CIE: Two CIE to be conducted for 25 marks each, consisting of MCQ 10 marks, descriptive 15 marks.. For grading CIE to be indicated for 50.

SEE paper pattern: SEE graded for 50 marks. Questions to be MCQs/ true or false/ match the following pattern. SEE online for 25 marks.

w.e.f Aug 2024

	Environmental studies 23CV5HSEVS													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	2					3	-							1
CO2	2					3	-							1

RESEARCH METHODOLOGY

Course	RESEARCH METHODOLOGY	Course Code	23CV5AERMY	SEE Duration	3 Hours
Credits	2	L:T:P	2:0:0	SEE+ CIE Marks	50 + 50
Contact hours	26 Hours	CIE	50 Marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

- CO1: Demonstrate the knowledge of research objectives, literature review, and ethical issues
- CO2: Demonstrate the knowledge of interpretation, writing of technical reports, and importance of acknowledgements and citations
- CO3: Describe the basic concepts of patents through case studies

Unit 1

Introduction: Meaning of Research, Objectives, of Engineering Research, and Motivation in Engineering Research, Types and characteristics of Engineering Research, Finding and Solving a Worthwhile Problem, developing research problem.
Survey of literature, primary and secondary sources, reviews, treatise, monographs, web as a source, searching the web, identifying gap areas from literature review.
Ethics in Engineering Research, Types of Research Misconduct, Ethical Issues Related to Authorship. **5hrs**

Unit2

Research Design and Research data: Basic principles, need, good and bad practices, developing a research plan, exploration, description, diagnosis and experimentation.
Steps in sampling design, types, measurements and scaling techniques, methods of data collection. Data analysis with statistical packages, concepts of data validation. **5hrs**

Unit 3

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication. **5hrs**

Unit 4

Interpretation and report writing - Techniques of interpretation - Structure and components of scientific reports - Different steps in the preparation - Layout, structure and language of the report -

Illustrations and tables - Types of report - Technical reports and thesis. **5hrs**

Unit 5

Patents: Inventions and creativity Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Geographical indications, trademarks, Copyrights.

Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations In India. Schemes and Programmes. 6**hrs**

Textbook

1. Dipankar Deb • Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0
2. Intellectual Property A Primer for Academia by Prof. Rupinder Tewari Ms. Mamta Bhardwa

Reference Book:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488- 4
2. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

CIE Pattern: Three CIE to be conducted for 40 marks each. Quiz for 10 marks.

SEE paper pattern:

- Totally 10 question are to be framed (20 marks each) and student has to answer 5 full questions. The choice of questions is to be given in all units.
- The maximum number of sub division in a question is restricted to 3.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Research methodology					RMY							
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	-	2					3	-						
CO2	2													
CO3	2													

VI SEMESTER

Syllabus

w.e.f Aug 2024 for 2022 admitted batch

Course	Design of Steel Structural Elements and software applications lab	Course Code	23CV6PCDSS	SEE Duration	3 hours
Credits	03	L:T:P	1:1:1	SEE+ CIE Marks	50+50
Contact hours	26 Lab : 10 to 12 class	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Provide fundamental knowledge of structural steel, design various steel structural members and their connections.

COURSE OUTCOMES: An ability to	
CO1	Apply the concept of limit state design for analyzing/designing the bolted and welded connections
CO2	Analyze and Design structural steel members subjected to tension/compression/bending using limit state design
CO3	Design, Model and analyze various civil Engineering structures using Software tools

UNIT-1

Introduction: Structural systems. Mechanical properties of steel. Various uses of steel in civil engineering. Various loads and their combinations. Design considerations, Limit state method of design, failure criterion of steel, codes of steel, rolled structural steel sections and specifications. Elastic modulus, Partial safety factors, load factor, working loads and ultimate loads.

Plastic Behavior Of Structural Steel:

Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, Plastic analysis of Continuous Beams.

6 Hours

UNIT-2

Bolted Connections:

Introduction. Terms used in bolted connections. Types of bolted connections, Modes of failure, efficiency of joints, Design of axially loaded joints with ordinary black bolts and High strength Friction Grip (HSFG) bolts, Design of joints for combined shear and tension, Design of eccentrically loaded bolted bracket connections.

Welded Connections:

Introduction, welding process, Advantages of welding, Types and properties of welds, Types of welded joints, Weld specifications, Effective areas of welds, Design of welds, Design of Simple joints, Moment resistant connections, eccentrically loaded bracket connections **5 Hours**

UNIT-3

Design of Tension Members:

Introduction, Types of tension members, slenderness ratio, behavior of axially loaded tension members, failure modes of tension members, Factors affecting the strength of tension members, Concept of shear lag, Design of axially loaded tension members with bolted and welded connections.

5 Hours

UNIT-4

Design of Compression Members:

Introduction, Behavior of compression members, rolled steel sections used for compression members. Effective length of compression members. Design of compression members using single section and compound angle sections. Design of built up compression members with lacing and battens. **5 Hours**

UNIT-5

Design of Beams:

Introduction, sections used for beams, types of beams, factors affecting lateral stability and behavior of simple rolled steel beams in bending. Design of laterally supported and laterally unsupported rolled steel beams,

5 Hours

SOFTWARE APPLICATIONS LABORATORY:

1. Analysis of Framed structures in 2D and 3D domain under various loading and boundary conditions.
2. Analysis and design of rolled steel roof trusses.
3. Analysis and design of multi-storey R.C. building in detail

List of Exercises

Sl.No.	Exercises
1	Introduction to FEM software packages in civil engineering and knowledge of structural elements, properties of elements, boundary conditions and loadings.
2	Analysis and design of simple beams elements and continuous beams.
3	Analysis and design of different kinds of 2D frames.
4	Analysis and design of different kinds of 3D frames.
5	Analysis and design of different kinds of simple steel trusses.
6	Analysis and design of rolled steel roof trusses.
7	Modelling of multi storey RC building by different techniques (creating geometry by different methods), assigning properties, boundary conditions, offsets, moment release, loads, load combinations and analysis.
8	Execution of results such as bending moments, shear force, deflections, axial force etc., and optimization of design parameters.

Text book/Codes:

1. Subramanian.N, "**Design of Steel Structures**", Oxford University Press, Third edition, 2018, New Delhi, India
2. Duggal S K, "**Limit state design of steel structures**", TMH Publishers, Third Edition, 2019, New Delhi, India
3. **IS 800-2007: General Construction in Steel Code Practice** (Third revision), Bureau of Indian Standards, New Delhi
4. SP 6(1) **"Hand book on structural Steel Sections",** Bureau of Indian Standards, New Delhi,

Reference books:

1. Ramachandra , " **Design of Steel Structures (Vol I and Vol II)**", Standard Book house, Seventh edition, 2016, New Delhi, India
2. Shiyekar M.R, "**Limit state design of steel structures** ", Prentice Hall India Pvt Ltd, Third Edition, 2019, New Delhi, India,
3. Sai Ram K S , " **Design of Steel Structures**", Pearson India Publishers, Third Edition, 2020, New Delhi, India
4. Bhavikatti S S, "**Design of Steel Structures**", Dreamtech press, Fifth edition, 2019, New Delhi, India
5. Kanthimathinathan S, " **Limit state design of steel structures**", Wiley India Pvt Ltd, First edition, 2019, New Delhi, India

E-learning resources:

1. nptel.ac.in/courses/105/105/105105162/
2. nptel.ac.in/courses/105/106/105106216/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Activity based learning:

Quizzes / AAT/ seminars /assignments/model submissions

CO-PO MAPPING SCALE 1 TO 3

	Design of Steel Structural Elements 23CV6PCDSS													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3	3										2	
CO2	3	3	3										3	
CO3	3	3	3		3				3	3				

Course	Bridge Engineering and Foundation Systems	Course Code	23CV6PCBFS	SEE Duration	3 hours
Credits	03	L:T:P	2:1:0	SEE+ CIE Marks	50+50
Contact hours	39	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the concepts of bridges, foundation systems, design the bridge components as per the relevant codal practices and design foundation systems to suit the practical requirements.

COURSE OUTCOMES: An ability to	
CO1	Apply the Bridge Engineering concepts to design bridge components.
CO2	Explain the concepts and design foundation systems of bridges.

Part – A Bridges

UNIT-1

Bridge theory:

Introduction, Components of a bridge, Classification of bridges, investigations and selection of bridge site, data collection, Design discharge, linear waterway, economical span, afflux, scour depth.

5 Hours

UNIT-2

Bridge design:

Standard specification for Road and railway bridges. Design of RCC Slab culvert and T- Beam and slab bridges (Bridge drawings for submission only). Introduction, General Features, Advantages and Design Criteria of Prestressed Concrete and steel bridges.

12 Hours

UNIT-3

Bridge Bearings :

General features, Type of Bearings, Design of Rocker & Roller bearings (both steel & RCC)

Piers and Abutments:

General Features, Materials, Forces and Stability and Design Principles.

6 Hours

Part B - Foundation Systems

UNIT-4

Pile foundations

Introduction, necessity, classification, Load carrying capacity static method based on IS 2911 and IRC 74 and dynamic formulae by Hiley's method. Settlement of piles, Negative skin friction, group action of piles, group efficiency, Pile load test and pile integrity test. Lateral capacity of piles by IS 2911 and Reese and Matlock method.

10 hours

UNIT-5

Well and Caisson foundations

Introduction, different shapes and characteristics of well, forces acting on the well, sinking of wells, causes and remedies of tilts and shifts, grip length and its calculations, caisson foundations- Types and applications, Bearing capacity of caissons, computation of sinking effort, thickness of concrete seal, perimeter shear and buoyancy

6 hours

Text book/Codes:

1. Murthy V.N.S, " **Advanced Foundation Engineering**" , 1st Edition, C.B.S Publishers, Bangalore, (2007).
2. Varghese P.C, "**Foundation Engineering**", Prentice hall of India, New Delhi, (2007).
3. D. Johnson Victor**, "Essentials of Bridge Engineering",** Oxford &IBH Publishing Co., New Delhi**,** 6th edition**, 2019**
4. N. Krishna Raju**, " Design of Bridges",** Oxford &IBH Publishing Co., New Delhi. 5th Edition, 2019

Reference books:

1. Bowles J.E. "**Engineering Properties of Soil and Their Measurements**", McGraw Hill Book Co. New York (1988).
2. Braja, M. Das, "**Principles of Foundation Engineering**", Seventh Edition, World Press, (2010).
3. Donald Coduto, William Kitch, Man-chu Yeung, "**Foundation Design-Principles and Practices**", Pearson Publishers, 2015.
4. IS 2911 Part1/sec1,sec2 and Part 4: 2010 (Reaffirmed in 2020) "**Design and construction of pile foundations –code of practice"**, BIS, New Delhi
5. IS 8009 (Part 2): 1980 (Reaffirmed in 2013) "**Code of practice for calculation od settlement of foundations"**, BIS, New Delhi
6. IRC:78 (2014), Sec 7, "**Standard specifications and code of practice for road bridges**", BIS, New Delhi

E-learning resources:

http://nptel.ac.in/courses/105107120/

CIE pattern:

CIE tests will be conducted, for 40 marks.
AAT – Bridge Design drawing (1 or 2 Drawings maximum) to be submitted and valued for 10 marks.

SEE paper pattern:

1. Totally 10 Main questions are to be framed (20 marks each) and students have to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	BFS		23CV6PCBFS											
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2	3								3		3	
CO2	3	2	3								-		3	

HYDROLOGY AND IRRIGATION ENGINEERING

Course	Hydrology and Irrigation Engineering	Course Code	23CV6PCHIE	SEE Duration	3 Hours
Credits	02	L:T:P	1:1:0	SEE+ CIE Marks	50+50
Contact hours	26	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire the basic concepts of Hydrology, the methods to estimate the hydrologic components, types of irrigation, estimation of water requirement of crops and Irrigation scheduling.

COURSE OUTCOMES: An ability to	
CO1	Compute the components of hydrologic cycle and select the appropriate method of measurements.
CO2	Identify the suitable system of water application and estimate the water requirements of the crops and irrigation scheduling.
CO3	Analyse the real world hydrological data for a catchment and calculate the irrigation potential.

UNIT-1

Introduction:

Characteristics of precipitation in India, Hydrologic cycle (Horton's qualitative representations and engineering representation). Concept of catchment, catchment water budget equation.

Precipitation:

Forms and types of precipitation, Measurement of rainfall (Symon's gauge and Syphon type gauge), Optimum number of rain gauge stations, Computation of mean rainfall Thiessen polygon method, Estimation of missing rainfall data (Arithmetic average, normal ratio). Rainfall hyetographs, return period.

5 Hours

UNIT-2

Evaporation:

Process, factors affecting Evaporation, measurement using **IS C**lass A Pan. Estimation using Meyer's formula, Evapotranspiration

Infiltration:

Factors affecting infiltration capacity, measurement (double ring infiltrometer). Horton's infiltration equation, Phi-index.

5 Hours

UNIT-3

Runoff:

Components, Factors affecting runoff, estimation of runoff using rational method, Hydrographs, Unit Hydrograph: definition, components, estimation of DRH from UH of single storm of same duration.

Stream Flow Measurement:

Measurement of stage, measurement of discharge by Area – Velocity method and slope area method.

6 Hours

UNIT-4

Introduction To Irrigation Engineering:

Definition, Need, Purpose, benefits, ill effects and scope of irrigation, seasons across the country, systems of flow irrigation and lift irrigation, methods of application of irrigation water.

Water Requirement Of Crops:

Crop period, base period, consumptive use, consumptive irrigation requirement, estimation of depth and frequency of irrigation based on the soil moisture, duty and delta.

6 Hours

UNIT-5

Canal Irrigation:

Distribution system for canal irrigation, command area, intensity of irrigation, time factor and capacity factor, kor watering, paleo irrigation, irrigation efficiencies.

4 Hours

Text books:

1. S.K. Garg, "**Irrigation Engineering., and Hydraulic Structures**", Khanna publishers, New Delhi, 38th latest edition, 2023
2. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain and Pande Brij Basi Lal, "**Irrigation and Water power Engineering,**". Lakshmi Publications, New Delhi, 17th edition, 2021

Reference books:

1. Ven Te Chow, "**Hand Book of Hydrology**", McGraw Hill Education, 1964.
2. R.K. Sharma and Sharma, "**Hydrology and Water Resources Engineering**", Dhanpat Rai, New Delhi, 3rd Edition, 1987
3. K Subramanya, "**Engineering Hydrology**", Tata McGraw Hill Education Pvt. Ltd, 5th Edition, 2020.

E-learning resources:

1. Water resources engineering https://nptel.ac.in/courses/105104103
2. Engineering hydrology https://nptel.ac.in/courses/105103213

3. Irrigation and drainage https://nptel.ac.in/courses/126105010

Self-study component

- Students need to work on real world data for a catchment, analyse the hydrological components of the catchment and calculate the irrigation potential that can be developed in the catchment.
- Self-study shall be evaluated through alternate assessment tools

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in **all units**
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	Hydrology and Irrigation Engineering												**23CV6PCHIE**	
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												3	
CO2	3	2											3	
CO3				3							3		3	

TRANSPORTATION SYSTEMS ENGINEERING

Course	Transportation Systems Engineering	Course Code	23CV6PCTSE	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE + CIE Marks	50 + 50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Provide basic knowledge of components of permanent way, types of rails and its components, design of rail geometrics, understand the layout of an airport and its classification and design of runway and taxiways, concepts of harbour and tunnel engineering.

COURSE OUTCOMES: An ability to	
CO1	Identify and describe the components of Railway engineering, Airport engineering,
CO2	Design geometric aspects of railway system, runway and taxiway.
CO3	Explain the concepts and components of Harbour and Tunnel Engineering.

UNIT – 1
RAILWAY ENGINEERING

Introduction to Railways in India:

Role of railways in transportation, Indian Railways in National Development, Railways for Urban Transportation, Modern developments – LRT & MRTS, Metro rail and Mono rail, Alignment – basic requirements and selection of routes.

3 Hours

Permanent way:

Introduction, requirements for an ideal permanent way, typical cross sections of single and double line B.G. tracks – in cutting, embankment. Concept of Gauges, Coning of wheels and tilting of rails, Creep in rails, Rails, Ballast, Sleepers and Rail fastenings and Track fittings, Calculation of quantity of materials needed for laying a track

4 Hours

UNIT – 2

High-Speed Rail:

Introduction to high-speed rail, Design principles, Technological advancements in train propulsion and aerodynamics, safety features and systems, Emerging technologies and applications, Case studies of high-speed rail systems.

Traction and tractive resistances:
Introduction, Tractive power, Hauling capacity, Problems.

07 Hours

UNIT – 3

Geometric Design of Railway track:
Necessity of Geometric Design of railway track, gradient and types of gradients, Compensation of gradients, Speed of train, horizontal curve, transition curve, super elevation, cant deficiency, negative cant, Problems.

