



K. K. Wagh Institute of Engineering Education and Research, Nashik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)



K. K. Wagh Institute of Engineering Education and Research, Nashik

Department of Civil Engineering

Final Year B. Tech

Civil Engineering

Syllabus

Pattern: 2022



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Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Final year B. Tech wef AY 2025-26

SEM-VII

Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	INSEM	ENDSEM	CCE	TUT	TW	PR	OR	TOTAL	TH	TU	PR	TOTAL
CIV224001	DCC	Highway and Bridge Engineering	3	-	-	20	60	20	-	-	-		100	3	-	-	3
CIV224002	DCC	Water Supply Engineering	3	-	-	20	60	20	-	-	-		100	3	-	-	3
CIV224003	DCC	Highway and Bridge Engineering Lab	-	-	2	-	-	-	-	25	-	25	50	-	-	1	1
CIV224004	DCC	Water Supply Engineering Lab	-	-	2	-	-	-	-	25	-	25	50	-	-	1	1
CIV224005	DEC	Elective IV	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
CIV224006	DEC	Elective V	2	-	-	20	30	-	-	-	-	-	50	2	-	-	2
CIV224007	ASM	Research Methodology	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
CIV224008	LHSM	Project Finance & Accounting System	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
CIV224009	PSI	Project Phase II	-	-	8	-	-	-	-	100	-	50	150	-	-	4	4
Total			16	00	12	100	270	130	-	150	-	100	750	16	-	6	22

Course Code (TH)	Elective IV (SEM VII)
CIV224005A	Renewable Energy Sources
CIV224005B	Metro Construction Technology
CIV224005C	Hydropower Engineering
CIV224005D	Design of Prestress Concrete Structures

Course Code (TH)	Elective V (SEM VII)
CIV224006A	Structural Design of Bridges
CIV224006B	Plumbing Engineering
CIV224006C	Structural Audit and Retrofitting of Structures
CIV224006D	Solid Waste Management



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SEM-VIII

Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	INSEM	ENDSEM	CCE	TUT	TW	PR	OR	TOTAL	TH	TU	PR	TOTAL
CIV224011	DCC*	Waste Water Engineering	3	-	-	-	60	40**	-	-	-	-	100	3	-	-	3
CIV224012	DEC *	Elective VI	3	-	-	-	60	40**	-	-	-	-	100	3	-	-	3
CIV224013	LHSM	Contract Tenders & Valuation	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
CIV224014	PSI	Internship	-	-	24	-	-	-	-	200	-	100	300	-	-	12	12
Total			08	00	24	-	120	130	-	200	-	100	550	08	-	12	20

* Considering Internship of 6 months, these courses to be offered in online mode.

** Four Written Assignments/LMS Tests of 10 marks each will be conducted at the end of each month and one at the end of semester, when students will report for review/presentation of Internship work.

Course Code (TH)	Elective VI (SEM VIII)
CIV224012A	Geo Synthetic Engineering
CIV224012B	Airport and Bridge Engineering
CIV224012C	Earthquake Engineering
CIV224012D	Engineering Materials for Sustainability
CIV224012E	Geoinformatics



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SEMESTER VII



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Course Code	CIV224001						
Course Name	Highway and Bridge Engineering						
Type of Course	DCC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	3	--	2	4			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	25	--	25	20	60	150

Prerequisites for the Course: The basic knowledge of Engineering Mathematic, Physics.

The course aims to:

Course Objectives	Description
1	To describe traffic studies, their analysis and their interpretation.
2	To learn Geometric Design of Cross Sectional Elements of pavement.
3	To enumerate different types of pavements and design of flexible and rigid pavement.
4	To understand the fundamentals of Bridge Engineering.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Explain the historical development and classification of roads, including various road patterns and current road development initiatives in India.
CO2	Describe the importance and design considerations for approach roads to bridges.
CO3	Make use of the various control parameters for the geometric design of highway alignment.
CO4	Collect and Analyze the field data required for traffic planning, control and regulations.
CO5	Assess pavement performance, design procedures and construction materials for pavement evaluation.

Course context, Relevance, Practical Significance: This course includes various road development plans, alignment survey and different traffic studies required for planning of highways. It covers geometric design of various components of highway alignment, various properties of materials used in highway construction and design and construction of flexible and rigid pavements.

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Highway development and planning: History, development plans, classification of roads, road patterns, road development in India: vision 2021, rural road development vision 2025, current road projects in India, highway alignment, highway project report preparation, (planning surveys & master plans based on saturation system).problems based on saturation system, Green highways, ITS (Intelligent Transportation Systems), Smart mobility and electric vehicle infrastructure.	8
2	Traffic Engineering and control: Traffic characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals,	7



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	islands, road markings), accident studies, types of road intersections, parking studies; highway lighting, problems, traffic simulation and signal optimization tools.	
3	Geometric design of highways: Introduction, highway cross section elements, sight distance, design of horizontal alignment, problems of horizontal alignment, design of vertical alignment, design of intersections.	7
4	Pavement Design: Introduction to various types of pavement, flexible pavements: computation of design traffic (vehicle damage factor, lane distribution factor, and traffic growth rate), flexible pavements, computation of design traffic, problems, stresses in flexible pavements, design guidelines for flexible pavements as per IRC 37-2018 without numerical. Rigid pavements: components and functions, factors affecting design, ESWL, Stresses in rigid pavements, wheel load stresses and temperature stresses, design guidelines for concrete pavements as per IRC 58-2015 without numerical, pavement evaluation and overlay design, Joints in CC pavements, problems, highway drainage: subsurface and surface drainage.	7
5	Bridge Engineering: Classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2.Understand	CO1	1,6,7,8,11,12	1
2	4.Analyze	CO 4	1,4,5,6,7,8,10,12	2
3	3.Apply	CO 3	1,2,3,4,5,6,7,12	1
4	5.Evaluate	CO 5	1,2,3,4,5, 12	1,2
5	2.Understand	CO 2	PO1,PO12	1

References Books:

- 1 Bridge Engineering, S. P. Bindra, Dhanpat Rai and Sons.
- 2 Principles of Transportation Engineering, G. V. Rao, Tata MacGraw Hill Publication.
- 3 Highway Engineering, Rangawala, Charotar publishing House.

Text Books:

- 1 Highway Engineering, S. K. Khanna, C. E. G. Justo and A. Veeraragavan, Nem Chand and Brothers
- 2 Principles and Practices of Highway Engineering, Dr. L .R. Kadiyali, Khanna Publishers Delhi
- 3 Highway and Bridge Engineering, B. L. Gupta and Amit Gupta, Standard publishers Distributors
- 4 Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, Prentice Hall of India Pvt. Ltd.

e Resources

1. <https://nptel.ac.in/courses/105/105/105105107>
2. <https://archive.nptel.ac.in/courses/105/101/105101087/>
3. <https://nptel.ac.in/courses/105/106/105106050/>

Useful websites / Video



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1. https://youtu.be/5zKC_aq4ypM
2. <https://youtu.be/ulJMehowVzA>
3. <https://youtu.be/dQqqfOM4J1c>
4. <https://youtu.be/-QVfnHyAfv0>
5. <https://youtu.be/d--SuJ9pglk>

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	-	-	-	1	3	1	-	-	2	3	3	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	3	-	2
CO 3	3	3	3	3	2	3	3	-	-	-	-	3	3	-
CO 4	3	-	-	3	2	3	1	2	-	1	-	3	-	2
CO 5	3	3	3	2	2	-	-	-	-	-	-	3	3	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224002						
Course Name	Water Supply Engineering						
Type of Course	DCC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	3	--	2	4			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	25	--	25	20	60	150

Prerequisites for the Course: Basic Concepts of Engineering Sciences and Mathematics, Advance Treatment, Distribution System etc.