8 Hours

UNIT – 4
AIRPORT ENGINEERING

Introduction:
Introduction to Airport Engineering, Layout of an airport with component parts and functions of each, Aircraft Characteristics, Airport Classifications, Criteria for airport site selection.

2 Hours

Runway Design:
Orientation of runway by using wind rose diagram, runway configurations, problems on basic length of the runway – corrections to runway length by ICAO and FAA specification, Geometric design of runways.

4 Hours

Taxiway Design:
Factors affecting the layout of the taxiway, geometrics of taxiway, design of Exit taxiways as per ICAO Specifications. Problems.

4 Hours

UNIT – 5
TUNNEL & HARBOUR ENGINEERING

Tunnels:
Introduction, types of tunnels, advantages and disadvantages. Construction methods and equipment used in Tunneling (TBM), Tunnel Safety and Maintenance.

Harbour:
Introduction, Definition of Basic Terms, Planning and Design of Harbours, requirements classification, natural phenomenon affecting the design of harbour viz. wind, wave, tide and currents. Harbour layout with component parts.

7 Hours

Note: Site visit to Metro construction site, Airport

Text book/Codes:

1. Saxena and Arora, "**A Text Book of Railway Engineering**", Dhanpat Rai Publications, New Delhi, 2010.

2. S K Khanna, M G Arora and S S Jain, "**Airport Planning and Design**", Nemchand, Roorkee. 1999
3. Srinivasan R., "**Harbour, Dock & Tunnel Engineering**", Charotar Publishing House, 28th Edition, 2016
4. Kadiyali, L.R. "**Traffic Engineering and Transport Planning"**, Khanna Publishers, 1999

Reference books:

1. Chandra S., and M M Agarwal, "**Railway Engineering**", M.M. Oxford University Press, New Delhi. 2013.
2. J. S. Mundrey, "**Railway Track Engineering**", McGraw Hill Publishing Co. 2017
3. C Venkatramaiah, "**Transportation Engineering**, Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels", Orient Blackswan Private Limited,. 2018
4. Horenjeff, R. and McKelvey, F., "**Planning and Design of Airports**", McGraw Hill Company, New York. 5th Edition, 2010
5. Bindra S P, "**A Course in Docks and Harbour Engineering**", Dhanpat Rai Publications, New Delhi, 2012.

E-learning resources:

https://nptel.ac.in/courses/105/107/105107123.

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Transportation Systems Engineering TSE													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												2	
CO2	3	3	3										3	
CO3	3												2	

Course	Project Management & Finance	Course Code	23CV6AEPMF	SEE Duration	3 hours
Credits	02	L:T:P	2:0:0	SEE+ CIE Marks	50+50
CONTACT Hours	26 Hrs	CIE Theory marks	50 marks	CIE lab marks	Nil

COURSE OBJECTIVES: To provide basic knowledge of project management and finance . For civil engg students focus is on construction projects.

COURSE OUTCOMES: An ability to

CO1	Develop project lifecycle and WBS based on project management principles.
CO2	Perform project scheduling using CPM and PERT models on the developed project networks.
CO 3	Apply the concept of time-cost trade-off and time value of money for different real time scenarios.

UNIT -1

Introduction:

Project – Meaning – Nature – Types of project – Concepts of Project management – Nature and scope of project management – Essentials of Project Management Philosophy – Project Management Principles - Project life cycle - Project selection, Project Scope, Project priorities - Project management as a profession - Role of project manager.

4 Hours

UNIT -2

Project Planning:

Organizational breakdown structure (OBS) - Work break down structure (WBS) - Integrating WBS with OBS – Resource planning, need and importance - Resource allocation - Managing project resources flow, cash flow - Project constrains - Materials management - Supply chain management - Concept of productivity

4 Hours

UNIT-3

Project Scheduling:

Project scheduling, purpose and importance - Networking techniques - Development of Project Network (AON, AOA) - Rules for developing network diagram – Time estimation - Determination of slack - Identification and analysis of the critical path – CPM Model - PERT Model

7 Hours

UNIT-4

Project monitoring:

Project Controls - Time-cost trade-off - Cost control in construction – Project fast-tracking – Project crashing - Capital budgeting – Capital budgeting process - Risk identification and management, risk analysis - Project feasibility studies – *Case studies*

4 Hours

UNIT-5

Project evaluation and Finance:

Project evaluation and appraisal, Techniques of project appraisal and their applications - Market appraisal –Technical appraisal –Financial appraisal - Working capital management.

Concepts on the following with relevant numerical examples: Time value of money – Net Present Value – Future value – Annuity – Return on Investment – Pay Back period – Make or buy decisions – Lease or buy decisions

7 Hours

Text Books:

1. R.Paneerselvam and P.Senthilkumar "Project Management" PHI Learning India Pvt Ltd.,2018
2. S.Choudharay "Project Management" TATA McGraw Hill Co., 2012
3. Project Planning and Control with PERT and CPM by B C Punmia and K K Khandelwal, 4th Edition, Laxmi Publications Pvt Ltd, July 2023

References:

1. PMBOK® Guide (2021) - A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute, 7th edition, 2021,
2. Srinath L.S, "PERT and CPM", East West Press Pvt Ltd New Delhi.
3. Van Horne J.C, "Fundamentals of Financial Management" Prentice Hall, 2009
4. Blank L and Anthony T, " Basics of Engineering Economy", McGraw Hill Education, Indian Edition, 2013.
5. Chitkara K K, "Construction Project Management, Planning, Scheduling and Controlling, McGraw Hill Education, 3rd Ed., 2014.

E-Resources: Mooc: https://onlinecourses.nptel.ac.in/noc17_mg01/preview

2http://nptel.ac.in/courses/109104068/30

https://prothoughts.co.in/wp-content/uploads/2022/06/a-guide-to-the-project-management-body-of-knowledge-6e.pdf

CIE Pattern: CIE for 40 marks each; AAT / Quiz/ Seminar for 10 Marks.

SEE Paper Patter:

1. Student shall answer FIVE full questions selecting one from each unit. Ten questions to be set.

CO-PO MAPPING SCALE 1 TO 3

	Project Management and Finance PMF													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO 2**
CO1	**2**	**3**	**3**	**-**	**-**	**-**	**2**				**-**			
CO2	**2**	**3**	**-**	**-**	**-**	**-**	**2**				**-**			
CO3	**2**	**3**	**-**	**-**	**-**	**-**	**2**				**-**			

VI Sem
DEPARTMENT ELECTIVES

Elective

Course	Basics of Flood Analysis	Course Code	23CV6PEBFA	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the concepts necessary to analyse the hydrological data, estimation and modelling of flood flows, flood hazard, risk estimation and an overview of various flood control structures.

COURSE OUTCOMES: An ability to	
CO1	Analyze and interpret hydrological data.
CO2	Estimate the flood flow for a given rainfall scenario and identify the flood control measures.
CO3	Model flood flow using physically based and data driven tools.

UNIT-1

Precipitation:

Precipitation- process, types, mechanism of Indian monsoon and rainfall pattern, climate zones in India, hydrological data and sources of data, rainfall classification based on the depth / intensity, extreme precipitation codes by IMD. Analysis of precipitation data: consistency of the data, mass curve, rainfall hyetograph from mass curve, Depth-area-duration relationship

7 Hours

UNIT-2

Runoff:

Components of runoff, empirical equations for runoff depth and volume, flow duration curve, flow mass curve.

Hydrograph, Unit Hydrograph, estimation of direct runoff hydrograph from unit hydrograph for simple and compound storm, generation of UH of different duration, synthetic unit hydrograph.

7 Hours

UNIT-3

Flood Characteristics:

Definition & causes of floods, Global climate change and influence on precipitation, importance of flood studies, Estimation of flood peak, flood peak-area relationship, envelop curves, time of concentration, Flood control measures, type of flood maps

7 Hours

UNIT-4

Design Flood Estimation:

Probability distribution and basic descriptive statistics, frequency of point rainfall, return period, intensity-duration-frequency relationship,

Flood frequency, extreme value distribution, design flood, SPF, PMF and its importance , Indian standard guideline for design of floods for dams, Selection of design storm, risk and reliability

9 Hours

UNIT-5

Flood Modelling:

Hydrologic modelling: conceptual model development, physical and data driven (ANN concepts), model performance indices.

Tool: HMS, SWMM , HECRAS

Hydrologic routing-level pool routing and channel routing

Basics of Hydrological forecasting: ARIMA, ANN

9 Hours

Text books:

1. Ven Te Chow, Maidment D.R., and Mays L.W, "**Applied Hydrology**", McGraw-Hill Book Company, New York, 1st Edition, 2017
2. K. Subrahmanya, "**Engineering Hydrology**", McGraw-Hill Book Company, New Delhi. 5th Edition, 2020

Reference books:

1. Linsley Ray, Kohler Max "**Applied Hydrology**", McGrawHill Exclusive (CBS), 2017

E-learning resources:

1. Water resources engineering https://nptel.ac.in/courses/105104103
2. Engineering hydrology https://nptel.ac.in/courses/105103213

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units
2. The maximum number of sub division in a question is restricted to 4.

Self-study component

- Students need to develop a computational model for hydrologic simulation
- Self-study component shall be evaluated through alternate assessment tools

CO-PO MAPPING SCALE 1 TO 3

	Basics of Flood Analysis 23CVPE6BFA													
	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1		3											3	
CO2		3											3	
CO3			3		3								3	

Elective: COMPUTATIONAL METHODS OF STRUCTURAL ANALYSIS

Course	Computational Methods of Structural Analysis	Course Code	23CV6PECMA	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Gain basic knowledge of structural systems and application of concepts of flexibility and stiffness matrices to solve problems on beams, frames and trusses.

COURSE OUTCOMES: An ability to

CO1	Evaluate simple structural systems using element flexibility and stiffness matrix methods
CO2	Formulate and solve engineering problems such as continuous beams, rigid frames and trusses using direct stiffness method
CO3	Develop computational programme (MATLAB) by using direct stiffness method.

UNIT-1

Introduction: Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, development of flexibility and stiffness matrices for beam and truss elements.

6 Hours

UNIT-2

Element Flexibility Method:

Force transformation matrix, assembly of structural flexibility matrix, flexibility method applied to the analysis of continuous beams and rigid plane frames.

8 Hours

UNIT-3

Element Stiffness Method:

Displacement transformation matrix, assembly of structural stiffness matrix, Stiffness method applied to the analysis of continuous beams and rigid plane frame structures with kinematic redundancy ≤ 3.

8 Hours

UNIT-4

Direct Stiffness Method: Local and Global coordinate systems, stiffness matrices of beam elements in global coordinates , analysis of continuous beams and rigid plane frames with kinematic redundancy$\leq$3. **10 Hours**.

UNIT-5

Analysis of Plane Truss:
Development of stiffness matrices of truss, local and global coordinates analysis of trusses by using stiffness and direct stiffness method.

7 Hours

Text book/Codes:

1. Weaver W and Gere J M, "**Matrix Analysis of Framed Structures**", CBS publications, New Delhi. 2nd Edition, 2018
2. Natarajan C, "**Matrix Methods of Structural Analysis Theory**", Prentice Hall India Learning Private Limited, 2014
3. Rajasekaran S, "**Computational Structural Mechanics**", PHI, New Delhi. 2001
4. Madhujit Mukhopadhay and Abdul Hamid Sheikh, "**Matrix and Finite Element Analysis of Structures**", Springer International Publishing, 1st Edition, 2022

Reference books:

1. Bowles J.E., "**Foundation Analysis and Design**" 5th Edition, McGraw Hill Pub. Co. New York, 2001
2. G Pundit and S Gupta, "**Structural Analysis - A Matrix Approach**", 2nd Edition, Tata McGraw Hill Publications, New Delhi, 2008.
3. A K Jain, "**Advanced Structural Analysis**", Nemchand Publications, Roorkee, 2015.
4. Manikaselvam, "**Elements of Matrix Analysis and Stability of Structures**", Khanna Publishers, New Delhi, 1998.
5. H C Martin, "**Introduction to Matrix Methods in Structural Analysis**", International textbook company, McGraw Hill, 1966.

E-learning resources:
https://nptel.ac.in/courses/105105180
https://nptel.ac.in/courses/111102152

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.
Activity based learning: Quizzes / Developing MATLAB program/assignments

SEE paper pattern:

1. Student shall answer FIVE full questions, selecting one from each unit. All units have internal choice.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	Computational Methods of Structural Analysis 23CV6PECMA													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3											3	
CO3	3	3			3								3	

Elective: DESIGN OF TALL STRUCTURES

Course	Design of Tall Structures	Course Code	23CV6PEDTS	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the components of a tall structure, its structural forms, loadings, stability, analysis, its construction procedure.

COURSE OUTCOMES: An ability to	
CO1	Explain concepts related to analysis and design of tall buildings for gravity and lateral loads.
CO2	Analyze and design various tall structural systems.
CO3	Analyze and check the stability of tall building.

UNIT-1

Introduction:

History, Advantages & disadvantages, Economics, Essential amenities, Lifts (elevator), Fire safety, Water supply, Drainage and garbage disposal, Miscellaneous services, Structural and foundation systems, Design criteria, Design philosophy, loading, Sequential loading, Materials, High performance Concrete, Fibre reinforced Concrete, Light weight Concrete, Design Mixes.

7 Hours

UNIT-2

Loading and Movement:

Gravity loading: Dead and Live load, methods of live load reduction, Impact, gravity loading, construction load. Wind loading: Static and Dynamic approach, Analytical and wind tunnel experimental method. Earthquake loading: Equivalent lateral force, Modal analysis, combinations of loading, working stress design, Limit state design, Plastic design.

8 Hours

UNIT-3

Behaviour of Various Structural Systems:

Factors affecting growth, Height and Structural form- High rise behavior, Rigid frames, braced frames, in filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger-Braced and hybrid mega system. **8Hours**

UNIT-4

Analysis and Design:

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of building as total structural system considering overall integrity and major subsystem interaction,

Analysis for member forces, drift and twist, computerized general three dimensional analysis. Structural elements: Sectional shapes, properties and resisting capacity, design, deflection, cracking, pre stressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

8 Hours

UNIT-5

Stability of Tall Buildings:

Overall buckling analysis of frames, wall- frames – Approximate methods, second order effects of gravity loading, P-Delta analysis, simultaneous first order and P-Delta analysis- Translational, Torsional instability, out of plane effects, stiffness of member in stability, effect of foundation rotation, Integration of Services.

8 Hours

Text book/Codes:

1. Taranath B.S, "**Analysis & Design of Tall Building**", McGraw-Hill Book Co,(2011)
2. Bryan S.S, and Alexcoull, "**Tall Building Structures, Analysis and Design**", John Wiley and Sons, Inc.,(1991)

Reference books:

1. Wolfgang. S, "**High Rise Building Structures**", John Wiley & Sons, (1977)
2. Peter Irwin, Roy. D, "**Wind Tunnel testing of High Rise Buildings**", Ctbuh Technical Guides, Routledge, 2013.

E-learning resources:

https://www.youtube.com/watch?v=-syqppgcoVE
https://www.youtube.com/watch?v=7NEfZXFOvxU

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 3.

Quizzes / AAT using E-TABS / / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Design of Tall structures DTS													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											2	
CO2	3	3	3										2	
CO3	2												2	

Elective: GROUND IMPROVEMENT TECHNIQUES

Course	Ground Improvement Techniques	Course Code	23CV6PEGIT	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the need for ground improvement and apply various alternate ground improvement techniques to suit the field requirements.

COURSE OUTCOMES: An ability to	
CO1	Identify the need for ground improvement and summarize the physical modifications of the soil
CO2	Assess and apply suitable ground improvement/modification techniques to suit field requirements

UNIT-1

Ground Improvement:

Historical development, Engineering properties of the soft, week and compressible deposits, Natural on land, off-shore and Man-made deposits, Objectives of soil improvement, Classification of ground improvement techniques, Factors to be considered in the selection of the best soil improvement technique. Influence of soil formation on the choice of ground improvement technique, Deep excavation.

Mechanical Modification:

Type of mechanical modification, Aim of modification, compaction, Principle of modification for various types of soils

8 Hours

UNIT-2

Conventional Compaction:

Evolution of compaction theories Effect of grain size distribution on compaction for various soil types. Effect of compaction on engineering properties like compressibility, swelling and shrinkage, Shear strength, stress-strain characteristics and Hydraulic conductivity.

Intelligent Compaction:

Principles, benefits, design considerations, construction, quality assurance.

Field Compaction:

Shallow and deep compaction. Static compaction, dynamic compaction, dynamic consolidation

impact type rollers, impact type compacters, vibratory type Vibro-flotation, vibro-replacement. Effect of saturation on compaction. Specifications of compaction-End product specification and Method specification. Tolerance of compaction

8 Hours

UNIT-3

Hydraulic Modification:

Definition, aim, principle, techniques. Methods of lowering of water table: sumps and ditches, well point system-Single stage, multistage well point, deep well point system, Robert's diagram, spacing of well points, vacuum dewatering, Electroosmotic dewatering.

Preloading:

Preloading, vertical drains, sand drains. Assessment of ground condition for preloading

8 Hours

UNIT-4

Chemical Modification:

Definition, aim, special effects, and methods. Admixtures, cement stabilization. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage. Criteria for cement stabilization. Stabilization using Fly ash. Lime stabilization – suitability, process, special effects, criteria for lime stabilization Other chemicals, chlorides, hydroxides, lignin, hydrofluoric acid. Properties of chemical components, reactions and effects. Bitumen, tar or asphalt in stabilization. Soil stabilization using enzymes.

Miscellaneous methods:

Concepts thermal methods- Ground Freezing and heating, advantages and disadvantages.

8 Hours

UNIT-5

Grouting:

Introduction, Effect of grouting. Chemicals and materials used. Types of grouting, Injection grouting, hydraulic fracturing, compaction grouting, and Jet grouting: Single fluid, double fluid and triple fluid jet grouting. Grouting procedure. Applications of grouting.

Method of Confinement:

Crib walls, gabions and Mattresses, concepts of reinforced earth The mechanism, Reinforcement materials and soil nailing- Applications, advantages and disadvantages.

7 Hours

Text book/Codes:

1. Purushothama Raj P, "**Ground Improvement Techniques**", Laxmi Publications, New Delhi. (2016).

Reference books:

1. Manfred Haussmann, "**Engineering principles of ground modification**", - Mc Graw Hill Pub. Co., New York. (2013)
2. Jie Han, "**Principles and practices of ground improvement**", Wiley and Sons. (2018)
3. Bell, F.G. Butterworths, "**Methods of treatment of unstable ground**", London. (1975)
4. Nelson J.D. and Miller D.J, "**Expansive soils**", John Wiley and Sons. (1992)

5. Ingles. C.G. and Metcalf J.B, "**Soil Stabilization; Principles and Practice**", Butterworths, London. (1972)

E-learning resources:

https://nptel.ac.in/courses/105/108/105108075/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Ground improvement techniques GIT													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	2											3	

Elective: PAVEMENT DESIGN

Course	Pavement Design	Course Code	23CV6PEPAD	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand terminology and concepts of pavement engineering, different types of pavements, design concepts of flexible and rigid highway pavements and conduct analysis of flexible and rigid pavements for stresses, strains and deflections.

COURSE OUTCOMES: An ability to

CO1	Apply fundamental theories to design flexible and rigid pavements.
CO2	Analyze the stresses in flexible and rigid pavements.
CO3	Design flexible and rigid pavement as per IRC specifications.

UNIT-1

Introduction:

Types of Pavement, Comparison of Flexible and Rigid Pavements, Components and Functions of Sub-Grade, sub-base, base course, surface course. Difference between highway pavement and air-field pavements.

Design Factors: Pavement Design Factors; Traffic factors – loads, axle load distribution, ESWL, EWL, VDF due to varying loads and CSA, Numerical.

7 Hours

UNIT-2

Fundamentals Of Design Of Pavements:

Design Life, Traffic Factors, Climatic Factors, Evaluation of Sub-grade soil strength – Plate Load test and CBR test, Stresses and Deflections, Boussinesq's elastic theory – principle, Assumptions and Limitations and Numerical using Stress and Deflection Charts, Burmister's 1, 2 and 3-Layer theory – Numerical on Repeated Loading.

8 Hours

UNIT-3

Flexible Pavement Design:

Assumptions, Empirical, Semi-Empirical, Analytical Methods of Design; Concept of Group Index Method, CBR Method McLeod Method; Design of Flexible Pavement using IRC:37-2018 only. Analysis of stresses and strains using IITPave tool. AASHTO Method – Numerical using Nomograph.

8 Hours

UNIT-4

Stresses In Rigid Pavement:

Components and their functions, design factors, Properties of Concrete affecting the design, Analysis of stresses, Assumptions, Westergaard's Analysis, Modified Westergaard's equations, Critical Stress Locations, Wheel Load stresses, Warping stresses, Frictional stress, combined stress – Numerical using Charts and Equations.

8 Hours

UNIT-5

Design Of Rigid Pavement:

Design of Cement Concrete Pavement by IRC:58 – 2015; Requirements of Joints, Types of Joints – Expansion, Contraction, Warping, Construction and Longitudinal Joints, Design of Joints – Numerical; Concept of White topping; Design Features of CRCP, SFRC and ICBP.

8 Hours

Text book/Codes:

1. S. K. Khanna, C. E. G. Justo and A. Veeraragavan, "**Highway Engineering**", Revised 10th Edition, Nem Chand and Bros, Roorkee, (2015).
2. R. Srinivasa Kumar, "**Textbook of Highway Engineering**", Universities Press (India), Private Ltd., (2011).
3. Huang, Y.H. "**Pavement Analysis and Design**", Prentice Hall, (1993).

Reference books:

1. E. J. Yoder and M. W. Witczak, "**Principles of Pavement Design**", Second Edition, John Wiley and Sons, Inc, (1975).
2. IRC:37-2018 – "**Guidelines for The Design of Flexible Pavement**", Fourth Revision, Indian Roads Congress, New Delhi, (2018).
3. IRC:58-2015 – "**Guidelines for the Design of Plain Jointed Rigid Pavements for Highways**", Fourth Revision, Indian Roads Congress, New Delhi, (2015).
4. AASHTO-1993. "**Guide for Design of Pavement Structures**", American Association of State Highway Transport Officials, Washington D.C, (1993).

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4. Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

Pavement design														
	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	2												
CO2		3			3									
CO3			3											

Elective: PAVEMENT MATERIALS AND CONSTRUCTION

Course	Pavement Materials And Construction	Course Code	23CV6PEPMC	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Acquire knowledge of highway materials and methods of construction of different types of flexible and rigid pavements

COURSE OUTCOMES: An ability to

CO1	Analyze the different types and characteristics of various pavement materials.
CO2	Design Bituminous mixes as per specifications.
CO3	Describe equipments used for the construction of different pavement layers.
CO4	Discuss specifications and methods of Flexible and Rigid pavement construction.

UNIT-1

Aggregates:

Origin, classification, requirements, properties and tests on road aggregates, Concepts of size and gradation-Design Gradation, Maximum aggregate size, Aggregate Blending-Methods

4 Hours

UNIT-2

Binders And Modified Binders:

Types, Origin, Preparation, Properties and Composition of Bituminous Road binders; Requirements-Tests-uses of Bituminous Binders and Modified Binders.

Bituminous Emulsions And Cutbacks:

Types, Properties, Tests and uses of Emulsions and Cutbacks.

Adhesion of Bituminous Binders to Road Aggregates:

Adhesion failure, Mechanism of stripping, Tests and methods of improving adhesion

7 Hours

UNIT-4

Equipment in Highway Construction: Various types of equipments for Excavation, Grading and Compaction, Pavers and Finishers, Working principle, Advantages and Limitations.

Subgrade: Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, Quality Control tests.

8 Hours

UNIT-5

Flexible Pavements:
Specifications of materials, Construction and field control checks and for various types of flexible pavement layers, Quality Assurance for Flexible pavements

Cement Concrete Pavements:
Specifications and method of cement concrete pavement construction (both CC and PQC); Quality control tests; Construction of various types of joints.

9 Hours

Text book/Codes:

1. S. K. Khanna, C. E. G. Justo and A. Veeraragavan, "**Highway Engineering**", Revised 10th Edition, Nem Chand and Bros, Roorkee, (2014).
2. Sharma, S.C, "**Construction Equipment and its Management**", Khanna Publishers, 1st Edition, 2019

Reference Books:

1. R. Srinivasa Kumar, "**Textbook of Highway Engineering**", Universities Press (India) Private Ltd., (2012).
2. S. P. Bindra, "**A Course in Highway Engineering**", Dhanpat Rai Publications, 5th Revised Edition, (2013).
3. Ministry of Road Transport and Highways "**Specifications for Roads and Bridges**", IRC, NewDelhi, 2013.

E-learning resources: https://www.nptel.ac.in/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3

	Pavement Materials and Construction													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	3	2										3	
CO3	3												3	
CO4	3												3	

Elective : STRUCTURAL MASONRY

Course	Structural Masonry	Course Code	23CV6PESMA	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	36 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the strength and elastic properties of masonry and its constituent materials and failure modes in addition to the design of load bearing masonry components for buildings.

COURSE OUTCOMES: An ability to	
CO1	Characterize and evaluate the properties of various masonry materials
CO2	Evaluate the behaviour and strength of masonry under compression, flexure and shear
CO3	Comprehend unreinforced and reinforced masonry
CO4	Analyze and design load bearing masonry components and systems as per BIS codes.

UNIT-1

Introduction, Masonry Units, Materials And Types:

Characteristics of bricks, stone, clay block, concrete block, stabilized mud block masonry units-strength, modulus of elasticity and water absorption. Masonry materials –classification and properties of mortars, selection of mortars.

7 Hours

UNIT-2

Strength of Masonry in Compression:

Behavior of masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, factors affecting the strength of masonry.

7 Hours

UNIT-3

Masonry Bond Strength:

Bond between masonry unit and mortar, tests for determining flexural and shear bond strength, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength

7 Hours

UNIT-4

Introduction to Masonry arches, vaults and domes

Types and behavior of masonry arches, vaults and domes.

Introduction to Reinforced Masonry:

Concepts for vertical and horizontal reinforcement schemes for masonry, confined masonry, construction process, BIS code provisions **6 Hours**

UNIT-5

Design of Load Bearing Masonry Buildings:

Permissible stresses, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels. Wall carrying axial loads with different eccentricity ratios, wall with openings, free standing walls. Design of load bearing masonry for buildings up to 3 to 8 story using BIS codes**.**

6 Hours

Text book/Codes:

1. K.S.Jagadish, "**Structural Masonry**", I K International Publishers, First Edition, 2015, New Delhi, India,
2. IS: 1905-1987, "**Code of practice for structural use of unreinforced masonry**", Bureau of Indian Standards,, 1987, reaffirmed 2002, New Delhi, India

Reference books:

1. A W Hendry, "**Text book on Structural Masonry**", Second edition, Macmillan press ltd, 1998, London, U.K
2. R G Drysdale, A Hamid, L R Baker, " **Text book on Masonry structures behaviour and design**", First edition, Prentice Hall, 1994, USA
3. W M C Mc Kenzie, "**Text book on Design of Structural Masonry**" First edition, Palgrave Publishers, 2001, New York, USA
4. Narendra Taly, "**Design of Reinforced Masonry Structures**", Second Edition, McGraw Hill publishers, 2010, New York, USA

E-learning resources: https://archive.nptel.ac.in/courses/105/106/105106197

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ seminars /assignments/model submissions

CO-PO MAPPING SCALE 1 TO 3

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3								2	2				
CO4		3	3					2					3	

Elective : SOLID WASTE MANAGEMENT

Course	Solid Waste Management	Course Code	23CV6PESWM	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Provide fundamental knowledge of the quantification and characteristics of solid waste, engineering remedies and processing methods, techno-legal and community requirements.

COURSE OUTCOMES: An ability to

CO1	Characterize and quantify the solid waste.
CO2	Analyze the mechanisms for providing engineering remedies related to disposal issues.
CO3	Illustrate the process for solid waste disposal for safety, legal and societal needs.

UNIT-1

Introduction:

Definition, land pollution-scope and importance of solid waste management, functional elements of solid waste management. Sources, Classification and characteristics-Municipal, Commercial & Industrial. Methods of quantification.

Collection And Transportation:

System of collection, Collection equipment, garbage chutes, transfer stations-bailing and compacting, route optimization techniques and problems.

8 Hours

UNIT-2

Treatment/Processing techniques:

Components of separation, volume reduction, size reduction, chemical reduction and biological processing problems.

Incineration:

Process-3T's, factors affecting incineration process, incinerators–types, prevention of air pollution, pyrolysis, design criteria for incineration.

8 Hours

UNIT-3

Composting:

Aerobic and Anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes, vermin composting. **8 Hours**

UNIT-4

Sanitary Land Filling:

Different types, Trench method area method, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas control methods , geosynthetic fabrics in sanitary landfills. **8 Hours**

UNIT-5

Experimental Techniques in SWM:

Surface complexation: surfaces and reactions; Surface complexation modelling: double-layer, constant capacitance, and triple-layer models. Experimental techniques for solid-phase investigations; Diffraction Principle of XRD, Bragg's law, Fundamentals of crystal structures-unit cells, lattice planes and Miller indices, important structure types, phase identification, Scherer equation. Microscopy: Principles and applications of SEM, TEM and associated energy dispersive X-ray spectroscopy (EDXS). Spectroscopy: Principles and applications of X-ray Fluorescence (XRF), Vibrational (IR and Raman), Absorption (XANES, EXAFS).

7 **Hours**

Text book/Codes:

1. George Tchobanoglous, H Theisen, S A Vigil, "**Integrated solid waste management**", McGraw Hill, 1993.
2. Bhide and Sundearashan, "**Solid waste management in developing countries**", Indian National Scientific Documentation Centre, 1983.

Reference books:

1. Pavonij.L, "**Hand Book on solid waste disposal**", McGraw-Hill, New York, 2015.
2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "**Environmental Engineering**" McGraw Hill Education, 2017.
3. Biomedical waste handling rules, https://dhr.gov.in/sites/default/files/Bio-medical_Waste_Management_Rules_2016.pdf

E-learning resources:

https://archive.nptel.ac.in/courses/105/103/105103205/
https://archive.nptel.ac.in/courses/120/108/120108005/

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

Quizzes / AAT/ / seminars /assignment

CO-PO MAPPING SCALE 1 TO 3

	Solid was management													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2				2	2						1	

OPEN ELECTIVE

Course	Climate Change and Carbon Capture	Course Code	23CV6OECCC	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Understand the important issues and aspects of global warming and climate change and their control strategies.

COURSE OUTCOMES: An ability to	
CO1	Identify various impacts of global warming and climate change control and analyze the mitigation measures.
CO2	Analyze the significance of ozone layer, carbon sequestration .

UNIT-1

Global warming:

Structure and composition of atmosphere, mechanism of greenhouse effect, sources of GHG emission, impacts of greenhouse gases on environment and control of GHG emission.

Bio-geochemical cycles: Hydrological cycle, carbon cycle, nitrogen cycle, oxygen cycle.

8 Hours

UNIT-2

Impacts of climate change on environment:

Rise in temperature, melting of glaciers, sea level rise, floods, droughts and landslides.

Impacts of climate change on various sectors:

Agriculture, water resources – human health – industry, settlement and society.

8 Hours

UNIT-3

Paris Agreement: Background, goals, current scenario, measures taken by India, issues, merits and limitations of Paris agreement.

Combating climate change: Role of citizens, countries and international bodies in combating climate change.

8 Hours

UNIT-4

Kyoto Protocol: Background, commitment periods, achievements and failure.

Flexibility Mechanisms: International emission trading, Joint implementation and Clean development mechanism, CDM Projects.

8 Hours

UNIT-5

Ozone layer depletion:

Ozone layer, causes for ozone layer depletion: natural and anthropogenic, ozone depleting substances (ODS), Effects of ozone layer depletion, Vienna convention, Control – Montreal Protocol.

Carbon sequestration:

Carbon sources and sinks techniques for carbon sequestration- Afforestation and reforestation, Direct air capture and storage (DAC-S) and Bioenergy with carbon capture and storage (BECCS).

7 Hours

Text book/Codes:

1. Dash Sushil Kumar, "**Climate Change – An Indian Perspective**", Cambridge University Press India Pvt. Ltd, 2007.
2. Bruce E. Johansen, "**Global Warming and the Climate Crisis**", Springer, 2023

Reference books:

1. J.M. Wallace and P.V. Hobbs, **"Atmospheric Science"**, Elsevier / Academic Press 2006.
2. Jan C. van Dam, Impacts of **"Climate Change and Climate Variability on Hydrological Regimes"**, Cambridge University Press, 2003.

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in **all units.**
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	CLIMATE CHANGE AND CARBON CAPTURE													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3					3	-		2				3	
CO2	3					3	-		2				3	

OPEN ELECTIVE : DISASTER MANAGEMENT AND MITIGATION

Course	Disaster Management and Mitigation	Course Code	23CV6OEDMM	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

Learn basic concepts of disaster management, planning, mitigation and its importance in the current scenario.

COURSE OUTCOMES: An ability to	
CO1	Classify the type of disasters; and identify the characteristics of various natural and manmade disasters.
CO2	Discuss the components of the disaster management cycle, disaster management policy and acts.
CO3	Discuss environmental issues and challenges related to disaster management.