The course aims to:

Course Objectives	Description
1	To introduce the fundamental concepts of water supply engineering, water quantity and quality requirements.
2	To impart knowledge of conventional water treatment processes and their design.
3	To introduce advanced water treatment technologies
4	To aware students with water distribution systems and Government initiatives.
5	To introduce the basics of wastewater engineering, their characteristics and quality standards.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	To impart knowledge about various aspects of the water supply scheme, including the estimation of water quantity and assessment of water quality.
CO2	To understand the principles and design of various treatment units of a water treatment plant.
CO3	To describe the advanced treatment operations, Government Initiatives, distribution system & design of elevated service reservoir.
CO4	Explain the fundamentals of wastewater, collection and conveyance of sewage system of wastewater.
CO5	To apply standard field testing methods to evaluate the physical, chemical, and biological characteristics of water and wastewater samples.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Basics of Water Supply Engineering: Introduction to water supply scheme: importance of water infra-structure, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes like domestic, industrial, institutional, commercial, fire demand and water system losses, factors affecting rate of demand, population forecasting, including numerical. Quality: physical, chemical, radioactivity and	8



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	bacteriological characteristics, heavy metals. Standards as per IS 10500-2012	
2	Principles of Water Treatment: Water treatment: principles of water treatment operations and processes, water treatment flow sheets with respect to various sources, criteria for site selection for WTP. Aeration: principle and concept, necessity, methods, design of aeration fountain. Sedimentation: plain and chemical assisted, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank.	7
3	Design of Water Treatment Plant: Coagulation and flocculation theory, Zeta Potential and its significance, concept of mean velocity gradient. Design of flocculation chamber and Clariflocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types: rapid, gravity, pressure filter, multimedia and dual media filters, components, under-drainage system, working and cleaning of filters, operational troubles, design of rapid sand gravity filters.	7
4	Advanced Water Treatment Methods, Distribution System & Government Initiatives: Water softening methods and demineralization: lime-soda, ion-exchange, R. O. and electro dialysis, fluoridation and Defluoridation, introduction to desalination. Disinfection: mechanism, factors affecting disinfection, types of disinfectants. ESR: design of ESR capacity. Use of GIS and drone technology in water management: source, treatment and distribution, Government of India initiatives such as SMART city mission and AMRUT mission for improvement of infrastructure sector, service level benchmarks in urban infrastructure and introduction to Jal Jeevan Mission and its implication in rural India.	7
5	Basics of Waste Water Engineering: Sewage quantity, Collection and conveyance of sewage, sources of sewage, variations in sewage flow, Flow quantity estimation (sewage and storm water quantification), design of storm water system, Design of circular sanitary sewers. Pumping of sewage, necessity, location. Effect of change of life style on sewage quality Characteristics of sewage: Methods of sampling, Physical, chemical and biological characteristics, Quality requirements for disposal and recycle/reuse of sewage as per CPCB norms.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	1-Remember	CO1, CO5	1,3,5,6,7,8,9,10,12	-
2	2-Understand 3- Apply	CO1, CO2	1,2,3,4,5,6,7,8,9,10,11,12	1
3	2-Understand 3- Apply	CO1, CO2	1,2,3,4,5,6,7,8,9,10,11,12	1
4	2-Understand 3-Apply	CO1, CO3	1,3,5,6,7,8,9,10,12	-



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5	3-Apply 4-Evaluate	CO4, CO5	1,2,3,4,5,6,7,8,9,10,11,12	-
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References Books:

- 1 Manual on Water Supply and Treatment, Central Public Health and Environmental Engineering Organization, Government of India Publication, New Delhi, 1993.
- 2 Water Treatment Processes, S. Vigneswaran and C. Visvanathan, CRC Press, Boca Florida, USA, 1995.
- 3 Environmental Engineering, A. P. Sincere and G. A. Sincere, Prentice-Hall of India Limited, New Delhi, 2004.
- 4 Water Supply and Waste Water Disposal, Fair G. M. and Geyer J. C., John Wiley and Inc., New York, 1968.
- 5 Environmental Engineering Laboratory Manual, B. Kotain and Dr. N. Kumarswamy, Nagpur.
- 6 Indian Standard code for drinking water is IS 10500: 2012.

Text Books:

- 1 Water supply and Sanitary Engineering, S. K. Hussain, 3rd edition, CBS Publishers Delhi, 2017.
- 2 Water Supply & Sanitary Engineering, G. S. Birdie, Dhanpat Rai & Sons, New Delhi,
- 3 Water and Waste water Technology, Hammer M.J., Prentice-Hall of India Pvt Ltd, 8th edition, 2012.
- 4 Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi.

e Resources

https://www.youtube.com/watch?v=4SRMmqH2s4&list=PLLy_2iUCG87AZvtaiuD3r4HATrBKhb90P

Useful websites / Video

1. https://www.youtube.com/watch?v=w85oBHE_UJc
2. <https://www.youtube.com/watch?v=s8IVjQg7yno>
3. <https://www.youtube.com/watch?v=f3krbjq0mb8>
4. <https://www.youtube.com/watch?v=1okqDYaK93Q&list=PLIXuZXFOazmvRYw6FDlHcdWmhfb6JfzZl>
5. <https://www.youtube.com/watch?v=GESY5jrk4KE&list=PLIXuZXFOazmvRYw6FDlHcdWmhfb6JfzZl&index=3>

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
 • Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	-	1	-	1	3	3	1	1	2	-	2	-	-
CO 2	2	2	3	2	2	3	3	1	1	2	1	2	3	-
CO 3	2	2	3	2	2	3	3	2	1	2	2	2	3	-
CO 4	2	-	1	-	1	3	3	1	1	2	-	2	-	-
CO 5	3	3	2	2	3	3	3	3	1	2	1	3	-	-



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Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224003						
Course Name	Highway and Bridge Engineering Lab						
Type of Course	DCC						
Teaching Scheme and Credits	TH(Hrs.)		TU(Hrs.)		PR(Hrs.)		Total Credits
Weekly Working Hrs	--		--		2		1
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	25	--	25	--	--	50

Prerequisites for the Course: The basic knowledge of Engineering Mathematic, Physics.

The course aims to:

Course Objectives	Description
1	Develop understanding of the physical and mechanical properties of highway construction materials.
2	Enhance the ability to interpret test results and assess the suitability of materials for highway Construction.
3	Prepare technical reports and provide practical solutions related to pavement material.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Explain the historical development and classification of roads, including various road patterns and current road development initiatives in India.
CO2	Describe the importance and design considerations for approach roads to bridges.
CO3	Make use of the various control parameters for the geometric design of highway alignment.
CO4	Collect and Analyze the field data required for traffic planning, control and regulations.
CO5	Assess pavement performance, design procedures and construction materials for pavement evaluation.

Course context, Relevance, Practical Significance: This course includes various road development plans, alignment survey and different traffic studies required for planning of highways. It covers geometric design of various components of highway alignment, various properties of materials used in highway construction and design and construction of flexible and rigid pavements.