UNIT-1

Introduction to Disaster Management:

Concepts of disaster, Definition of terms- hazard, vulnerability, risk, capacity, mitigation, prevention, risk management, capacity building; Impacts of disaster- ecological, physical, social effects, Disaster Management- objectives and components, Hazard-Vulnerability analysis.

Type of Disaster Classification:

Based on i) Based on the forces responsible for the occurrence ii) Levels of disaster iii) Based on the nature of the hazard iv) General:-Natural and man-made disasters v) HPC classification

7 Hours

UNIT-2

Characteristics, causes and general measures for disasters:

Natural disasters: Causes, characteristics, general measures and challenges - Floods, landslides, forest fire, cyclone and tsunamis, earth quake, drought, volcanoes, soil erosion.

Manmade disasters: Causes, characteristics, counter measures, prevention and management of – chemical or Industrial hazards, nuclear hazard, soil degradation, biological disasters, Traffic accidents, Fire hazards, Urban flooding, and land degradation.

8 Hours

UNIT-3

Disaster Management Cycle:

Components of disaster management cycle, Disaster preparedness: Introduction Principles, mapping, zoning, Team building, community relations, warning systems.

Disaster mitigation: Introduction, measures, structural and non- structural measures, Mitigation measures adopted for --Flood, landslide, Earth quake, epidemic, Environmental Management Plan. ***Risk analysis***: Qualitative and quantitative Methods, Tools.

Disaster Response & Recovery: Objectives, control process, evacuation, first aid, restoring essential service, search and rescue, ICT, Different stages of recovery, systematic frame work for planning recovery, capacity building for reconstruction and rehabilitation, compensation.

8 hours

UNIT-4

Disaster Management in India:

Disaster profile of India – floods, droughts, cyclone, earthquake, tsunami, landslide, heat and cold waves, Manmade disasters. Disaster Management Act 2005, National Policy.

Organizational structure of disaster management agencies in India, role and responsibilities of local, state bodies, agencies, stakeholders, media. Disaster management information system

7 hours

UNIT-5

Environmental Issues and Challenges in Disaster Management:

Challenges in disaster management: Education, research and training; public health system; early warning system and charting hazard map; policy implementation; community and ethical issues; adoption of innovative technologies; environmental vulnerability

Environmental degradation, Ozone layer depletion.

Global warming: Causes of climate change, Climate change projection, impact of climate change on the disaster risk. International treaties to reduce the climate change-UNFCC, Kyoto protocol, Doha amendment and Paris agreement, Earth summit

7 Hours

Text books:

1. S.C. Sharma, "**Disaster Management**" Khanna book publishing co., (2nd Edition), (2022)
2. R Subramanian, "**Disaster Management**", Vikas Publishing House (2018).

Reference books:

1. Dr. Mrinalini Pandey, "**Disaster Management**", Wiley India pvt., (2014, reprint 2016)
2. A.K. Srivastava, "**Text book of Disaster Management**" Scientific Publishers (India), 2021
3. Singhal J.P. "**Disaster Management**", Laxmi Publications, 2019.
4. Tushar Bhattacharya, "**Disaster Science and Management**", McGraw Hill India Education Pvt. Ltd., (2012). (E-book) ISBN - 9789339212940

E-learning resources:

1. Disaster Management in India
   http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf
2. Disaster Management in India
   https://www.unisdr.org/2005/mdgs-drr/national-reports/India-report.pdf

3. Disaster management Act
   https://ndma.gov.in/sites/default/files/PDF/DM_act2005.pdf

4. Self-Study Programme on Disaster Risk Management, NATIONAL INSTITUTE OF DISASTER MANAGEMENT, Ministry of Home Affairs, Government of India
   https://ssp.nidm.gov.in/enrol/index.php?id=147

CIE: CIE is for 40 marks and Quizzes / AAT/ / seminars /assignments will be for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1						3								3
CO2						3								3
CO3						3								3

OPEN ELECTIVE: MECHANICS OF FRP COMPOSITES

Course	Mechanics of FRP composites	Course Code	23CV6OEMFC	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students

To provide fundamental knowledge of basic properties and manufacturing process of different types of composites and their applications.

COURSE OUTCOMES: An ability to	
CO1	Identify different composite materials and summarize its mechanical properties.
CO2	Analyze and formulate constitutive matrix of Composite laminates based on Kirchoff's hypothesis.
CO3	Develop computational programme by using MATLAB.

UNIT-1

Introduction to composite materials:
Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.

Constituent of composite materials:
Reinforcements, Matrix, Coupling agents, coatings & fillers.

Reinforcements:
Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of Fibers

Matrix Materials:
Polymers, Metals and Ceramic Matrix Materials.

8 Hours

UNIT-2

Micro mechanics of Composites:
Introduction, Density, Evaluation of mechanical properties and prediction of elastic constants by using Rule of mixture, Numerical problems.

Macro mechanics of Composites:
Introduction, Hooke's law for different types of materials, Number of elastic constants, two dimensional relationship of compliance and stiffness matrix

8 Hours

UNIT-3

Macro Mechanics of a FRP Lamina:

Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations of lamina for any arbitrary orientation, Numerical problems.

8 Hours

UNIT-4

Macro Mechanical Analysis of Laminate:

Introduction, Kirchoff hypothesis, CLT, A, B, and D matrices (Detailed derivation), special cases of laminates.

8 Hours

UNIT-5

Composite Biaxial Strength Theories:

Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai - Wu tensor theory.

7 Hours

Text book/Codes:

1. Robert M Jones, "**Mechanics of Composite Materials**", 2nd Edition, CRC Press, 1998.
2. P. K. Mallick, "**Fiber Reinforced Composites, Materials, Manufacturing, and Design**", 3rd Edition, CRC Press, 2007.

Reference books:

1. Autar K. Kaw, "**Mechanics of composite materials**", 2nd Edition, CRC Press New York 2005.
2. K. K. Chawla, "**Composite Science and Engineering**", 3rd Edition, Springer Verlag 2012.
3. Mel M Schwartz, "**Composite materials hand book**", 2nd Edition, McGraw Hill Book Company, 1991.
4. Ronald F. Gibron, "**Principles of composite Material mechanics**", 3rd Edition, McGraw Hill international, 2011.
5. Madhujit Mukhopadhya, "**Mechanics of Composite Materials and Structures**", University Press 2005.

E-learning resources:

http://www.ae.iitkgp.ac.in/ebooks/ http://nptel.ac.in/course.html

CIE: CIE for 40 marks and AAT for 10 marks totalling to 50 marks.

AAT : Hands on practices for preparing FRP laminates and finding out their mechanical properties / Developing MATLAB program.

SEE paper pattern: Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.

1. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	2			-								3	3
CO2	3	3			-								3	3
CO3	3	3			3								3	3

EXTENSIVE SURVEY PROJECT

Course	Extensive Survey Project	Course Code	23CV6PWESP	SEE Duration	1 Hour
Credits	2	L:T:P	0:0:2	SEE+ CIE Marks	50+50
		CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students

To work on real time data pertaining to hydraulics, highway, water supply, sanitation, housing and town planning and present the drawings and reports related to the relevant projects.

COURSE OUTCOMES: An ability to	
CO1	Work in a team to collect data with conventional and Modern surveying Tools.
CO2	Analyse real time data to plan, draw and design civil Engineering systems.
CO3	Write and present reports.

The extensive survey project may be conducted at a suitable site for a period of about 5 to 8 days.

Field data shall be collected using both modern surveying tools such as total station, auto levels, etc., as well as conventional equipment. Students to be encouraged to download and process the data each day.

Project could be chosen from the following set.

Projects:

1. Hydraulics & Irrigation
2. Roads and Bridges
3. Water Supply and Sanitation
4. Infrastructure related projects.
5. Housing and town planning
6. Any other

CIE: Students to submit a report with drawings and designs and take up viva voce.
Evaluation by internal project committee for 50 marks.

SEE pattern:

- Students are expected to prepare a detailed report giving the introduction, project details and design, for a final viva-voce examination. External examiner to evaluate with one internal examiner.
- Each batch to submit One complete report with drawings and design of all survey projects carried out.

CO-PO MAPPING SCALE 1 TO 3

	Extensive survey project 23CV6PWESP													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3	-	3	3	-	-	3	-		3		2	
CO2	3	3	3	3	3	3	-	3	-		3		3	
CO3	-	-	-	-	-	-	-	-	3		3		-	-

Course	Major project phase-1	Course Code	23CV6PWMP1	SEE Duration	-
Credits	01	L:T:P	0:0:1	SEE+ CIE Marks	50+50
contact Hours	2 hr/week	CIE Theory marks	50 marks	CIE lab marks	-

COURSE OBJECTIVES:

To work on a project related to civil engineering domain in order to gain insight about research and development of new products or new alternative methods or any such.

COURSE OUTCOMES: At the end of the course, the students are able to	
CO1	Identify a civil engineering problem, research / industry related, and conduct literature survey.
CO2	Set objectives , Plan methodologies for experiments.
CO3	Write report and present.

The students are expected to conduct literature survey and identify the topic, set objectives , plan methodology and materials.

CIE Pattern: CIE to be conducted for 50 marks with an internal committee

SEE Pattern: SEE to be conducted for 100 marks with an external examiner and internal examiner.

VII SEM SYLLABUS

For Admission year : 2022 onwards

w.e.f Aug 2025

Course	Quantity Surveying and Estimation	Course Code	23CV7PCQSE	SEE Duration	3 hours
Credits	03	L: T: P	2: 1 :0	SEE+ CIE marks	50+50
CONTACT Hours	39	CIE Theory marks	50 marks	CIE lab marks	

COURSE OBJECTIVES:

To provide basic knowledge of estimation and analyze the methods of estimation for various civil engineering works

COURSE OUTCOMES:

CO1: Estimate the material quantities and cost of various Civil Engineering works.
CO2: Calculate the quantity of earthwork for roads by different methods.
CO3: Write specifications and perform Rate Analysis for various civil engineering works.

UNIT 1	8Hrs
INTRODUCTION: Estimation, types of estimation, approximate methods of estimation, Detailed methods of estimation, cost of materials and labor, Contract , types of contract, Tender and its Process	
UNIT 2	**8 Hrs**
ESTIMATION OF BUILDINGS: Introduction, terms used in estimation, units of measurement, abstract. Methods of taking out quantities– center line method, long wall, and short wall method. Preparation of detailed and abstract of estimates for the following Civil Engineering works – Masonry buildings with flat roofs. RCC structural elements such as slabs, columns, isolated footings, and beams.	
UNIT 3	**8 Hrs**
ESTIMATION OF OTHER CIVIL WORKS: Steel trusses, RCC slab culvert, manhole, and Septic tanks.	
UNIT 4	**7Hrs**
EARTHWORK ESTIMATION: Methods of earthwork estimation. Estimation of earthwork of roads by mid-sectional area method, mean sectional area method, trapezoidal and Prismoidal formula methods.	
UNIT 5	**8 Hrs**

SPECIFICATIONS:

Introduction, Definition of specifications, objectives of writing specifications, essentials in specifications, general and detailed specifications of common items of works in buildings only.

ANALYSIS OF RATES:

Definition. Working out quantities and rates for the following standard items of works – earthwork in different types of soils, plain cement concrete of different mixes, brick, and stone masonry, flooring, plastering, and RCC works.

TEXT BOOKS:

1. Estimating and Costing in Civil Engineering by B. N. Dutta, UBS Publishers and Distributors Pvt. Ltd, New Delhi
2. Estimating, Costing, Specification & Valuation In Civil Engineering By M Chakraborti

REFERENCE BOOKS:

1. Quantity Surveying-P.L.Basin S. Chand: New Delhi.
2. Estimating & Specification - S.C. Rangwala:: Charotar publishing house, Anand.
3. Text book of Estimating & Costing- G.S. Birde, DhanpathRai and sons : New Delhi.
4. A text book on Estimating, Costing and Accounts- D.D. Kohli and R.C. Kohli S. Chand : New Delhi.Head K.H., (1986), "Manual of Soil Laboratory Testing", Vol. I, II, III, Princeton Press, London

CIE : for 40 marks and 10 marks for AAT/ quiz/ assignment.

SEE Paper Pattern:

- Students shall answer FIVE full questions selecting one from each unit. Ten questions to be set.
- All units have internal choice.

	Course Code: 23CV7PCQSE													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	2	-	-		-	-			1	1		2	-
CO2	3	2	-	-		-	-			1	1		2	-
CO3	3	2	-	-		-	-			1	1		2	-

Course	Machine Learning for Civil Engineering Applications	Course Code	23CV7BSMLC	SEE Duration	3 hours
Credits	2	L:T:P	2:0:0	SEE+ CIE Marks	50+50
CONTACT Hours	26 Hrs	CIE Theory marks	50 marks	CIE lab marks	-

Prerequisite: Basic knowledge about linear algebra, probability, statistics

COURSE OBJECTIVES :

- To introduce students to **machine learning**, enhancing their problem-solving skills in civil engineering applications

COURSE OUTCOMES: An ability to	
CO1	Explain the basic concepts of machine learning and its application
CO2	Comprehend the concepts of supervised and unsupervised learning
CO3	Model different algorithms for civil engineering applications

Unit 1

Introduction to Machine Learning

Introduction to machine learning and its significance in civil engineering, recap of basic statistics, Types of machine learning: supervised learning, unsupervised learning, and reinforcement learning, Basics of data preprocessing: data cleaning, normalization, and feature scaling , machine learning packages **5 Hours**

Unit 2

Unsupervised Learning Understanding unsupervised learning: discovering patterns in data without labeled responses. Clustering: grouping similar data points together. Introducing k-means clustering: dividing data into 'k' clusters based on similarity. Exploring hierarchical clustering:

building a tree-like hierarchy of clusters. Dimensionality reduction: reducing the number of features while preserving essential information. Introduction to Principal Component Analysis (PCA): finding the most important features. **5 Hours**

Unit 3

Supervised Learning

Overview of supervised learning algorithms: regression and classification, Classification algorithms: logistic regression, decision trees, and random forests, Model evaluation techniques: cross-validation, confusion matrix, and performance metrics (accuracy, precision, recall).

Linear regression and polynomial regression for predictive modeling **5 Hours**

Unit 4

Feature Engineering and Model Selection

Feature engineering: feature extraction, feature selection, and feature transformation

Introduction to ensemble methods: bagging, boosting, and stacking

Hyper parameter tuning and model selection techniques: grid search, random search, and cross-validation **5 Hours**

Unit 5

Application of machine learning in civil engineering

Predictive modeling of

- Infrastructure deterioration and maintenance needs
- Predictive maintenance in transportation infrastructure
- Urban planning and land use prediction
- Traffic flow modeling and optimization
- Pollutant dispersion in air and water
- Any other relevant topic. **6 Hours**

Text Books

1) Machine Learning for Civil Engineers: A Practical Approach to Data-Driven Analysis, Explainability, and Causality June 2023, y John Wiley & Sons Inc; 1st edition WILEY -NEW DELHI ISBN-10 : 1119897602, ISBN-13 : 978-1119897606; CBS Publishers

References

1) Machine Learning For Beginners, Jonathan Walker, January 2023, publisher: JW Choices, first edition, ISBN-10 : 9814950629, ISBN-13 : 978-9814950626.

Suggested Learning Resources:

CIE: CIE for 40 marks , reduced to 20.

AAT: Hands- on any relevant Civil Engineering topic mentioned in above Unit modules.

SEE: Ten questions to be set. All units to have internal choice.

CO-PO Mapping

	Machine learning													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3										2		2	
CO2	3										2		2	
CO3					3						2		2	

Course	Professional Practice in Civil Engineering	**Course Code**	23CV7PCPPR	**SEE Duration**	1.5 hours
Credits	01	**L: T: P**	1:0:0	**SEE+ CIE marks**	25+25 =50
Contact hours	**15 Hrs**	**CIE Theory marks**	25 marks	**CIE lab marks**	**-**

COURSE OBJECTIVES:

To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession and to gain knowledge and awareness about aspects of building contracts, arbitration, and role of civil engineers in construction industry.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1:	Discuss various aspects of civil Engineering profession and the role of professional engineering bodies.
CO2:	Describe types and salient features of tenders and contracts.
CO3:	Explain arbitration and ethics in civil Engineering practice.

UNIT 1

INTRODUCTION

Profession: Idea of profession, Difference between profession, Business, and trade.

Civil Engineering Profession: Types and extent of services offered by civil engineers, scale of fees, stages of payment, and contract between client and Civil Engineer.

Practice: Types of companies and their roles in building industry: Construction firm, Renovation firm, construction management firm, Architecture firm, General contractor, specialty contractors - plumbers, electricians, Flooring contractors, HVAC, Roofing contractor, wood work, painting contractor.

Types of companies: proprietorship, partnership, associate ship and private limited firms; advantages and disadvantages of each type of firm; building clientele and projects.

Office Management: Administration of civil Engineering firm; basic accounting procedures.

3hours

UNIT 2

Professional bodies and Standards

Role of professional bodies: Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards)

3 hours

UNIT 3

Tender and Contract

Tender: Introduction to basic concepts, proposal, acceptance, promise, promisor, promisee, agreement and contract, competency of parties to contract.

Invitation to tender , its modes, types, prequalification of tenders, submission of tenders, Irregularities in submission, withdrawal , acceptance of tenders.

Contract : Introduction, provision of Act, essentials of valid contract, void and voidable contracts, collateral contracts, implied contract, contract documents. Breach of contract, breach by owner, contractor, refusal to perform, consequences of breach of contract, common breaches of contract, and its remedies. **3 hours**

UNIT 4

Arbitration

Introduction, types of dispute resolution, essentials of arbitration, selection and appointment of arbitrator, qualification of an arbitrator, powers and duties of arbitrator, arbitration in construction contracts. **3 hours**

UNIT 5

Professional Ethics

Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of

Engineers (India); Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art;

3hrs

TEXT BOOKS:

1. **Dr. Roshan.H. Namavati, (1984) "Professional practice" Lakhani Book depot**
2. **B.S. Patil, and S.P. Wool house (2019) "Building and Engineering contracts" 7th edition CRC PRESS**
3. **B.V. Subba Rao, (2000) " Building and Engineering contracts", Lexis Nexis; Fourth edition**
4. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application.
5. Ethics in Engineering (2022)- M.W.Martin & R.Schinzinger, McGraw-Hill, 5th edition
6. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai

REFERENCE BOOKS:

1. **Arbitration Act (2005)**
2. **Institution of Engineers https://www.ieindia.org/webui/iei-Home.aspx**
3. **Engineers council of India https://www.ecindia.org/ECI-MF-BOX.htm**
4. **Publications of Handbook on Professional practice by IIA.**
5. **K . Gajaria, (2000) "Law relating to building and Engineering contracts in India",**

CIE: Minimum two CIE to be conducted**.** CIE to be conducted for 25 marks (10 MCQ and 15 marks for descriptive writing). Test duration for 50 minutes. CIE marks to be graded for 50.

SEE Paper Patter: SEE to be conducted for 50 marks, 20 MCQs and 30 marks for descriptive with choice questions. Descriptive : to set 5 questions and to answer any three questions. 1.5 hour .
SEE graded for 50 marks.

	Course Code: 23CV7PCPPR													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1						3	3						2	
CO2						3	3						2	
CO3						3	3						2	

PROGRAM ELECTIVE

Course	Advanced Design of RCStructures	Course Code	23CV7PEADR	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50

COURSE OBJECTIVES: To understand the concepts of advanced reinforced concrete design.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1	Analyse and design flat stab, continuous beams and grid floor system
CO2	Analyse and design RCC bunkers and silos
CO3	Analyse and design circular overhead RC water tanks with staging
CO4	Analyse and design Raft foundation

UNIT -1

CONTINOUS BEAMS

Continuous beams, loads, concept of long span beams, redistribution of moments. **8 hours**

UNIT -2

FLAT SLABS:

Basic concepts of flat slab, parts of a flat slab, types of flat slab, analysis and design of a typical flat slab with and without drops **8 hours**

UNIT-3

GRID FLOORS:

Analysis and Design of grid floor. **8hours**

UNIT-4

OVER HEAD WATER TANK:

Forces to be considered in the analysis of RC circular overhead water tanks. Parts of a Circularoverhead water tank and their Design. **8 hours**

UNIT-5

RAFT FOUNDATIONS:

Forces to be considered. Analysis and design of a simple raft foundation **7 Hours**

Text Books

1. N. Krishnaraju, Structural Design & Drawing Reinforced Concrete & Steel,

University Press.
2. S. Krishnamoorthy, Structural Design and Drawing (Concrete s t ructures), CBS Publishers, NewDelhi. Tata McGraw Publishers.

Reference Books And Is Codes:

1. Is: 456-2000, Is: 800–2007, Sp-16, Sp-34, Sp 6 (1) – 1984 Or Steel Table.
2. B.C. Punmia, Reinforced Concrete Structures, Laxmi Publishing Co.
3. S.N. Sinha, Reinforced Concrete Design, Mcgraw-Hill Education

E-Learning Resources:

.
http://Nptel.Ac.In/Courses/105106112/

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

SEE Pattern: Total ten Questions To Be Set Covering All 5 Units. Students Shall Answer Five Full QuestionsChoosing One Full Question from Each Unit

- All units to have internal choice.
- All Questions Shall Have Maximum Three Sub Questions.

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

Course	EARTH RETAINING STRUCTURES	Course Code	23CV7PEERS	SEE Duration	3 hours
Credits	03	**L:T:P**	3:0:0	**SEE+ CIE Marks**	50+50
Contact hours	39hrs	**CIE**	50 marks	**Lab**	Nil

COURSE OBJECTIVES:

- The objective of this course is to provide students the fundamentals needed for the design and stability analysis of earth structures (Dams) and earth retaining structures (Conventional Retaining walls, MSE walls, Cantilever and Anchored sheet pile walls, Braced cuts and Coffer dams)

COURSE OUTCOMES: An ability to

CO1	Analyze earthen dams for their seepage and stability.
CO2	Identify and analyse conventional and reinforced earth retaining walls.
CO3	Analyze different earth retaining structures.

UNIT-1

EARTHEN DAMS: Introduction about earthen dams - different types of earthen dams with sketches and their suitability. Hydraulic fill and rolled fill methods of construction – causes of failure of earth dam –Protection & Construction: Slope protection, embankment construction materials and construction, quality control. Instrumentation and performance observations in earth dams- Design criteria of earth dams – Selection of suitable preliminary section of dams- Stability analysis of earthen dams – Seepage control in earthen dams - Role of Filters in Earth Dam Design, Numericals.

ROCK FILL DAMS - Origin and usage of rock fill dams, Different parts of rock fill dams. **8 hrs**

UNIT-2

RETAINING WALLS: Introduction, types, failure of retaining walls by sliding, overturning and bearing - Stability analysis and Principles of the design of retaining walls – Gravity retaining walls, cantilever retaining walls, counter fort retaining walls (no structural design) – Other modes of failure of retaining walls – Drainage from the backfill.

8 hrs

UNIT-3

REINFORCED EARTH RETAINING WALLS: Introduction, cross section of walls, components of reinforced earth walls, functions of components, Types, Backfill and Reinforcing Materials, Construction of RE walls, Design considerations, Design methods of walls, Stability of RE walls : External Stability of walls, internal stability – Problems on stability of geogrid and geotextile walls. Concept of soil nailing, Nailed excavations and Ground anchors

8 hrs

UNIT-4

Cantilever sheet pile walls: Introduction, Types of sheet pile walls, Free cantilever sheet pile, cantilever sheet pile in cohesion-less soils, cantilever sheet pile penetrating in clay.

Anchored Sheet Pile Walls: Anchored sheet pile with free earth support in cohesion-less and cohesive soil, Bulkheads with fixed earth support method, Analysis using equivalent beam method, Problems.

8 hrs

UNIT-5

BRACED CUTS: Introduction, Lateral earth pressure on sheeting's, Different types of sheeting and bracing systems, design principles of various components of bracings.

COFFER DAMS & CELLULAR COFFER DAMS: Introduction, types of coffer dams, Design method of cellular coffer dams on rock by Tennessee Valley Authority (TVA) method, safety against sliding, slipping, overturning, vertical shear and stability against bursting,

7 hrs

Text book/Codes:

1. K.R. Arora (2019) “Soil Mechanics and Foundation Engineering”, Standard Publishers & Distributors

2. S.K. Garg (2023) “Irrigation Engineering and Hydraulic Structures”, Khanna publishers.

Reference books:

1. Bowles J.E. (2001), “Foundation Analysis and Design” 5th Edition, McGraw Hill Pub. Co. New York.
2. Braja M. Das (2021), “Principles of Geotechnical Engineering”, 10th Edition, Cengage Learning.
3. J.A. Knappett and Craig R.F. (2019), “Craig’s Soil Mechanics”, 9th edition, CRC press, New York.

4. Gopal Ranjan and Rao A.S.R. (2022), "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi.
5. Terzaghi, K., Peck, R. B., & Mesri, G. (2009). Soil mechanics in engineering practice, 3RD Edition. John Wiley & Sons.
6. Murthy V.N.S (2017). "Advanced foundation engineering: geotechnical engineering series", CBS Publishers
7. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain (2020) "Soil Mechanics And Foundations" 17th edition, Laxmi Publications

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

SEE paper pattern: Ten questions to be set. Student shall answer FIVE full questions, selecting one from each unit. All units to have internal choice.

CO-PO MAPPING SCALE 1 TO 3

	ERS 23CV7PEERS												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	2	3										3	
CO3	3	3											3	

Elective

Course	Industrial wastewater Treatment	Course Code	23CV7PEIWT	SEE Duration	3 hours
Credits	03	L: T: P	3: 0 :0	SEE+ CIE marks	50+50
Lecture Hours	39 Hrs	CIE -Theory marks	50 marks		

COURSE OBJECTIVES:

To gain knowledge on the concept and application of industrial pollution prevention, cleaner technologies and process flow of different Industrial Categories.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: **Characterize** the industrial wastewater and identify the impacts on environment.

CO2: **Select** the appropriate treatment technologies for various industrial effluents.

CO3: **Identify** suitable sludge treatment technologies and process flow of different industrial categories.

UNIT 1

Introduction **6 Hrs**

Importance of treatment of industrial waste water, Difference between domestic and industrial wastewater, effects on streams and on Municipal Sewage treatment plants, and receiving water bodies .Regulatory frame work and standards governing industrial waste water discharge. effluent and stream standards and legislation to Control water pollution.

UNIT 2

Sampling and Analysis of Industrial wastewater: **7 Hrs**

Sampling: Stream sampling techniques, Stream quality, dissolved oxygen Sag curve in Streams, Streeter-Phelps formulation, Numerical problems on DO prediction

Analytical measurements: Heavy metals analysis using AAS, Dyes using spectrophotometer, anions and cations using IC and Hydrocarbons using HPLC. – working principle, advantages and limitations.

UNIT 3

Effluent Treatment Plant **10 Hrs**

Reactors: Types: Batch and Continuous flow – Plug flow and CSTR –numerical on mass balance relationship, Pretreatment: Volume reduction – process changes, equipment modifications, segregation of wastes**.**

Strength reduction: Equalization tank including design, neutralization and proportioning.

UNIT 4

ADVANCED TREATMENT METHODS: **8 Hrs**

Removal of Inorganic, Organic solids, suspended, colloidal and dissolved solids – Adsorption, Ion Exchange, UASB, Gas stripping. AOP.

Treatment and disposal of sludge – Anaerobic digestion**,** Sludge drying beds, centrifuge, thickening - filter press, multi stage evaporators, sludge conditioning.

UNIT 5

Characteristics and process flow of Industries 8 hrs

Red category: Paper and pulp, pharmaceutical Industry. Sugar and distillery industry

Yellow Category: Tanning Industry, textile industry and electroplating,

Orange category: Dairy industry and food processing.

treatment, storage, and disposal facilities (TSDF) and Common effluent treatment plant (CETP)

TEXT BOOKS:

1. M.N.RAO AND A.K. DATTA (2015) - Wastewater Treatment.
2. Nemerow N.L., (2006) – Industrial Wastewater Treatment- Contemporary New York. Practice and Vision for the Future, Elsevier Science and technology.

REFERENCE BOOKS:

1 1R.D. (1968), “Industrial Waste Disposal”, Reinhold Environmental Series,
2 Mahajan (1984) –” Pollution control in Process industries”. TMH, New Delhi.
3 G.L. KARIA AND R.A. CHRISTIAN (2008) - Wastewater Treatment-concepts and Design Approach PHI learning, New Delhi-110001.
4 Eckenfelder (2000), “Industrial Water pollution Control”- McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA.

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

SEE Paper Patter:

1. Ten questions to be set. Student shall answer FIVE full questions selecting one from each unit.
2. **All units have internal choice**

	Industrial waste water treatment													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3					2							3	
CO2	3		2			2							3	
CO3	3		2			2							3	

Elective

Course	Structural Dynamics	Course Code	23CV7PESDY	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
CONTACT Hours	39 hrs	CIE Theory marks	50 marks	CIE lab marks	Nil

COURSE OBJECTIVES: The objective of the course is to teach the concept of structural dynamics and to understand time dependent vibration response of linear systems. Also, to enable students to learn the physical behaviour of vibrating systems through experimental modules.

COURSE OUTCOMES: Students will develop an ability to

CO1	Compute natural frequency and free vibration response of SDOF systems
CO2	Set-up the equation of motion and obtain the dynamic magnification factor of SDOF systems subjected to harmonic inputs.
CO 3	Set-up equation of motion of MDOF systems for free& forced vibration response, determine natural frequencies, mode shapes and forces adopting dynamic analysis in a MDOF system.

UNIT -1

Introduction to Dynamical problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's Principle, energy principles, idealization of lumped SDOF system, springs-in-series and springs-inparallel configuration, types of damping, natural frequency and free vibration response of un-damped SDOF systems.

7 Hours

UNIT -2

Free vibration response of viscously damped SDOF system, logarithmic decrement, critical damping, over-damped and under-damped system

7 Hours

UNIT-3

Forced vibration response of damped SDOF system - response to harmonic loading, support motion, evaluation of damping, vibration isolation & transmissibility, response to aperiodic forces – triangular and rectangular impulse adopting Duhamel integral

8Hours

UNIT-4

Mathematical models of un-damped and damped MDOF systems, Free vibration of un-damped MDOF systems - Natural frequencies and mode shapes – orthogonality conditions, modal analysis –

free and forced vibration with and without damping. Determination of forces (storey shears) in a MDOF system due to external dynamic force(harmonic) by dynamic analysis method using ABS and SRSS methods. Concept of response spectrum analysis. **10 hours**
UNIT-5
Introduction to dynamics of continuous systems - free flexural vibration response uniform beams with various boundary conditions, Introduction to experimental dynamics: principle of vibration-measuring instruments–seismometer and accelerometer, free vibration tests on SDOF and MDOF systems to obtain natural frequencies and damping through logarithmic decrement along with use of impulse hammer. **6 Hours**

Text Books:

1. Mario Paz, Structural Dynamics – Theory and computation, 6th edition, 2019, Springer publication.
2. William T Thomson, Theory of Vibrations with application, 5th edition, 2008, Pearson publication.
3. Anil K. Chopra, Dynamics of Structures, 5th edition, 2020, Prentice Hall of India.
4. R.W. Clough & J. Penzien, Dynamics of Structures, 3rd edition, 2003, McGraw Hill.

Reference Books:

1. John M Biggs, Introduction to Structural Dynamics, 1964, McGraw Hill
2. Schaum's outline series – Mechanical Vibrations-S Graham Kelly-1996, McGraw Hill, India
3. M Mukhyopadhyay, Structural Dynamics, 2008, Ane Books Publication (Ane's Student Edition)
4. Leonard Meirovitch, Elements of Vibration Analysis, 2nd Edition, 2015, McGraw Hill

E-Resources:

https://archive.nptel.ac.in/courses/105/106/105106151/
https://archive.nptel.ac.in/courses/105/101/105101209/
https://nptel.ac.in/courses/101105081

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

SEE Paper Pattern:

Ten questions to be set. Student shall answer **Five full questions**, selecting one from each unit**. All units have internal choice.**

CO-PO MAPPING SCALE 1 TO 3

	SDY 23CV7PESDY													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3	-	-	-	-	-	-	2		-		1	
CO2	3	3	-	-	-	-	-	-	2		-		1	
CO3	3	3	-	-	-	-	-	-	2		-	-	1	

Elective

Course	Geometric Design of Roads	**Course Code**	23CV7PEGDR	**SEE Duration**	3 hours
Credits	03	**L: T: P**	3: 0 :0	**SEE+ CIE marks**	50 + 50
CONTACT Hours	**39 Hrs**	**CIE Theory marks**	50 marks	**CIE lab marks**	-

COURSE OBJECTIVES:

To understand the design aspects of road geometrics to plan and design road stretches.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Identify the appropriate cross section elements for different roads

CO2: Analyze and Design the horizontal and vertical alignment for a road stretch

CO3: Design rotary intersection and special elements of the roadway.

UNIT 1

INTRODUCTION **9 Hrs**

Importance of Geometric Design, Geometric Controls and Criteria as per IRC and AASHTO standards and specifications, Introduction to Indo HCM – PCU – Factors affecting PCU and Capacity for Geometric Design – Rural and Urban Roads

CROSS SECTIONAL ELEMENTS

Pavement surface characteristics - friction – skid resistance – Numericals – pavement unevenness – light reflecting characteristics; Camber – objectives – type of camber – methods of providing camber in the field – numericals; Carriageway, Kerbs, Medians, Road Margins, Roadway, Right of Way, Design of Road humps as per IRC standards.