List of Laboratory Experiments

S	Laboratory Experiments (Any 11)	CO Mapped
A. Aggregate		
1	Aggregate Impact Value Test	CO5
2	Aggregate Crushing Strength Test	CO5
3	Los Angeles Abrasion Test	CO5
4	Shape Test (Flakiness Index and Elongation Index)	CO5
5	Specific Gravity and Water Absorption Test by basket method	CO5
6	Stripping Value Test	CO5
B. Bitumen		



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7	Penetration Test	CO5
8	Ductility Test	CO5
9	Softening Point Test	CO5
10	Flash Point & Fire Point Test	CO5
11	Bitumen Extraction Test	CO5
12	Specific Gravity Test of bitumen	CO5
13	Marshall Stability Test	CO5
Technical visits		
1	Road Construction Site	CO3,CO4,CO5
2	Hot mix Plant with detailed report	CO3,CO4,CO5
Compulsory Assignments		
1	Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat.	
2	Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC)	
3	Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflect meter FWD)	

**Guidelines for Laboratory
Conduction**

1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical.
2. Apparatus required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant.
4. After performing the practical students will check their results from the teacher.
5. After checking they have to write the conclusion of the practical.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.

**Guidelines for Termwork
Assessment**

1. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224004						
Course Name	Water Supply Engineering Lab						
Type of Course	DCC						
Teaching Scheme and Credits	TH(Hrs.)		TU(Hrs.)		PR(Hrs.)		Total Credits
Weekly Working Hrs	--		--		2		1
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	25	--	25	--	--	50

Prerequisites for the Course: Characteristics, Principles, Procedure, Testing etc.

The course aims to:

Course Objectives	Description
1	To introduce the fundamental concepts of water supply engineering, water quantity and quality requirements.
2	To impart knowledge of conventional water treatment processes and their design.
3	To introduce advanced water treatment technologies
4	To aware students with water distribution systems and Government initiatives.
5	To introduce the basics of wastewater engineering, their characteristics and quality standards.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand the collection procedure of water sample for analysis.
CO2	Describe various sample preservation techniques.
CO3	Understand principles of different unit in water and waste water treatment plant
CO4	Apply procedures to calibrate and standardize laboratory equipment
CO5	Perform field-oriented testing of water and wastewater

List of Laboratory Experiments/Assignments

(Any five practicals from Sr. No. 1 to 7 and any four from Sr. No. 8 to 12 practicals from Sr. No. 13,14 & 15 are compulsory)

Sr. No.	Laboratory Experiments/Assignments	CO Mapped
1.	Sampling and preservation methods for water and wastewater (Demonstration only)	CO2
2.	Determination of pH & Alkalinity of raw water and other samples such as prepared sample, soft drinks and tea etc.	CO1, CO4, CO5
3.	Total hardness and its components in raw water.	CO1, CO4, CO5
4.	Determination of chlorides in water.	CO1, CO5
5.	Determination of chlorine demand and residual chlorine.	CO1, CO5
6.	Determination of turbidity and optimum dose of alum.	CO1, CO4,



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		CO5
7.	Determination of Most Probable Number (MPN) of Coliform Bacteria in a Water Sample	CO1, CO4, CO5
8.	Determination of dissolved oxygen in a given water and wastewater sample	CO4,CO5
9.	Determination of Bio-Chemical Oxygen Demand in a given wastewater sample	CO1, CO4,CO5
10.	Determination of Chemical Oxygen Demand in a given wastewater sample	CO1, CO4, CO5
11.	Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample	CO1, CO4, CO5
12.	Determination of Sludge Volume Index in a given wastewater sample.	CO1, CO4, CO5
13.	Site visit to a water treatment plant	CO3
14.	Site visit to domestic / Industrial wastewater treatment plant & its detailed report.	CO3
15.	Design of WTP by using any suitable software	CO3

Guidelines for Laboratory Conduction

1. Teacher will brief the given practical to students along with its procedure, tools, and outcome.
2. Students will perform the allotted practical individually under the supervision of faculty.
3. After performing the practical students will check their manual from the teacher on given time.

Guidelines for Student's Lab Sheets

Manuals must be neat and clean.

Every information in manual should be filled properly.

Guidelines for Termwork Assessment

1. Each experiment from given syllabus is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for Timely Completion, R-2 for Understanding and R-3 for Presentation/sheets drawing where each rubric carries Ten marks.

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224005 A						
Course Name	Elective IV – Renewable Energy Sources						
Type of Course	DEC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)				Total Credits
Weekly Working Hrs	3	--	--				3
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	--	--	--	20	60	100

Prerequisites for the Course: Basic electrical engineering and thermodynamics.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Describe the global and national energy scenarios, evaluate the environmental and socio-economic impacts of conventional energy sources, and explain the imperative for renewable energy transition.
CO2	Describe the principles and applications of solar radiation , solar thermal and solar Photovoltaic systems
CO3	Illustrate the operating principles of wind energy conversion systems.
CO4	Describe the concepts of fuel cell and hydro-energy technologies
CO5	Outline the features of biomass and small hydro energy resources

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Energy and Sustainable Development: Global and National Energy Scenario: Current energy demand, supply, reserves (fossil fuels vs. renewable). Energy Crisis and Environmental Impacts: Climate change, pollution, greenhouse gas emissions. Principles of Renewable Energy: Definition, advantages, limitations, importance of sustainability. Energy Conservation and Management: Principles, techniques, energy auditing. Energy Policy and Economics: Renewable energy policies, incentives, carbon credits, project financing, life cycle assessment.	8
2	Solar Energy: Solar Radiation: Physics of the sun, solar constant, extraterrestrial and terrestrial radiation, solar geometry, measurement techniques (pyranometer, pyrliometer), solar maps. Solar Thermal Systems : Flat Plate Collectors:- Working Principle , advantages and disadvantages , Concentrating Collectors: Working Principle , advantages and disadvantages, Thermal Energy Storage:- Sensible, latent heat, thermo chemical storage. Solar Photovoltaic (PV) Systems: Photovoltaic Effect: Principle, p-n junction, solar cell characteristics. Types of Solar Cells: Crystalline silicon , thin-film, advanced cells. Applications: Solar street lighting, domestic lighting, water pumping, solar power plants.	7
3	Wind energy: Introduction- Basic principles of Wind Energy Conversion	7



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	Systems (WECS) wind speed measurement-Classification of Wind Energy Conversion Systems (WECS)- types of rotors. wind power equation -Betz limit. Electrical Power Output and Capacity Factor of Wind Energy Conversion Systems Wind Energy Conversion Systems (WECS)- Advantages and Disadvantages of WECS -site selection criteria.	
4	Biomass energy: Introduction- Biomass fuels-Biomass conversion technologies - Urban waste to Energy Conversion- Biomass Gasification- Biomass to Ethanol Production- Biogas production from waste biomass-factors affecting biogas generation-types of biogas plants – Khadi and Village Industries Commission (KVIC) and Janata model-Biomass program in India.	7
5	Emerging technologies: Fuel Cell-principle-classification- conversion efficiency and losses - applications .Hydrogen energy -hydrogen production -electrolysis - thermo chemical methods -hydrogen storage and utilization.	7

References Books:

- 1 G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002.
- 2 Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning 2011.
- 3 Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012.
- 4 Abbasi S. A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impacts, Prentice Hall of India, 2001.