UNIT 2

SIGHT DISTANCE **7 Hrs**

Importance – Types of Sight Distance - Stopping Sight Distance – Overtaking Sight Distance, Criteria for Sight Distance Requirements, Sight Distance at Controlled Intersections, Factors affecting Sight Distance, IRC standards and Numerical. Sight Distance at Horizontal/Vertical Curves and at Shared- Use paths.

UNIT 3

HORIZONTAL ALIGNMENT **8 Hrs**

Definition – Design Speed, Horizontal Curves, Radius of Horizontal Curve, Superelevation, Assumptions – Numerical – Methods of providing

Superelevation for different curves; Widening of pavement at Horizontal Curves – Objectives and Types Horizontal Transition Curve – Objectives, Ideal Requirement and Types of Transition Curve –-Length of Transition Curve – Numerical, Set- back distance on horizontal curve, Curve Resistance; Numerical, Lane Balancing, Access Controls.

UNIT 4

VERTICAL ALIGNMENT **7 Hrs**

Definition, Gradient – Types of Gradient; Types of Vertical curves – Design Criteria for design of Summit and Valley Curves, Design of Valley Curves based on Sight Distance – Night Visibility Considerations, Design Standards for Hilly Roads; Numerical, Vertical Clearances.

UNIT 5

DESIGN OF ROTARY AND SPECIAL ELEMENTS OF ROADWAY **8 Hrs**

Principle – At-grade and Grade separated intersection – Good and Bad Practices - Types of Interchanges – Design Principle, Warrants; Elements of a Rotary – Analysis and design – Consideration of Sight distance at a rotary/ round-about; Numerical, Truck/ Bus Lay byes, Bus Rapid Transport stations and terminals; Toll Plaza layout design.

TEXT BOOKS:

1. S. K. Khanna, C. E. G Justo and A. Veeraragavan, (2015).“Highway Engineering”, Revised 10th Edition, Nem Chand and Bros, Roorkee, ISBN: 978-81-85240-93-0.
2. R. Srinivasa Kumar, (2012). “Textbook of Highway Engineering”, Universities Press (India) Private Ltd, ISBN: 978-81-7371-681-2

REFERENCE BOOKS:

1. L. R. Kadiyali, N. B. Lal (2017). “Principle and Practice of Highway Engineering”, Khanna Publishers, Seventh Edition.
2. Indo Highway Capacity Manual (2017). CSIR – CRRI, New Delhi.
3. AASHTO Report, (2018). “A Policy on Geometric Design of Highways and Streets, 7th Edition, AASHTO, Washington D.C. ISBN: 978-1-56051-676-7
4. Relevant IRC Codes **– IRC 73, IRC 38, IRC: SP-23**

E-learning resources:

3. https://archive.nptel.ac.in/courses/105/107/105107220/
4. https://ces.iitjammu.ac.in/courses/transportation-and-highway-engineering/

CIE Pattern:

1 CIE theory shall be evaluated for 40 marks.

2 AAT shall be evaluated for 10 marks.

Identification of cross section elements for an assigned stretch & Group activity for evaluation of an existing stretch/ intersection.

SEE Paper Pattern:

1. Ten questions to be set. Student shall answer FIVE full questions selecting one

from each unit. All units to have internal choice.

(w.e.f Aug 2025)
CO-PO Mapping :

	Course Code: 23CV7PEGDR **Course: Geometric Design of Roads**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	2	3						2	2		2			
CO2	2	2	3										3	
CO3	2	2	3					2	2		2		3	

Course	Groundwater Hydrology	Course Code	23CV7PEGWH	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hrs	CIE Theory marks	50 marks	CIE lab marks	00

COURSE OBJCTIVES :
The objective of this course is to understand the ground water availability, flow and storage with relevant techniques of practical relevance.

COURSE OUTCOMES: An ability to	
CO1	Explain the fundamental concepts of the occurrence and movement of groundwater, Estimate the ground water flow rate and flow direction using modelling techniques
CO2	Estimate the yield from a well and analyse the performance of a recharge well
CO3	Analyse the flow of pollutants within the groundwater and the interface between freshwater and groundwater., Explain groundwater investigation methods.

UNIT-1

Introduction:

Groundwater utilization &historical background, groundwater in hydrologic cycle, groundwater budget, and groundwater level fluctuations **2 Hours**

Occurrence and movement of groundwater:

Origin & age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration & saturation, aquifers and their characteristics/classification, groundwater basins & springs, Darcy's Law, permeability & its determination, Dupuit assumptions, Groundwater flow rates & flow directions, general flow equations through porous media, Groundwater Interaction with Streams and Lakes **8 Hours**

UNIT-2

Well Hydraulics:
Steady, unsteady, uniform, radial flow to a well in a confined/ unconfined aquifers, Partially penetrating/horizontal wells, testing for yield.

8 Hours

UNIT-3

Concept & methods of artificial ground water recharge, Hydraulics of recharge wells, wastewater recharge for reuse.

Pollution and quality analysis of groundwater:

Sources of groundwater pollution, advection and dispersion, criteria & measures of ground water quality, ground water salinity, groundwater remediation **7 Hours**

UNIT-4

Saline water intrusion in aquifers:
Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, upcoming of saline water, saline water intrusion control. **6 Hours**

UNIT-5

Surface/ sub-surface investigation of ground water:
Geological /geophysical exploration/ remote sensing / electric resistivity /seismic refraction based methods for surface investigation of ground water, test drilling & ground water level measurement, sub-surface ground water investigation **8 Hours**

Text books:

1. Todd D.K., Ground Water Hydrology, John Wiley and Sons, Third Edition, 2011, ISBN-10: 9788126530038.
2. K. R. Karanth, "Ground Water Assessment, Development and Management", McGraw Hill Education Company, 2017, ISBN-10: 0074517120.

Reference books:

1. Raghunath H.M., Ground Water Hydrology, New Age International Publishers, Third Edition, 2007.
2. Bear J., Hydraulics of Groundwater, McGraw-Hill International, 1979.
3. Willis, R. and W.W.G. Yeh, Groundwater Systems Planning and Management, Prentice-Hall, 1987.
4. S.P. Garg, Groundwater and Tube Wells, Oxford & IBH Publishing Co., 1993.

E-learning resources:
https://archive.nptel.ac.in/courses/105/105/105105042/
https://nptel.ac.in/courses/105103026

CIE Pattern : 3 CIE (Best 2 out of 3): 40 marks ; 1 Quiz/AAT: 10 Marks
SEE paper pattern: ten questions to be set. Student shall answer FIVE full questions, selecting one from each unit.
All units have internal choice

CO-PO MAPPING SCALE 1 TO 3

COURSE : Groundwater Hydrology												CODE: 23CV7PEGWH		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	-	-

PRE-STRESSED CONCRETE STRUCTURES

Course	Pre-stressed Concrete Structures	Course Code	23CV7PEPSC	SEE Duration	3 Hours
Credits	03	L:T:P	3:0:0	SEE+ CIE Marks	50+50
Contact hours	39 Hours	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to
Understand concepts in pre-stressing concrete and design simple PSC elements.

COURSE OUTCOMES: An ability to	
CO1	Comprehend pre-stressing materials, systems and behavior of Prestressed members
CO2	Analyse and design flexural members (Rectangular and flanged sections only) and anchorage zones.

UNIT-1

Introduction, Materials of pre stressing, Pre stressing systems:
Basic concepts of pre stressing, historical development need for high strength steel and concrete, Terminologies, advantages and applications. Tensioning devices, pre and post tensioning systems, Thermo electric pre stressing, chemical pre stressing.
Analysis of pre stress; Basic assumptions, analysis of pre stress, resultant stresses at a section, Pressure line or Thrust line. Concept of load balancing.

8 Hours

UNIT-2

Losses of pre stress:
Nature of losses of pre stress, losses due to elastic deformation, loss due to shrinkage, creep, relaxation of stresses in steel, friction, anchorage slips, and total losses allowed for design.
Deflection of pre stressed concrete members:
Importance of control of deflection, factors influencing the deflections, Evaluation of short term and long term deflections, I.S code limitations

10 Hours

UNIT-3

Flexural and shear strength of pre stressed concrete sections:
Types of flexural failure, strain compatibility, codal provisions Principal stresses, design of rectangular and flanged sections

8 Hours

UNIT-4

Design of Prestressed Concrete Members:

Design of Prestressed Concrete Sections under Flexure (using Fiber Stresses).

8 Hours

UNIT-5

Anchorage zones:

Introduction, stress distribution in end block, Transmission of pre stress, Analysis of anchorage zone stresses, anchorage reinforcement. Design as per IS Code of Practice.

6 Hours

Text book/Codes:

1. N. Krishna Raju (2018), "**Prestressed Concrete"**, 6th Edition, Tata McGraw Hill Education Publishing Company limited
2. Muthu K.U., Ibrahim Azmi, Janardhana Maganti (2016), "**Prestressed Concrete"**, Prentice Hall India Learning Private Limited
3. P. Dayaratnam and P Sarah (2017), "**Prestressed Concrete"**, 7th Edition, Medtech

Reference books:

1. T.Y. Lin and Ned H. Burns (2010), "**Design of Prestressed Concrete Structures"**, 3rd Edition, Wiley India Private Limited.
2. N. Rajagopalan (2005), "**Prestressed Concrete"**, Alpha Science International Ltd.
3. G. S. Pandit and S. P. Gupta (2019), "**Prestressed Concrete"**, CBS Publishers.
4. Shamsher Bahadur Singh (2023), '**Analysis and Design of Prestressed Concrete Structures**", Wiley India Private Limited.
5. **IS:1343- 2012 "Indian standard code of practice for Prestressed Concrete Design",** Bureau of Indian Standards, New Delhi, 2012

E-learning resources:

https://nptel.ac.in/courses/105106117
https://archive.nptel.ac.in/courses/105/106/105106118/

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions selecting one from each unit. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.
   Quizzes / AAT/ / seminars /assignments

CO-PO MAPPING SCALE 1 TO 3 23C

	PSC 23CV7PEPSC													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	2	3										3	

OPEN ELECTIVES

Course	Finite Element Analysis	**Course Code**	23CV7OEFEA	**SEE Duration**	3 hours
Credits	03	**L: T: P**	3: 0 :0	**SEE+ CIE marks**	50+50
CONTACT Hours	**39 Hrs**	**CIE Theory marks**	50 marks	**CIE lab marks**	0

COURSE OBJECTIVES:

The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues associated with solids and structures.

COURSE OUTCOMES:	
At the end of this course, students will be able to	
CO1	**APPLY** basics of Theory of Elasticity to continuum problems.
CO2	**FORMULATE and DEVELOP** finite element models for 1D and 2D elements for linear static structural analysis.
CO3	**SOLVE** problems related to 1D and 2D structural elements
CO4	**UTILIZE** finite element software to simulate practical problems.

UNIT -1

Fundamental concepts: Principles of Elasticity: Concept of stress – Stress at a point – equilibrium equations. Strain displacement relationships in matrix form – Constitutive relationships for plane stress and plane strain.
05 Hrs

Introduction to Finite element method (FEM), Different approximate methods, Basic concept, Historical background, Engineering applications, Classification of elements, Banded matrix and node numbering, Steps for solving problems using FEM. Commercial packages – Preprocessor, Solver and Post processor. **03 Hrs**

UNIT – 2

One dimensional problems: Finite Element Modeling using two noded bar element– Definition of generalized coordinates and identification of degrees of freedom. Polynomial based interpolation model, Convergence criteria, Shape functions, Stiffness matrix by minimum potential energy principle, Properties of stiffness matrix, Global stiffness matrix, Consistent load vectors for traction and body force and Temperature effects. Numerical problems on simple bars subjected to forces and temperature change for displacements, reactions and stresses.

08 Hrs

UNIT - 3

Analysis of Trusses and beams: Formulation of stiffness matrix for trusses. Hermite shape functions, Formulation of stiffness matrices for beams, Consistent load vectors for uniformly distributed load and triangular load. Numerical examples on beams and Trusses.

08 Hrs

UNIT-4

Two dimensional problems: Nodal displacement parameters, PASCAL's triangle – geometric isotropy. Shape functions in Cartesian and Natural coordinates for three noded triangular (CST) and four noded quadrilateral elements. Numerical examples to find stress and strain at a given point.

07Hrs

UNIT-5

Concept of isoparametric elements: Concept of isoparametric elements, Development of strain-displacement matrix and stiffness matrix, Jacobian matrix, consistent nodal load vector. Sub-parametric and Super-parametric elements and Numerical integration using gauss quadrature approach. Higher order elements – Serendipity and Lagrangian family of Finite elements.

08Hrs

TEXT BOOKS

1. Krishnamoorthy C.S., "Finite Element Analysis", 2nd ed., Tata-McGraw-Hill Education Pvt. Ltd., 2004.
2. Desai.Y.M.,Eldho.T.I., and Shah. A.H., "Finite Element Method with Applications in Engineering", Pearson publication, 2011.

REFERENCE BOOKS

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", 2nd ed., Prentice Hall, India, 2003.

2. Zienkiewicz O.C., "The Finite Element Method – Basic & Fundamentals", 7th ed., Book-Aid International, 2013.

3. Reddy J.N., "An Introduction to the Finite Element Method", 3rd ed., McGraw-Hill, 2005.

4. Cook R.D., "Concepts and Applications of Finite Element Analysis", 4th ed., John Wiley & Sons, 2004.

5. Rajashekaran S., "Finite Element Analysis in Engineering Design", Wheeler Publishing, 2006.

6. Logan D.L., "First Course in the Finite Element Method", 4th ed., Cengage Learning, 2007.

7. Hughes T.J.R., The Finite Element Method: Linear Static and Dynamic Finite Element Analysis", 1st ed., Dover Publications, 2000

E-Books / Web References : http://nptel.ac.in/courses/112104115/

MOOCs

1. Finite Element Method (FEM) Analysis and Applications https://www.edx.org/course/finite-element-method-fem-analysis-tsinghuax-70120073x
2. A Hands-on Introduction to Engineering Simulations https://www.edx.org/course/hands-introduction-engineering-cornellx-engr2000x

CIE Pattern

1. 3 CIE (Best 2 out of 3): 40 marks
2. 1 Quiz/AAT: 10 Marks
3. **Alternate assessment tool (AAT) for CIE:** Utilization of finite element software to simulate practical problems – ABAQUS/ANSYS etc.

SEE Pattern : Ten questions to be set. Student shall answer **Five** full questions, selecting one from each unit. All units have internal choice.

CO-PO MAPPING SCALE 1 TO 3

	Course Code: 23CV7IEFEA													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	3											2	
CO2	3	2											-	
CO3	3	3											2	
CO4	3	3			3								-	

OPEN ELECTIVE

Course	Remote Sensing and GIS	Course Code	23CV7OERSG	SEE Duration	3 hours
Credits	03	L: T: P	3: 0:0	SEE+ CIE marks	50+50
Contact hours	39 Hrs	CIE Theory marks	50 marks	CIE lab marks	00

COURSE OBJECTIVES:

To impart knowledge on the concepts and application of remote sensing and GIS as a vital tool for faster decision making.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Explain the concepts of remote sensing and GIS

CO2: Discuss the application of multi-criteria decision analysis for various issues.

CO3: Recognize the various advances in GIS, Applications of Expert GIS

UNIT 1

Remote Sensing:

Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Advantages and Limitations of Remote Sensing, Resolution, image registration and Image and False color composite, elements of visual interpretation techniques. **7 Hrs**

UNIT 2

Geographic Information System:

Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones. **7 Hrs**

UNIT 3

Multi-Criteria Decision Analysis and SDSS:

Elements of multi-criteria decision analysis, classification of decision problems, evaluation criteria, hierarchical decision alternatives and constraints, alternatives and decision variables, deterministic variables, criteria weighting , estimation weights, ranking methods, decision rules, multi-attribute decision rules, sensitivity analysis, multi-criteria spatial decision support systems (SDSS). **8 Hrs**

UNIT 4

Advanced GIS : GIS Software, GIS Database

Spatial database raster analysis: raster Data Manipulation and Reclassification, : Raster Data Analysis- Arithmetic Operations and Decision Rule Based, Raster Data Formats, Spatial database vector analysis : Overlay Analysis- Union, Intersection, Proximity Analysis- Buffering, Networking Analysis: Optimal Path & Neighborhood, Map Manipulation, Vector Data Formats

Expert GIS:

Introduction to concepts of Expert GIS. **9 Hrs**

UNIT 5

Enterprise GIS:

User need assessment; old and new spatial database models, SDE layers, Geo database, Architecture design, capacity planning (Hardware), security planning, RDBMS software selection, GIS software selection, planning for migration. Enterprise GIS management, **Case Studies :**

Land Resource Management; Air Pollution Management; Coastal Zone Management; Disaster Management; Watershed Management; Conservation of Resources. **8 Hrs**

TEXT BOOKS:

1. GIS and Multi-criteria decision analysis by Jacek Malczewski, John Wiley and sons.1st Edition, 1999.
2. Concepts and Techniques of Geographic Information Systems CP Lo Albert K WYeung, 2015 Prentice Hall of India.