Text Books:

- 1 G. D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, 2010.
- 2 Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 1999

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Five Assignments on Unit No. 1 to 5	10
2	Report writing (Field visit and Expert Talk)	05
3	LearniCo on Unit No. 1 to 5	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224005 B						
Course Name	Elective IV – Metro Construction Technology						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
	3	--		--		3	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	--	--	--	20	60	100

Prerequisites for the Course: Surveying, Transportation Engineering.

The course aims to:

Course Objectives	Description
1	To impart knowledge of metro construction.
2	To build facts related to metro development in India.
3	To understand the alignments and land utilizations for mass transport development
4	To impart the knowledge related to estimation and contracting process for metro project
5	To build the geometrical features of a metro rails

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Summarize the evolution of Indian metro rail systems and outline the essential criteria for track alignment, surveys, and basic track components.
CO2	Interpret the roles of track components including rails, sleepers, and analyze the nature of track stresses acting in metro railway systems.
CO3	Implement geometric design principles for metro rail tracks considering parameters such as gradients, curvature, superelevation, and cant deficiency.
CO4	Utilize knowledge of train resistance factors, traction systems, and signalling technologies for effective metro train operation and control.
CO5	Examine and structure comprehensive project estimates, tender documents, and rate analysis frameworks for various metro construction activities.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	a) Introduction and Engineering Surveys: Developments in Indian Metro Railways, General Features of Indian Metro Railways, Important Statistics of Indian Metro Railways, Importance of Good Alignment, Basic Requirements of an Ideal Alignment, Selection of a Good Alignment. Engineering Surveys and Construction of Metro Railway. b) Track and Track Stresses: Requirements of a Good Track, Track as an Elastic Structure, Forces Acting on the Track Tunnel Railways	8
2	a) Rails and Sleepers: Types of rails, rail wear, rail failure,	7



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	functions and requirement of sleepers, types of sleepers, concrete sleepers. b) Geometric Design of Track: Necessity for geometric design, details of geometric design of track, gradients, grade compensation, circular curves, superelevation, cant deficiency, negative superelevation.	
3	a) Underground constructions: Railway tunnelling, necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel. b) Elevated constructions: Viaducts, metro viaduct erection methods, pre-cast yard development, formwork in metro projects.	7
4	a) Train Resistances: Resistance due to friction, wave action, wind, gradient, curvature, starting and accelerating, tractive effort of locomotive, hauling power. b) Power supply systems and signaling: Non electrical and electrical traction system, different types of signaling systems (historic), semaphore (lower & upper quadrant) mechanical signals, multiple aspect colour light signals, track circuits – train detection (occupancy of track) panel interlocking signaling system, route relay interlocking (RRI) system, electronic interlocking axle counters, principle and methods of interlocking and devices used for interlocking	7
5	a) Estimation valuation and tendering: Tender procedure for Metro project, definition of estimation and valuation, purpose of estimation, type of estimates, data required for estimation as a prerequisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement, mode of measurement of building items/works. b) Introduction to components of estimates: Face sheet, abstract sheet (BOQ), measurement sheet, rate analysis, lead statement. Provisional sum & prime cost items, contingencies, work charged establishment, centage charges. Introduction to D.S.R.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO1, CO3	1, 2, 12	1, 2
2	4 Analyze	CO2, CO 5	1, 12	1, 2
3	4 Analyze	CO2, CO5	1, 12	1, 2
4	3 Apply	CO3	1, 2, 12	-
5	4 Analyze	CO4	1, 11, 12	2

References Books:

- 1 S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, 2nd Edition (2017), Charotar Publishing House, Anand.
- 2 Indian Railways Permanent Way Manual Published by Indian Railways corrected up to 2017
- 3 Estimating and Costing: R. C. Rangwala , 18th Edition, Charotar Publ. House, Anand (2017)



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Text Books:

- 1 Metro Rail Projects in India: A Study in Project Planning Book by M. Ramachandran, First Edition 2011, Oxford University Press, New Delhi.
- 2 S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, Delhi, 2013.
- 3 Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow (2016).

e Resources

<https://nptel.ac.in/courses/105107463> - Prof. Rajat Rastogi, Railway Engineering, IIT Roorkee

Useful websites / Video

1. <https://youtu.be/RTv85VOrgyA> - Problems associated with tunnels & Tunneling in various subsoil conditions and rocks
2. <https://youtu.be/Cl6K3xEUJdI> - Basic Concepts for Lined, Unlined, and Pressure Tunnels

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	-	-	-	-	-	-	-	--	-	3	1	1
CO 2	3	-	-	-	-	-	-	-	-	-	-	3	1	1
CO 3	3	2	-	-	-	-	-	-	-	-	-	3	1	1
CO 4	3	-	-	-	-	-	-	-	-	-	2	3	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	3	-	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224005C						
Course Name	Elective IV – Hydropower Engineering						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)		TU(Hrs.)		PR(Hrs.)		Total Credits
	3		--		--		3
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	--	--	--	20	60	100

Prerequisites for the Course: Surveying.

The course aims to:

Course Objectives	Description
1	To understand the types, layouts, and classification of hydropower plants, including their substructure and superstructure components.
2	To analyze electrical loads, evaluate hydro-thermal power systems, and assess factors such as load curves, tariff structures, and hybrid systems.
3	To assess the power and energy potential of hydropower projects using hydrological data, including flow duration curves, reservoir regulation, and sedimentation effects.
4	To explain the components and alignment of water conductor systems, powerhouse layouts, and the role of instrumentation and control systems.
5	To design hydraulic turbines and surge tank systems based on site-specific requirements, incorporating principles of hydraulic transients and turbine selection.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand types, layouts, and classification of hydropower plants.
CO2	Analyze electrical loads and evaluate hydro-thermal power systems.
CO3	Assess power and energy potential using hydrological data
CO4	Explain water conductor systems and power house components.
CO5	Design hydraulic turbines and surge tank systems based on site requirements.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Hydropower and Classification:- Sources and forms of energy, types of power plants, elements of hydropower schemes, hydropower development in India, substructure and superstructure of power houses, classification of hydropower plants, surface and underground stations, low-medium-high head plants, pumped storage, tidal and micro tidal plants.	8
2	Load Assessment and Hydro-Thermal Mix:- Estimation of electrical load on turbines, load factor, plant factor, peak demand and utilization factor, load curve and duration curve, prediction of load, tariff structures, hydro-thermal mix and combined plant efficiency, hybrid systems.	7
3	Hydrology and Energy Potential:- Hydrological data processing, long-term and extreme event data usage, mass and elevation-volume curves,	7



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	flow duration curves, gross and net head, reservoir regulation and sedimentation, estimation of power and energy potential, installed capacity, load characteristics.	
4	Water Conductor System and Powerhouse Layout:- Water conductor system alignment, intake structure types and location, trash rack, penstock, pressure shaft, types and layouts of powerhouses, plant equipment, instrumentation and control systems, underground powerhouse concepts.	7
5	Turbine Design and Hydraulic Transients:- Hydraulic turbine components, standardization and selection, Pelton, Francis, axial and bulb turbine designs, draft tube theory and application, water hammer and surge tanks, rigid and elastic water column theories, pressure evaluation, surge tank behavior and design.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	3 Apply	CO1	1,2,3,12	1
2	3 Apply	CO2	1,2,3,4,5,7	1,2
3	4 Analyze	CO3	1,2,3,4,5,6,7	1,2
4	3 Apply	CO4	1,2,3,5,10	1,2
5	4 Analyze	CO5	1,2,3,4,5,6,7	1,2