REFERENCE BOOKS:

1. Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc,New York, 2014.
2. Geographical Information Systems – Principles and Applications, Volume I edited by David J.Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 2014.
3. Remote Sensing and Geographical Information Systems by M Anji Reddy, MTG Learning Media, 4th Edition, 2014.

E-learning resources:

1. Geographic Information Systems - Prof. Bharath H Aithal
   https://www.youtube.com/playlist?list=PLbRMhDVUMnge82bjZncVW83GErY5D38rW

CIE: CIE conducted for 40 marks and AAT / QUIZ/ Seminar/ Assignment for 10 marks.

SEE Paper Patter:

1. Ten questions will be set. Student shall answer FIVE full questions selecting one from each unit. All units to have internal choice questions.

	Course Code: 23CV7OERSG													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3													
CO2	2	3												
CO3		3			3			3	3					

Course	Major project Phase-2	Course Code	23CV7PWMP2	SEE Duration	
Credits	7	**L:T:P**	0:0:7	**SEE+ CIE Marks**	100+100
Contact hours	-	**LAB**	**-**	**CIE marks**	**100**

COURSE OBJECTIVES:

Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis,

In contrast to the majority of courses studied elsewhere in the program, projects are undertaken in small groups.. The projects undertaken span a diverse range of topics, including theoretical, simulation and experimental studies, and vary from year to year. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

COURSE OUTCOMES:

At the end of the course, the students have an ability to

CO1	Identify a problem, conduct literature survey, set objectives and create methodology
CO2	Analyse and / or design and /or develop technology or process or product
CO3	Implement and evaluate the technology at laboratory
CO4	Presentation and report writing skill

Assessment : Project presentation and thesis submission.

CIE Pattern: CIE will be conducted for 100 marks with internal committee

SEE Pattern: SEE will be conducted for 100 marks with external and internal faculty as examiners.

Course : Indian Knowledge system :

1:0:0 = 1 credit 25MA7HSIKS

Course Learning Objectives: The students will be able to	
1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2	To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

Unit-I	**05 Hrs**
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.	
Unit – II	**05 Hrs**
Traditional Knowledge in Humanities and Sciences: Lingistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.	
Unit -III	**05 Hrs**
Traditional Knowledge in Professional domain: Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2:	Appreciate the need and importance of protecting traditional knowledge.
CO3:	Recognize the relevance of Traditional knowledge in different domains.
CO4:	Establish the significance of Indian Knowledge systems in the contemporary world.

Reference Books	
1	**Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
2	**Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
	Suggested Web Links:
1.	**https://www.youtube.com/watch?v=LZP1StpYEPM**
2.	**http://nptel.ac.in/courses/121106003/**
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

SYLLABUS

VIII SEM

(for batch 2022 admitted and onwards)

w.e.f Aug 2024 : 11 POs

PROGRAM ELECTIVES

Course	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	**Course Code**	23CV8PEERD	**SEE Duration**	3 hours
Credits	3	**L: T: P**	3: 0 :0	**SEE+ CIE marks**	50+50
Contact hours	**39 Hrs**	**CIE Theory marks**	50 marks	**CIE lab marks**	nil

COURSE OBJECTIVES:	
The knowledge of structural dynamics shall be utilized to introduce the students to (a) engineering seismology and (b) concepts for earthquake resistant design Design and detailing aspects to achieve ductility in structures shall be emphasized PRE-REQUISITE: Structural Dynamics	
COURSE OUTCOMES:	
At the end of this course, Students will be able to	
CO1:	Describe the fundamentals of engineering seismology
CO2:	Characterize the Earthquake ground motions and prepare the basis for estimation of seismic forces
CO3:	Analyse, design and detail, buildings for seismic resistance through concepts of ductility as per BIS codes
UNIT 1	
INTRODUCTION TO SEISMOLOGY Definition, List of different soil types. Definition of mass, weight. Relation between mass and weight. Units of mass and weight in SI units. Phase Diagram, basic definitions and weight volume interrelationships Numerical problems: inter-relationships, borrow area- embankment	**6 Hrs**
UNIT 2 **SEISMIC RESPONSE OF BUILDINGS AND RESPONSE SPECTRUM CONCEPT** Seismic response of buildings, structures, and sites, the study of response of buildings and structures during past earthquakes. The Response Spectrum –	**6HRS**

elastic and elastoplastic spectra, tripartite plot, use of response spectrum in earthquake resistant design.	
UNIT 3 **DYNAMICS OF MULTI-STOREYED BUILDINGS**	
Dynamics of multistoried buildings – natural frequencies and mode shapes, Analysis of multistoried buildings, obtaining seismic forces using IS-1893.	**10 Hrs**
UNIT 4	
STRUCTURAL CONFIGURATION FOR EARTHQUAKE RESISTANT DESIGN AND DUCTILITY Structural Configuration for earthquake resistant design, frames, shear walls and dual systems, Effect of infill masonry walls on frames, problems of the soft first-story, Capacity design procedures. Ductility and energy absorption in buildings, Reinforced concrete for earthquake resistance, confinement of concrete for ductility, ductility of columns and beams – codal provisions	**10 Hrs**
UNIT 5	
BEHAVIOR OF MASONRY BUILDINGS DURING EARTHQUAKES Behavior of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, concepts for earthquake-resistant masonry buildings. **TEXT BOOK AND CODES:** 1. P Agarwal and M Shrikande, "Earthquake Resistant Design of Structures", Prentice Hall (India) Ltd, New Delhi, July 2014. 2. IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993 **REFERENCE BOOKS:** 1. D J Dowrick, "Earthquake Risk Reduction"- John Wiley and Sons, 2003 2. Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw Hill Pub. 3. G GPenelis and A J Kappos, "Earthquake Resistant Concrete Structures", Chapman and Hall, 1999 4. T Paulay and M J N Priestley, "Seismic Design of Reinforced Concrete	**6 Hrs**

and MasonryBuildings", John Wiley and Sons, 1992 5. S.K.Duggal, (2007), "Earthquake Resistant Design of Structures", OxfordUniversity Press, New Delhi 2007. 6. Steven L Kramer, "Geotechnical Earthquake Engineering", Pearson Education pub. 7. Anil K Chopra, "Dynamics of Structures – Theory and Application to Earthquake Engineering"- 2nd ed., Pearson Education pub. 8. Anderson,R.A., "Fundamentals of Vibrations"- McMillan 9. Clough and Penzien, "Dynamics of Structures"- McGraw Hill 10. Mukyopadhyaya, "Vibration and Structural Dynamics", Oxford &IBH 11. James Ambrose and Dimitry Vergun, "Design for Earthquakes"-avid Key, "Earthquake Design Practice for Buildings". Scheme of Examination: Student shall answer Five full questions, selecting one from each unit. Unit 3 12. E Resources like NPTEL materials	

CIE: CIE conducted for 40 marks each and AAT / QUIZ/ Seminar/ assignment for 10 marks.

SEE Paper Patter:

1. Ten questions to be set.Student shall answer FIVE full questions selecting one from each unit. All units to have internal choice.

	Course Code: 23CV8PEERD ERD													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3													
CO2	2	3												
CO3		2	3											
CO4	3													

Elective

Course	Environmental Impact assessment	Course Code	23CV8PEEIA	SEE Duration	3 hours
Credits	03	L: T: P	3: 0 :0	SEE+ CIE marks	50+50
CONTACT Hours	39 Hrs	CIE	50 marks		

COURSE OBJECTIVES:

This course will explore the need for environmental impact assessments, the different types of assessments, the regulatory and technical requirements for preparing an assessment.

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: **Identify** different types and stages of Environmental Impact Assessment in India.

CO2: **Evaluate** impacts on environmental attributes using EIA methodologies

CO3: **Develop** EMP for various developmental projects and selection of public participation techniques

UNIT 1 **7 Hrs**

INTRODUCTION

Purpose and Need for EIA, Evolution of EIA in India and world- NEPA, Development activity and Baseline information, Types of impacts.

Relationship between EIA, EIS, and FONSI, Types of EIA- REIA and CEIA, Advantages and Limitations of EIA.

UNIT 2 **8 Hrs**

EIA PROCESS

EIA notifications in India: 1994, 2006, 2020, Steps in conducting EIA, EIA process: Screening, Scoping, Public participation, Appraisal.

MoEF Guidelines in Siting Developmental Projects, Frame work of impact assessment related to Indian conditions.

UNIT 3 **9 Hrs**

METHODOLOGIES OF EIA

Assessment and prediction of impacts on environmental attributes: air, water, noise, land, ecology, soil, cultural and socio-economic environment.

Criteria for selection of methodologies, methodologies of EIA: Adhoc, checklist, matrix, network, overlay, index methods.

UNIT 4 **6 Hrs**

PUBLIC PARTICIPATION

Importance, Regulatory Requirements, Objectives, Levels of public participation, Advantages and Disadvantages, Selection of Public Participation Techniques.

UNIT 5 **9 Hrs**

IMPACT IDENTIFICATION AND QUANTIFICATION

Environmental management plan (EMP), Preparation of EMP for developmental projects: Water resource- Dams, Canals, Highway projects, Airport, Nuclear Power plant, Hazardous Waste Disposal Sites, Mining, Thermal Power Plant.

TEXT BOOKS:

1. Environmental Impact Assessment –L.W.Canter (1996), McGraw Hill Inc.
2. Environmental impact Assessment methodologies - Anjaneylu.Y

REFERENCE BOOKS:

1. Environmental Impact analysis - Jain R.K, Urban & Stacey—Van No strand Reinhold Co
2. Guidelines for EIA of Developmental Projects. Ministry of Environment and Forests, Government of India.

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

SEE Paper Patter:

1. Ten questions to be set.Student shall answer FIVE full questions selecting one from each unit. All units to have internal choice.

	EIA 23CV8PEEIA														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2	PSO3
CO1	3					2							2		
CO2	3					2							2		
CO3	3					2							2		

CO-PO MAPPING

Elective

Course	Geosynthetics and Soil Reinforcement	**Course Code**	23CV8PEGSR	**SEE Duration**	3 hours
Credits	03	**L:T:P**	3:0:0	**SEE+ CIE Marks**	50+50
Contact hours	39 hrs	**CIE**	50 marks	**Lab**	Nil

COURSE OBJECTIVES:

- To provide an insight into fundamentals of Reinforced Earth structures, materials used, their properties, their design procedures and guidelines for construction of reinforced Earth structures.

COURSE OUTCOMES: An ability to	
CO1	Explain the basic principle and application of reinforced soil and classify various types of geosynthetics.
CO2	Outline the testing method and desirable properties of geosynthetics.
CO3	Design a reinforced earth retaining wall.
CO4	Explain requirements and guidelines for usage of geosynthetics in pavements, foundations, and as liners.

UNIT-1

INTRODUCTION:

Historical background, development of concept of reinforced soil, Principle and Mechanism of reinforced soil, advantages of reinforced earth structures over similar structures, their Potential areas of use – for filtration, drainage, reinforcement, and as separators.

MATERIALS FOR REINFORCEMENT: Introduction and overview, Historical developments, Recent developments. Classification based on materials, Geosynthetics – geotextiles, geogrids, geomembranes, geocomposites, geonets and other products, geomats, geomeshes, geowebs, their basic functions. **Natural geotextiles**: Classification, Factors governing their usage, Jute fibers, coir geotextile, Bamboo, their preservation, advantages and disadvantages. **7hours**

UNIT-2

PROPERTIES, TESTING & EVALUATION OF GEOSYNTHETICS:

Physical properties- (type of structure, specific gravity, mass per unit area, thickness and stiffness). **Mechanical properties**- (index and performance properties)-tensile properties (grab

tension test); compressibility property; seam strength; burst strength; tear strength and puncture strength; friction; pull out resistance. **Hydraulic properties**- porosity; percentage open area; apparent opening size; permittivity; transmissivity; soil retention. **Endurance properties** Installation damage; creep and stress relaxation; abrasion and clogging; **07 hours**

UNIT– 3

REINFORCED EARTH RETAINING WALL:

Introduction, Components of reinforced Earth structure: **Soil or fill-matrix**- choice of soil, backfill materials desirable properties. **Reinforcement**: Types and functions. **Facing Elements** Types, functions, Principles of design, internal stability, external stability, Numerical: Retaining wall design using metallic strips. **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.

07 Hours

UNIT-4

GEOSYNTHETICS FOR PAVEMENTS AND FOUNDATION:

Pavements : Introduction, Application of geosynthetics in roadways, benefits, Role of subgrade conditions, Giroud and Noiray approach, **Numerical** using Giroud and Noiray approach, Geotextile survivability. **Foundation**: Improvement in bearing capacity, modes of failure, shear layer effect, confinement effect, surcharge effect, location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, guidelines on use of geogrids **07 Hours**

UNIT -5

GEOSYNTHETICS FOR FILTRATION, DRAINAGE AND AS BARRIERS:

Filter & Drain – Introduction, Conventional granular filter design criteria, Geosynthetic filter design requirements, Boundary conditions, Drain and filter properties, Design criteria : soil retention, Geosynthetic permeability, anti-logging, survivability and durability. **Landfills** – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Ministry of Environment and Forest guidelines for liner and cover systems in India, Barrier walls for existing landfills and abandoned dumps ,some issues in usage of geosynthetics. **08 Hours**

Text book:

1. An Introduction to Soil Reinforcement and Geosynthetics – G L Siva Kumar Babu, Universities press (India) Pvt Ltd, 2006.

2. Reinforced soil and its Engineering Applications – Swami Saran., I.K. International Pvt. Ltd. Third edition, 2019

Reference books:

1. Designing with Geosynthetics- Robert .M. Koerner. - Prince Hall Publication, 2012.

2. Earth reinforcement and Soil structure- Jones CJEP- Butterworths, London, 1996.

3. Reinforced Earth- Ingold, T.S. - Thomas, Telford, London.1982.

4. Geosynthetics in Civil Engineering – Edited by R.W. Sarsby, CRC Press, Boca Raton. 2006

5. Geosynthetics - New Horizons, Eds. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana, Asian Books Private Ltd., New Delhi, 2012

6. "Engineering with Geosynthetics", Venkattappa Rao, G., & Suryanarayana Raju., G. V.S, Tata McGraw Hill publishing Company Limited., New Delhi.,1990

E-learning resources:
Nptel courses: https://nptel.ac.in/content/storage2/courses/105106052

CIE Pattern: 40 marks + 10 Marks (Quizes / AAT/ / seminars /assignments)

1. **SEE paper pattern:** Ten questions to be set. Student shall answer FIVE full questions selecting one from each unit. All units to have internal choice.

CO-PO MAPPING SCALE 1 TO 3

	GSR 23CV8PEGSR													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	2	3										3	
CO3	3	3											3	

Course	Integrated Watershed Management	Course Code	23CV8PEIWM	SEE Duration	3 hours
Credits	03	**L:T:P**	3:0:0	**SEE+ CIE Marks**	50+50
Contact hours	**39 Hrs**	**CIE Theory marks**	50 marks	**CIE lab marks**	00

COURSE OBJECTIVES: Objective of this course is to understand fundamental concepts of watershed behavior, planning and effective management.

COURSE OUTCOMES: An ability to	
CO1	Explain the fundamental concepts of watershed behavior and integrated watershed management and its societal aspects.
CO2	Apply different models to estimate runoff and soil erosion from a watershed and various methods to assess / model flood and drought
CO3	Identify the types and sources of water pollution and recognize use of modern techniques in watershed management

UNIT -1

Introduction: Concept of watershed, introduction to watershed management, different stakeholders and their relative importance, watershed management policies and decision making.

Sustainable Watershed Approach & Watershed Management Practices: Integrated water resources management, natural resources management, agricultural practices, integrated farming, conjunctive use of water resources, rainwater harvesting; roof catchment system, water conservation and recycling. Integrated development, Watershed Management Practices in Arid and Semiarid Regions, Case studies.

Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies. **10 Hours**

UNIT – 2

Watershed Modeling: Standard modeling approaches and classifications, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall-runoff process, Soil erosion and conservation, estimation of soil erosion

. **09 Hours**

UNIT-3

Storm Water And Flood Management: Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies on flood damage.

Drought Management: Drought assessment and classification, drought analysis techniques, drought mitigation planning. **10 Hours**

UNIT-4

Management Of Water Quality: Water quality and pollution, types and Sources of pollution, water quality modeling, environmental guidelines for water quality **05 Hours**

UNIT-5

Use Of Modern Techniques In Watershed Management: Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management

05 Hours

Text books:

1. Vir Singh, Raj, Watershed Planning and Management, Yash Publishing House, Bikaner, 3rd revised edition 2016. ISBN-10 : 9788186882405, ISBN-13 : 978-8186882405.