References Books:

- 1 Hydropower Resources in India – CBIP
- 2 Hydro Power Structures – R.S. Varshney
- 3 Water Power Development – E. Mosonyi (Vol. I & II)
- 4 Hydraulic Structures – Novak et al.
- 5 Hydro-Electric Handbook – Creager & Justin

Text Books:

- 1 Water Power Engineering, Dandekar and Sharma, Vikas Publishing House, New Delhi
- 2 Water Power Engineering, P. K. Bhattacharya, Khanna Publishers, Delhi
- 3 Water Power Engineering, M. M. Deshmukh, Dhanpat Rai Publications

Useful websites / Video

1. https://www.youtube.com/watch?v=j_JL-Z__h6Q
2. <https://www.youtube.com/watch?v=W1pTtcE5NN8>
3. <https://graconllc.com/what-is-hydropower-engineering/>

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

• Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	1	1	–	–	–	–	–	–	–	–	1	1	–
CO 2	3	3	2	2	1	–	2	–	–	–	–	–	3	1
CO 3	3	3	2	3	2	2	3	–	–	–	–	–	3	2
CO 4	3	2	2	–	1	–	–	–	–	2	–	–	3	1
CO 5	3	2	3	1	2	2	2	–	–	–	–	–	3	1



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Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224006A						
Course Name	Elective V – Structural Design of Bridges						
Type of Course	DEC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)				Total Credits
Weekly Working Hrs	2	--	--				2
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	--	--	--	20	30	50

Prerequisites for the Course: Design of bridges.

The course aims to:

Course Objectives	Description
1	To introduce the fundamental concepts, classifications, components, and IRC standards related to various types of bridges.
2	To develop an understanding of the design principles and analysis methods for reinforced concrete and steel bridges.
3	To provide basic knowledge of prestressed and modern bridge types, including segmental, box girder, and balanced cantilever bridges.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Learn types of bridges, their parts, and design loads as per IRC.
CO2	Understand how to design slab and T-beam bridges using basic methods.
CO3	Know the basics of prestressed bridges and modern bridge types.
CO4	Learn about steel bridges and how they work under railway loads.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Bridges and IRC Standards: Types and classification of bridges (RC, steel, PSC, etc.), Components of a bridge, Site selection and planning, Basic terms: linear waterway, economic span, afflux, scour depth, Design loads on bridges: IRC Class AA, A, B loading, Factors affecting bridge type selection, Overview of IRC specifications.	7
2	Reinforced Concrete Slab and T-Beam Bridges: Bridge deck types: slab and T-beam, Design principles and assumptions, Effective width concept, Courbon's method (basic), Introduction to Pigeaud's curves, Analysis and design of simply supported slab bridge, T-beam bridge (three girder system): layout, load analysis, and design (only main steps).	7
3	Prestressed Concrete and Other Bridge Types: Introduction to prestressing: basic concepts, Prestressed concrete bridge: general features and advantages, Cable profiles and stress zones, Design considerations (only concept level), Introduction to segmental bridges, balanced cantilever, and box girder bridges.	7
4	Steel Bridges: Types: Truss, and box girder bridges, Overview of Indian Railway	7



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	loadings, Design concept of plate girder (only overview, no detailed design), Role of stiffeners (vertical and horizontal), Expansion joints and bearings in steel bridges.	
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Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO1	1,2,3,4,5,12	1
2	3 Apply	CO2	1,2,3,4,5,6,12	1,2
3	5 Evaluate	CO3	1,2,3,4,5,12	2
4	3 Create	CO4	1,2,3,4,5,6,7,12	1,2

References Books:

- 1 S.P. Bindra – Bridge Engineering, Dhanpat Rai Publications
- 2 D.J. Victor – Essentials of Bridge Engineering, Oxford & IBH
- 3 Indian Roads Congress (IRC) Codes:
 IRC:6 – Loads and Load Combinations
 IRC:21 – Concrete Road Bridges
 IRC:18 – PSC Road Bridges
 IRC:83 – Bridge Bearing

Text Books:

- 1 T.R. Jagadeesh & M.A. Jayaram – Design of Bridge Structures, PHI,
- 2 V.K. Raina – Concrete Bridge Practice, Shroff Publishers.
- 3 N. Krishna Raju – Design of Bridges. Publisher: Oxford & IBH Publishing

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	2	2	1	--	--	--	--	--	--	1	1	--
CO 2	3	3	3	2	2	1	--	--	--	--	--	1	2	1
CO 3	3	3	2	2	3	--	--	--	--	--	--	1	2	--
CO 4	3	3	3	2	2	1	1	--	--	--	--	1	2	1

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224006 B						
Course Name	Elective V – Plumbing Engineering						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
	2	--		--		2	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	--	--	--	20	30	50

Prerequisites for the Course: Building Technology, Water supply and waste water Engineering, Hydraulics.

The course aims to:

Course Objectives	Description
1	Introduce fundamental concepts and terminology related to plumbing systems, including standards, codes (UPIC, NBC), and municipal regulations.
2	Familiarize students with essential plumbing components and terminologies, ensuring accurate communication and understanding in plumbing design and execution.
3	Develop an understanding of plumbing hydraulics to enable students to design and analyze water supply and drainage systems in buildings.
4	Introduce sustainable practices through the study of rainwater harvesting and siphonic systems for efficient water resource management.
5	Provide knowledge of materials, fixtures, and modern equipment used in plumbing systems, including considerations for accessibility, water conservation, and system maintenance.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand the fundamental principles of plumbing systems, including terminology, codes, standards (UPIC, NBC), and municipal regulations.
CO2	Identify and describe key plumbing terminologies and their applications in real-world plumbing systems.
CO3	Analyze and design plumbing systems based on hydraulic principles, including flow in pipes, water hammer, hydraulic zones, tank capacities, and pipe sizing.
CO4	Evaluate and design rainwater harvesting and siphonic rainwater systems for sustainable water management.
CO5	Select appropriate plumbing materials, fixtures, and equipment, with consideration for water efficiency, special user needs and maintenance practices.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Plumbing and Plumbing Terminologies: Definition of Plumbing, codes and Standards in Plumbing UPIC, NBC, and other codes, Local Municipal Laws, Approvals, General Regulations, and Typical Gravity water Distribution and Pressurized	5



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	Water Distribution Plumbing system. Plumbing organizations and Publications Basic Planning for Plumbing, Location of wet Areas, Location of shaft, Services in Plumbing Shafts Architectural and Structural coordination, Sizes of wash rooms, Mounting heights of washroom Fixtures, Sunken toilets, Location of columns, beams 2nd Post Tensioned slabs, Importance of Ledge walls and Water Proofing	
2	Plumbing Terminology: Airgap, Backflow, Back Siphonage, Backwater Valve, Cesspool, cross connection, Float valve, Flush valve, Flush Tank, Gully Trap, Interceptor, Manhole, Push Tap, Metered Faucet, Single level mixer, Static Head, Slope, strainer, Fe Thermostatic Valve, Trap, Vent, Water Hammer, Aerated fittings, Dirty Arm, Receptors, Slip joints, Floor sink, Blow off, Adapter Fitting Bell and Spigot joint, Ferrule,	4
3	Plumbing Hydraulics: Components of Plumbing services, principles of Plumbing System Design, Basics of Plumbing Hydraulics, Density, Viscosity, and Pressure Gravity flow in pipes, Pressure flow in pipes. Coefficient of Roughness (c), Water hammer, Design of Rain Water outlets, Design of gutters, Hydraulic zones for tall buildings. Pumping systems, Types of pumps, Estimation of water requirement, Estimation of Underground & overhead tank capacity, plumbing capacity calculation, Design of pipe diameters and branch line	6
4	Rainwater Harvesting (RWH): Focuses on rainwater measurement, components of RWH systems, design of RWH systems, recharge and disposal systems in RWH Siphonic rainwater systems.	3
5	Materials and equipment in Modern Plumbing Engineering: Sanitary fixtures and fittings, water supply systems (cold and hot water), pipes, fittings, valves, appurtenances, and storage cisterns. Plumbing equipment: flow measurement devices and firefighting devices. washrooms for differently abled persons, water conservation devices, water efficient products, and operation and maintenance in plumbing	6

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand	CO1	1,2,3,4,5,6,7,8,9,10,11,12	1,2
2	2-Understand	CO2	1,2,3,4,5,6,7,8,9,10,11,12	1,2
3	4-Analyze	CO3	1,2,3,4,5,6,7,8,9,10,11,12	1,2
4	5-Evalute	CO4	1,2,3,4,5,6,7,8,9,10,11,12	1,2
5	5-Evalute	CO5	1,2,3,4,5,6,7,8,9,10,11,12	1,2

References Books:

1. Uniform Illustrated Plumbing code - India, 2014, JAPMO
2. Green Plumbing code, supplement -India-2013, IAPMO
3. Water Efficient Products-India (WEP-1), IAPMO
4. National Building code, SP: 7, B.I.S. New Delhi



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5. Handbook of water supply and Drainage with special Emphasize on Plumbing, SP: 35, B.I.S. New Delhi
6. IS 12183 (Part 1) Code of Practice for Plumbing in multi-storeyed buildings (Part I, Water Supply), BIS, New Delhi

Text Books:

1. Plumbing-Design and Practice, S. G. Deolalikar, Tata Mc Graw-Hill Education Pvt Ltd, New Delhi,
2. A Guide to Good Plumbing Practices, Published by Indian Plumbing Association
3. Plumbing, Steve Muscroft, Routledge: Talyor and Francis Group, Special Indian Edition

e Resources

1. <https://www.wtgroup.com/solutions/plumbing-engineering>
2. <https://imegcorp.com/services/plumbing-piping-engineering/>
3. <https://www.wsp.com/en-in/services/mechanical-electrical-and-plumbing>

Useful websites / Video

1. https://youtu.be/Z5TRf5WIWLA?si=_WTQeycxO5rCTNus
2. <https://youtu.be/XKZ9Ym6oNvQ?si=bE6klrMfFH6tZOnY>
3. https://youtu.be/8jxRn-T_LCs?si=dE0-tjQRf61Uw3-q
4. <https://youtu.be/2IeLsnC93Ho?si=09A9QfTdMbDioPHG>
5. https://youtu.be/SsPtZqOAF4s?si=sxn8h_S54mRMIJkF

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
• Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	1	1	2	2	1	2	1	2	1	2	3	2
CO 2	2	2	1	1	1	1	1	1	1	2	1	2	2	1
CO 3	3	3	3	2	3	1	2	1	2	2	1	3	3	2
CO 4	3	2	3	1	2	2	3	1	1	2	1	3	3	2
CO 5	3	2	2	2	3	2	3	2	2	2	1	3	3	2

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224006 C						
Course Name	Elective V – Structural Audit and Retrofitting of Structures						
Type of Course	DEC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	2	--		--		2	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	--	--	--	20	30	50

Prerequisites for the Course: Concrete Technology, Structural analysis.

The course aims to:

Course Objectives	Description
1	To introduce Structural Audit: its necessity, procedure involved and report writing.
2	To introduce Retrofitting of structures: its necessity, materials & methods for retrofitting, retrofitting of RC, Steel & Masonry structures.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Identify and explain the causes of structural damage and differentiate between repair and retrofitting techniques.
CO2	Analyze the structural audit process and structural health monitoring techniques using visual observations, NDT tools, and AI-based systems.
CO3	Evaluate various non-destructive testing methods and advanced techniques used for assessing structural integrity in concrete and steel structures.
CO4	Apply appropriate repair, rehabilitation, and retrofitting techniques based on structural material, type, and historical importance.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction: Causes of structural damages: mechanical actions, chemical attacks, earthquake, fire, damage to steel structures due to corrosion, damage to RC structures due to corrosion: corrosion induced by carbonation of concrete, chloride induced corrosion and corrosion induced by leaching of concrete. Introduction to structural audit, its necessity, introduction to retrofitting of structures, its necessity, repairs, difference between repairs and retrofitting.	6
2	Structural Audit and Structural Health Monitoring (SHM): Structural audit, assessment of health of structure, study of structural drawings, visual observations, nature of distress, collapse and investigation, limitations on investigator, tools for investigation, introduction of various NDT methods for assessing strength of distressed materials, role of client, architect, consulting engineer and contractor, Introduction to SHM, Local and Global	6



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	techniques for SHM, short and long-term monitoring, active and passive monitoring, remote and wireless SHM Techniques. Instrumentation, data acquisition, data processing for SHM, Artificial Intelligence in SHM.	
3	Non-destructive testing of concrete quality: Non-destructive testing of connections in steel, Corrosion assessment in reinforcements in RCC elements and components in steel structures; Design principles, techniques and working mechanism various instruments used for NDT evaluations (for strength, durability etc.) like Rebound Hammer, UPV, impact echo, concrete endoscopy etc.; Technology used in various advanced instruments like Imaging techniques, RCPT, Core Test, Carbonation, GPR, Thermography, Tomography etc.	6
4	Materials for repairs, rehabilitation and retrofitting processes: Methods for repairs, rehabilitation and retrofitting including surface preparation, Study of failures of buildings and lesson learnt, Role of quality control in construction as Preventive measures Maintenance of buildings. Retrofitting of Structures: Methods of retrofitting: moisture barrier systems, mass reduction technique, jacketing, shotcreting, Ferro cement mesh, inserting new member, base isolation. Suitability of various retrofitting techniques for RC structures, steel structures and masonry structures and introduction to retrofitting of Historical Structures.	6

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO1	1,2,3,4,5,12	1
2	4 Analyze	CO2	1,2,3,4,5,6,12	1,2
3	5 Evaluate	CO3	1,2,3,4,5,12	1
4	3 Apply	CO4	1,2,3,4,5,6,7,12	1,2

References Books:

- Concrete Microstructures, properties and materials - P Kumar Mehta and Paulo J. M. Monteiro
- Properties of concrete - A. M. Neville
- Materials for construction - Lai, James, S.
- Structural condition assessment - Robert T. Ratay
- Handbook of retrofitting earthquake damaged buildings.

Text Books:

- Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.
- Repairs and Rehabilitation, Compilation from Indian Concrete Journals.
- Building: Structural Audit, Repairs and Restoration, Arun Kelkar, Majestic Publishing House
- Concrete Building Pathology, Susan Macdonald, Blackwell Publishing.

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).