Reference books:

1. Allam, Gamal Ibrahim Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
2. Black Peter E., Watershed Hydrology, Prentice Hall, London, 1991.
3. Michael A.M., Irrigation Engineering, Vikas Publishing House, 1992.
4. Murthy, J.V.S., Watershed Management in India, Wiley Eastern, New Delhi, 1994.
5. Purandare, A.P., Jaiswal A.K., Waterhed Development in India, NIRD, Hyderabad, 1995.
6. Singh, V.P., & Frevert, D.K. (Eds.). (2010). Watershed Models (1st ed.). CRC Press. https://doi.org/10.1201/9781420037432
7. Tideman, E.M. (1996) Watershed Management, Guidelines for Indian Conditions. Omega Scientific Publishers, New Delhi, 372.

E-learning resources:

1. https://nptel.ac.in/courses/105/101/105101010/

CIE: Three tests to be conducted for 40 marks each and AAT / QUIZ for 10 marks.

1. **SEE paper pattern:** Ten questions to be set. Student shall answer FIVE full questions selecting one from each unit. All units to have internal choice.

CO-PO MAPPING SCALE 1 TO 3

	COURSE : Integrated Watershed Management IWM													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-		-	2	-	-	3	3		-	-	-	-

Course	Urban Transport Planning	Course Code	23CV8PEUTP	SEE Duration	3 hours
Credits	03	L:T:P	3:0:0	SEE + CIE Marks	50 + 50
Contact hours	39 hrs	CIE	50 marks	Lab	Nil

COURSE OBJECTIVES: The course enables the students to

To cover concepts of urban transportation planning, various modes, transit systems and their suitability and to provide knowledge of Land use planning and transportation interaction.

COURSE OUTCOMES: An ability to	
CO1	Enumerate the various survey procedures related to transportation planning.
CO2	Develop trip production and trip distribution models, compute trip attraction rates and calibrate using gravity model.
CO3	Build aggregate mode split models & analyze transportation network flows.

UNIT -1

INTRODUCTION:

Urbanization, urban class groups, transportation problems and identification, Characteristics of different modes of transportation, Importance, functions and characteristics of urban transportation planning, Transport and Socioeconomic Activities.

TRANSPORTATION PLANNING PROCESS:

Interdependence of Land Use and Traffic, Systems Approach, Stages in Transport Planning.

07 Hours

UNIT – 2

TRANSPORT SURVEYS:

Study Area, Zoning, Planning of different types of surveys and interpretation, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Traffic surveys for mass transit system planning.

07 Hours

UNIT-3

TRIP GENERATION:

Trip Purpose, Factors governing Trip Production and Attraction, Methods of Trip generation, Trip Production Models, Category Analysis.

08 Hours

UNIT-4

TRIP DISTRIBUTION:

Methods of trip distribution, Application of gravity model, Calibration of gravity model, Problems. Opportunity models. **10 Hour**

UNIT-5

MODAL SPLIT AND TRIP ASSIGNMENT:

Factors affecting modal split; Modal split in transport planning; Purpose of Trip Assignment, principles of traffic assignment; Assignment techniques - All or Nothing Assignment method, Multiple route assignment, Capacity restraint assignment techniques, Diversion Curve method, Linear programming technique.

07 Hours

Text book/Codes:

1. Kadiyali, L.R. "**Traffic Engineering and Transport Planning"**, Khanna Publishers
2. C. Jotin Khisty & B. Kent Lall, **"Transportation Engineering-An Introduction"**, Prentice Hall of India Private Limited, Third Edition, New Delhi, 2006.

Reference books:

1. Hutchinson, B.G, 'Introduction to Urban System Planning', McGraw Hill.
2. Khisty C.J., 'Transportation Engineering – An Introduction' Prentice Hall.
3. Papacostas,'Fundamentals of Transportation Planning', Tata McGraw Hill.

E-learning resources:

1. nptel.ac.in/courses/105107067/
2. nptel.ac.in/downloads/105106058/

CIE pattern:

1. Three tests will be carried out for 40 marks each. Best of 2 will be considered.
2. Quiz will be conducted for 10 marks.

SEE paper pattern:

1. Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

CO-PO MAPPING SCALE 1 TO 3

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

OPEN ELECTIVE					
Course	Occupational Safety and Health Administration	**Course Code**	**23CV8OEOSH**	**SEE Duration**	3
Credits	**3**	**L:T:P**	3-0-0	**SEE+ CIE Marks**	50+50
Contact hours	**39**	**CIE**	50	**Lab**	Nil

COURSE OBJECTIVES: To introduce occupational safety and health as a vital tool for enforcing safe working conditions. The main aim of the course is to impart knowledge on the concept and application of safety and health issues at work environment.

COURSE OUTCOMES: An ability to	
CO1	**Identify** the safety rules, regulations and compliance in an occupation and **choose** the relevant industry specific PPE and safety gadgets
CO2	**Investigating** accidents and **implementing** effective fire prevention measures
CO3	**Evaluate** occupational health and toxicology by **analyzing** risks, hazards, and potential exposures, **predicting** responses for effective management and mitigation.

UNIT -1

Safety control principles

History of Safety movement, Evolution of modern safety concept, General concepts of management planning for safety for optimization of productivity. Productivity, quality and safety line and staff. Functions for safety: budgeting for safety. Safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, Safety sampling, evaluation of performance of supervisors on safety. Occupational safety and Health act, Guide lines, Occupational safety and Health administration, Right to know laws, EHS (environment, Health and safety) and its compliance. PPE, Safety gadgets and equipment's, its need and types.

8**Hrs**

UNIT – 2

Accident, its analysis and prevention

Concept of an accident, Causes and Types, Accident reporting, prevention, investigation , analysis, records and documentation, Accident causation theories, accident cost, analysis of accident indices and average accident rate **7 Hrs**

UNIT-3

Fire Accident and its control : Fire triangle, fire development and its severity, Classification of fire Control: Types of fire protection, Classification of fire extinguishers, fire stoppers, hydrant pipes, hoses, monitors–fire watchers , lay out of stand pipes ,fire station ,fire alarms and sirens–maintenance of fire trucks–foam generators, fire rescue operations–fire drills –notice -first aid for burns

. **9Hrs**

UNIT-4

Hazard and risk analysis

Risk :Types, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation and ranking, Review and monitoring the assessment and documentation

Hazard- Identification and its control Hazard assessment, procedure, methodology; safety audit, checklist analysis, what if analysis, safety review, preliminary hazard analysis(PHA), human error analysis, hazard operability studies(HAZOP),safety warning systems-Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology

Ergonomics: Objectives, IEA, NAC, guidelines, Elements, MSD, Ergonomics at computer work station **9 Hrs**

UNIT-5

Occupational health and Toxicology

Toxicology, Exposure. Response on human body and environment when exposed to different environment, Health Emergency, Environmental Management plans for safety and sustainability 6 **Hrs**

Text books:

[1] D. L. Goetsch, "Occupational Safety and Health for Technologists, Engineers, and Managers", Publisher: Pearson, Year: 2016.
[2] B. J. Healey and K. T. Walker, "Introduction to Occupational Health in Public Health Practice", Publisher: Jones & Bartlett Learning, Year: 2011.

Reference books:

[1] J. S. Angle, "Occupational Safety and Health in the Emergency Services", Publisher: Jones & Bartlett Learning, Year: 2013.
[2] C. D. Reese, "Occupational Safety and Health: Fundamental Principles and Philosophies", Publisher: Wiley, Year: 2017.
[3] United States Congress House of Representatives, "Occupational Safety and Health Administration OSHA", Publisher: S.n., Year: 2020.
[4] H.W. Heinrich, "Industrial Accident Prevention", Publisher: McGraw Hill.2019

E-learning resources:

https://nptel.ac.in/courses/110/105/110105094/
https://nptel.ac.in/courses/103/107/103107156/

CIE: Conducted for 40 marks. AAT/Quiz/ Seminar for 10 marks

1. **SEE pattern: :** Totally 10 question are to be framed (20 marks each) and students has to answer 5 full questions. The choice of questions is to be given in all units.
2. The maximum number of sub division in a question is restricted to 4.

AAT

Group activity related to study of standards, rules and regulations, enforcements, accidents etc, pertaining to various occupation, identified by various department students (in their domain) from the OSHA website www.osha.gov

CO-PO MAPPING SCALE 1 TO 3

	OSHA					23CV8OEOSH							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	3	3									2			2
CO2	3	2				3	3	2	2		2			2
CO3	3	3				3	3	2	2		2			2

OPEN ELECTIVE

Course	Sustainability and Life cycle Assessment	Course Code	23CV8OESLA	SEE Duration	3 hours
Credits	03	**L:T:P**	3:0:0	**SEE+ CIE Marks**	50+50
Lecture hours	39	**LAB**	-	**CIE Lab marks**	-

COURSE OBJECTIVES:

This course will provide students the conceptual, methodological, and scientific bases to quantify and improve the impact of engineering decisions on the environment, with a focus on applying life cycle analysis (LCA). The course will foster students to assess the environmental sustainability early on in their research to help design and develop more sustainable materials, products, and processes including manufacturing, logistics, and supply chain. Knowing that human society and environment need to co-exist in a 'sustainable' manner, it has become imperative for engineers to understand the solution space beyond the conventional technical solutions.

COURSE OUTCOMES:

At the end of the course, the students are able to

CO1	Conceptualize sustainable parameters and Engineering practices.
CO2	Identify and Quantify the sustainable indicators and Environmental impacts of product life cycle or process.
CO3	Conduct LCA with system boundaries and Interpret LCA results for decision making.

UNIT -1

Introduction to sustainability and LCA

Concept of Sustainability, Sustainable engineering and practices, Pillars of sustainability, Challenges to Sustainability, UNESCO sustainable development goals. LCA History and ISO Framework. **5 Hrs**

UNIT-2

Sustainable Development Indicators

Sustainable D evelopment Indicators (SDI), Necessity of SDI, Themes of SDI, Criteria for a viable SDI, Grouping of SDI, GHG emissions and eco-indicators / Environmental indicators, Types, impact categories. **8 Hrs**

UNIT – 3

Embodied Energy and Embodied carbon of materials

Different types of Engineering Materials - understanding the properties beyond engineering parameters, Common materials consumption and lifecycle patterns, Classification of **9 Hrs**

different forms of energy, Ecological footprint, Eco-efficiency and Eco-label, Estimation of embodied energy and carbon footprint of materials - Numericals and case studies.

UNIT-4

Life-cycle analysis of products and Systems

Components of lifecycle analysis as per ISO 14040 standards, Different methods of LCA-Process based analysis, Input-Output analysis, Hybrid analysis, Life Cycle Inventory Analysis (LCIA), Different boundary conditions, Product Life cycle, End-of-life analysis, Benefits and drawbacks of LCA, Introduction LCA Software and databases (Eco-invent, Gabi etc.) -Numericals and case studies **9 Hrs**

UNIT-5

Strategies for sustainable Engineering

Environmental Impact assessment (EIA), Classification, Impact assessment methods, Numericals on EIA. Selection of suitable alternatives Interpretation of the LCA Results, Choice of renewable forms, Necessity of Waste management for sustainable development, Sensitivity analysis, Life Cycle Cost Analysis (LCCA). -Numericals and case studies. **8 Hrs**

Text books:

1. Materials and the Environment, Michael Ashby, Elsevier, Butterworth-Heinemann (BH) Publishers- 2012, 2nd Edition, ISBN: 0123859719.

Reference book and codes:

1. International Organization for Standardization (ISO), 14040:2006, Environmental management - Life cycle assessment - Principles and framework, 2006.
2. National Building Code (NBC) of India - 2016, part 2, BIS, New Delhi
3. Engineering for sustainable Development : Guiding Principles, Richard Doddys & Roger Venables, The Royal Academy of Engineering, 2005
4. Sustainable Construction - Green Building Design and Delivery, Charles J Kibert, 5th edition, Wiley Publishers, 2022, ISBN: 1119706459.
5. Alternative building Materials and Technologies - K S Jagadish, B V Venkatarama Reddy and K S NanjundaRao, New Age International Ltd. Publishers, New Delhi, 2023. ISBN: 9389802725.

CIE: Conducted for 40 marks. AAT/ quiz/ Seminar for 10 marks.

SEE paper pattern:

Ten questions to be set. Student shall answer five full questions. All units to have internal choice.

All questions should carry equal marks (20 marks for one full question). Each question should not have more than three sub divisions.

CO-PO MAPPING

	SLA					23CV8OESLA							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	2		2			3					2			2
CO2	2		2			3					2			3
CO3	2		2			3					2			3

Course	Seminar on Technical Internship	Course Code	23CV8SRINT	SEE Duration	1 hour
Credits	06	L:T:P	0:0:6	SEE+ CIE Marks	50 +50
	-	LAB	-	CIE Lab marks	-

COURSE OBJECTIVES:

The purpose of Industrial Training is to expose students to real work of environment experience and at the same time, to gain the knowledge through hands on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. This practical training program allows students to relate theoretical knowledge with its application in the construction industry.

COURSE OUTCOMES:

At the end of the course, the students are able to demonstrate

CO1	Knowledge of organization and management technique adopted at training site.
CO2	Explain about tools / techniques used for execution of a project
CO3	Presentation and report writing skills

Internship can be Industry based / Rural based / Research based from an eminent industry / institute. Students are encouraged to learn beyond curriculum and get exposure to industry techniques and procedures or current research methods**.** Duration of internship is about 12 to 16 weeks.

Assessment: Report submission and presentation**.**

CIE Pattern:

Students to take up CIE and present individually before an internal committee. CIE conducted for 50 marks.

SEE Pattern: SEE conducted for 100 marks with an internal examiner and an external examiner.

Mandatory

AICTE Activity points

1) Regular students to earn 100 points over a period of four years.

2) Lateral entry students to earn 75 points over a period of three years.

To Refer VTU circulars on AICTE activity points.

A Report in a specified format with proof of activity must be submitted by each student before the end of Eighth semester.

Note : Online MOOC courses can be taken up as non-credit course and certificate submitted.

APPENDIX

III SEMESTER CO-PO MAPPING

wef AUG 2024: As per NBA : 11POs

For Batch : 2023 admitted & onwards

	23CV3PCBMC										*wef Aug 2024*			
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	-											-	2
CO2	2	-											-	-
CO3	3	-											-	-
CO4	-	-	-	3	-	-	-	3	3		-	-	2	-

	ENGG GEOLOGY				23CV3ESENG								wef Aug 2024	
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	2	-											2	
CO2	2	-											2	
CO3	2	-											2	
CO4	-	2	-	3	-	-	-	3	3		-	-	2	

	Geodesy 23CV3PCGDY										*wef Aug 2024*			
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												2	
CO2	3													
CO3	3												2	
CO4	-	-	-		2	-	-	3	3		-			

	FME		23CV3PCFME fluid mechanics								Wef aug 2024			
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	-											-	-
CO2	3	-											--	-
CO3	2	3											3	-
CO4	-	-	-	3	-	-	-	-	-	-	2		-	-

	23CV3PCSOM						Strength of materials							
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3											3	

	Biology for engineers 23CV3BSBFE													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	2					2								
CO2	2					3								
CO3	2					3								

	MS EXCEL 23CV3AEIME *wef Aug 2024*													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11		**PSO1**	**PSO2**
CO1	2				3									
CO2	2				3				2					
CO3	2				3			2	2				2	

APPENDIX

IV SEMESTER

wef August 2024 : As per NBA

Batch 2023 admitted & onwards

	BPD 23CV4ESBDC *wef aug 2024*													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	-	2											2	
CO2	-		3										2	
CO3	-		3		3								2	

	CONCRETE TECHNOLOGY 23CV4PCCON wef Aug 2024													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3		-	-					-	-			-	2
CO2	2	-	3	-					-	-			3	-
CO3	-		-	2	-	-	-	3	3		-		2	-

	Environmental Engg-I 23CV4PCENV *wef Aug 2024*													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3												2	
CO2	3	2	2										2	
CO3	2												2	

	GTE-1 23CV4PCGTE wef aug 2024													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	-											2	
CO2	3	2											2	
CO3	3	-						3	3		-	-	2	

	HYDRAULIC ENGINEERING 23CV4PCHYE wef 2024 Aug													
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											2	
CO2	3												2	
CO3	3												2	
CO4				3					3		2		2	

	23CV4PCSTA									wef AUG 2024				
	PO1	**PO2**	**PO3**	**P04**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3											3	

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

	COURSE: Building Information Modeling					**CODE: 23CV4AEBIM**								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**		**PSO1**	**PSO2**
CO1	3		2											
CO2	3	3			3									
CO3	2			3		2					**3**		3	
CO4														

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