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Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	2	2	1	--	--	--	--	--	--	1	1	--
CO 2	3	3	3	2	2	1	--	--	--	--	--	1	2	1
CO 3	3	3	2	2	3	--	--	--	--	--	--	1	2	--
CO 4	3	3	3	2	2	1	1	--	--	--	--	1	2	1

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224006 D						
Course Name	Elective V – Solid Waste Management						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
	2	--		--		2	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	--	--	--	20	30	50

Prerequisites for the Course: Municipal Solid Waste, collection, Processing, Rules, landfill etc.

The course aims to:

Course Objectives	Description
1	To introduce the fundamentals of solid waste management, its composition and characteristics.
2	To familiarize students with key government policies and initiatives.
3	To impart knowledge on the collection, storage, and transportation of solid waste
4	To explain various processing and transformation techniques for solid waste
5	To provide insights into waste-to-energy technologies and disposal methods.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	To impart the basic knowledge about solid waste management, Its characteristic and generation rate. also understand the legal requirements of special waste.
CO2	Understand the role of government initiatives in solid waste management and apply engineering principles and modern tools for efficient collection, transportation and route optimization in integrated solid waste systems.
CO3	To understand processing of solid waste, material recovery facility and to design composting systems, maintain and operate composting process for effective organic waste recycling.
CO4	To understand working of waste to energy system, landfill and its construction criteria and treatment of leachate.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Solid Waste Management: Definition, objectives of SWM, impacts of improper SWM: soil, water and air, functional outlines of SWM, sources and types of solid waste. MSW: composition, characteristics: physical, chemical, biological and generation rate, factors affecting generation rate, estimation of quantity of solid waste. Sustainable solid waste management for smart cities. MSW Rules 2016:- Objectives, MSW rule 2016 for Hazardous and other waste management, construction and	6



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	demolition (C&D) waste, E-waste management, plastic waste management, reuse and recycling of plastic waste in road construction,	
2	Government Initiatives, Collection & Transportation of Solid Waste:- Swachh survekshan and its impact on the SWM scenario in India, national urban livelihood missions (NULM) and its role in SWM, social entrepreneurship, swachhta & rural engagement cell (SESREC): government of India initiatives, role of urban local bodies in waste management, Integrated solid waste management, storage, different methods of collection, collection systems, transfer and transportation of solid waste, uses of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicles location, optimization of route.	6
3	Processing and Transformation of Solid Waste:- Source reduction, segregation and salvage, material recovery facility centres, recycling and reuse of solid waste, Carbon credits, circular economy in waste management. Theory of composting, processing before composting, types of composting (home composting, vermicomposting, organic waste converter, rotary drum, continuous flow reactor), explain methods: Indore method, Bangalore method, mechanical composting plant, factors governing composting and design of composting system.	6
4	Waste to Energy, Disposal & Special Waste Management:- Bio-methnation: theory of anaerobic digestion, stages, factors affecting anaerobic digestion, design of anaerobic digester. Energy content of MSW, Theory and types of incinerators. Landfill: Introduction, components of land filling, site selection, construction techniques, maintenance and precautions, leachate and landfill gas: treatment and disposal/reuse control of contamination of ground water. Introduction to life cycle assessment (LCA) in solid waste management.	6

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO-1	1,2,4,6,7,8,9,10,11,12	2
2	2 Understand 3 Apply	CO-1, CO-2	1,2,3,4,5,6,7,8,9,10,11,12	-
3	2 Understand 3 Apply	CO-1, CO-3	1,2,3,4,5,6,7,8,9,10,11,12	2
4	2 Understand	CO-1, CO-4	1,2,3,4,5,6,7,8,9,10,11,12	2

References Books:

- 1 Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Singapore.
- 2 Vesilind, P.A., and Worrell W. A. (2016) Solid Waste Engineering, 2nd Ed., Cengage Learning, Peavy, H.S, Rowe, D.R., and Tchobanoglous, G., (2017)
- 3 CPHEEO, Manual on Municipal Solid waste management, Central Public Health Environmental Engineering Organization, Government of India, New Delhi, 2000.



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Text Books:

- 1 Integrated Solid Waste Management: Engineering Principles and Management Issues, C Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil S McGraw-Hill Companies, Incorporated.
- 2 Solid waste management, Dr. A.D. Bhide
- 3 Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI.

e Resources

https://www.youtube.com/watch?v=cjIacnNRLHE&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv

Useful websites / Video

1. <https://www.youtube.com/watch?v=scMp6nvnqEQ>
2. https://www.youtube.com/watch?v=_P4eKwo7D80
3. <https://www.youtube.com/watch?v=n3YWMaPw7Yo>
4. https://www.youtube.com/watch?v=xa_596IbiKI
5. <https://www.youtube.com/watch?v=RAXbohaBGt8>

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

• Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	2	-	1	-	3	3	3	1	1	1	2	-	1
CO 2	2	2	2	1	3	2	3	1	1	2	2	2	-	-
CO 3	2	2	3	1	2	2	3	2	1	1	1	2	-	1
CO 4	2	2	1	2	2	2	3	1	1	1	1	2	-	2

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224007						
Course Name	Research Methodology						
Type of Course	ASM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	3	--	--	3			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	--	--	--	20	60	100

Prerequisites for the Course: Project Based Learning, Technical Report Writing.

The course aims to:

Course Objectives	Description
1	To introduce students to the fundamental concepts and significance of research in academic and professional contexts
2	To equip students with knowledge of data collection and data processing techniques for effective analysis.
3	To develop an understanding of hypothesis formulation and testing in research studies.
4	To enable students to interpret statistical test results and draw meaningful conclusions.
5	To train students in organizing and presenting research findings effectively in a structured report.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand the importance of Research and the aspects associated with it.
CO2	Apply the method of data processing for analyzing the data.
CO3	Relate the hypothesis testing with the outcome.
CO4	Conclude the work based on test results.
CO5	Compile the results to write the report.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction: Meaning, Objectives; Motivation; Types of Research; Research Approaches, Significance of Research. Steps in Research Process; Criteria of Good Research; Research Methos versus Methodology. Ethics in Research. Research Formulation and Literature Review: Problem Definition and Formulation; Characteristics of Good Research Question; Literature Review Process.	6
2	Data Collection: Primary and Secondary Data; Primary and Secondary Data Sources; Data Collection Methods; Data Processing; Classification of Data. Data Analysis -Statistical Analysis; Multivariate Analysis; Correlation Analysis; Regression Analysis; Principle Component Analysis; Samplings	8
3	Research Design: Need for Research Design; Features of a Good Design; Types of Research Designs; Induction and Deduction. Hypothesis Formulation and	8



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	Testing-Hypothesis; Important Terms; Types of Research Hypothesis; Hypothesis Testing; Z-Test; t-Test; f-Test; Making a Decision; Types of Errors; ROC Graphics.	
4	Test Procedures: Parametric and Non Parametric Tests; ANOVA; Mann-Whitney Test; Kruskal-Wallis Test; Chi-Square Test; Multi-Variate Analysis.	6
5	Interpretation and Report Writing: Meaning of interpretation, Techniques of Interpretation, Presentation of the Research Work -Technical Research Report, General tips for writing reports, Presentation of Data, Bibliography and references, Intellectual Property rights, Open Access Initiatives, Plagiarism.	8

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	1 Remember	CO1	1,2,4,6,8,9,10,12	--
2	2 Understand	CO2	1,2,5,9,10,12	--
3	2 Understand	CO3	1,2,5,9,10,12	--
4	3 Apply	CO4	1,2,3,5,9,10,12	--
5	3 Apply	CO5	1,2,5,9,10,12	--

References Books:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.

Text Books:

1. Research Methodology: C. R. Kothari

e Resources

1. <https://www.coursera.org/learn/research-methodologies>
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Useful websites / Video

1. <https://www.youtube.com/watch?v=iSHcC-QNCP4>
2. https://www.youtube.com/watch?v=XEMyDu_VoeQ

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	1	1	-	2	-	1	-	1	1	1	-	1	-	-
CO 2	1	2	-	-	2	-	-	-	1	1	-	1	-	-
CO 3	1	1	-	-	1	-	-	-	1	1	-	1	-	-
CO 4	1	1	1	-	-	-	-	2	1	1	-	1	-	-
CO 5	1	1	-	-	1	-	-	-	1	1	-	1	-	-



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Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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Course Code	CIV224008						
Course Name	Project Finance & Accounting System						
Type of Course	LHSM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	2	--	--	2			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	50	--	--	--	--	--	50

Prerequisites for the Course: Project Scheduling & Execution.

The course aims to:

Course Objectives	Description
1	To introduce students to principles and practices of project finance in civil infrastructure development.
2	To develop competence in evaluating financial feasibility of projects using appraisal techniques.
3	To familiarize students with budgeting, financial forecasting, resource management, and modern project costing methodologies.
4	To build knowledge on various modes of infrastructure financing, public-private partnerships (PPP), and risk management strategies.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand the fundamentals of project finance, accounting systems, and their relevance in infrastructure project management.
CO2	Apply financial appraisal and evaluation techniques for infrastructure project proposals.
CO3	Analyze project costing, budgeting, cash flow forecasting, and resource allocation strategies.
CO4	Examine different financing models, risk analysis frameworks, and capital structuring practices in infrastructure projects.
CO5	Evaluate project accounting processes, auditing mechanisms, statutory reporting, and financial performance indicators.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Fundamentals of Project Finance and Accounting System Introduction to Project Finance: Concept, features, scope, relevance in infrastructure projects, Differences between Project Finance and Corporate Finance , Historical Evolution of Project Finance in India and globally, Project Finance Process Flow — from initiation to post-completion , Stakeholder Roles: Sponsors, Lenders, Multilateral Agencies, Consultants, and Regulatory Authorities, Life Cycle of a Civil Infrastructure Project: Planning, Financing, Execution, Operations, Handover , Project Accounting Systems: Principles, Methods, and Real-World Importance , Overview of Accounting Standards applicable to infrastructure projects: Indian Accounting Standards (Ind AS), International Financial Reporting	5



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	Standards (IFRS), Case Study: Financial model analysis of a highway or metro rail project.	
2	Project Financial Appraisal and Economic Evaluation Concept of Time Value of Money — Discounting, Compounding, Annuity , Financial Appraisal Methods: NPV, IRR, Payback Period, BCR, Profitability Index, Modified Internal Rate of Return (MIRR), Investment Decision Making: Accept/Reject criteria, Comparative Financial Appraisal of Multiple Projects , Sensitivity Analysis: Single and Multi-variable, Scenario Analysis: Best-case, Worst-case, and Most-likely, Break-even Analysis and Graphical Interpretation , Cost-Benefit Analysis in Public Infrastructure Projects , Social Cost-Benefit Analysis (SCBA) for urban projects , Case Study: Financial feasibility of a municipal solid waste management project.	5
3	Project Cost Estimation, Budgeting, and Financial Planning Principles of Project Costing in Civil Engineering , Detailed Project Report (DPR) Financial Components , Cost Classification: Fixed, Variable, Semi-variable, Direct, Indirect, Contingency, Escalation , Cost Inflation Adjustments and Indexing , Methods of Project Budgeting: Traditional, Zero-Based, Activity-Based, Performance Budgeting , Financial Forecasting Techniques: Trend, Moving Average, Regression , Cash Flow Forecasting and Fund Flow Management , Budgetary Control: Variance Analysis, Revised Estimates , Case Study: Budget formulation for a medium-scale housing project.	5
4	Project Financing, PPP Models, Risk Management and Capital Structuring Types of Project Financing: Equity, Debt, Mezzanine, Bonds, Debentures, Government Grants, International Financing , Public-Private Partnership (PPP) Models in India: BOT, BOOT, DBFOT, EPC+F, Annuity, Selection Criteria for Project Financial Instruments, Financial Closure Process in Project Finance , Project Risk Management Framework: Identification, Quantification, Allocation & Transfer, Mitigation Strategies , Qualitative and Quantitative Risk Assessment , Capital Structuring Strategies: Debt-Equity Ratio, Leverage, Re-financing, Capital Budgeting Decisions under Uncertainty, Government Guidelines: NITI Aayog, MoRTH , Case Study: Capital structuring and risk management in a smart city project.	5
5	Project Accounting, Auditing, Financial Reporting and Performance Evaluation Introduction to Project Accounting and Financial Reporting Principles , Project Financial Statements: Trial Balance, Income Statement, Balance Sheet, Cash Flow Statement , Internal Control Mechanisms: Budgetary, Cash, Asset Control, Project Internal and External Audit Process , Financial Performance Ratios: ROI, ROCE, Operating Ratio, Net Profit Margin, DSCR , Financial Reporting Standards: IFRS, Indian Accounting Standards , Accounting for Contingencies, Provisions, Contract Retentions ,	4



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	Statutory Requirements and Taxation Aspects , Software Tools: Tally Prime, QuickBooks, MS Excel , Case Study: Auditing and financial review of a metro or port project.	
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Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO1	1, 2, 4, 5, 6, 7, 10,11,12	2
2	3 Apply	CO2	1, 2, 3, 4, 5, 6, 10, 11, 12	1, 2
3	4 Analyze	CO3	1, 3, 4, 5, 6, 11,12	1, 2
4	4 Analyze	CO4	1, 3, 4, 5, 6, 7, 10, 11,12	1, 2
5	4 Analyze	CO5	1, 2, 3, 4, 5, 6, 7,10, 11,12	1, 2

References Books:

- 1 Vijayakumar, A., Financial Management, Lakshmi Publications, 2017.
- 2 Anthony, R.N., Management Control Systems, McGraw Hill Education.
- 3 Chandra, Prasanna, Projects: Planning, Analysis, Selection, Financing, Implementation Review, McGraw Hill, 2019.
- 4 Nevin, John A., Financial Accounting, Prentice Hall.
- 5 MoRTH, Model Concession Agreements for Highways and Smart Cities Projects.

Text Books:

- 1 Kumar Neeraj Jha, Construction Project Management, Theory and Practices, 3rd Edition, Pearson.
- 2 Gatti, Stefano, Project Finance in Theory and Practice, Academic Press, 2018.

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
 • Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	-	-	-	-	-	2	-	2	-	2	-	-
CO 2	3	3	3	2	2	-	-	-	2	2	-	2	-	-
CO 3	3	3	3	3	2	-	-	-	3	3	-	2	-	-
CO 4	3	3	3	3	2	-	-	2	3	2	2	2	-	-
CO 5	3	3	2	2	2	2	-	2	2	3	2	2	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	15
2	LMS Tests	05
3	Presentation (For individual student)	10
4	Case Study (For individual student)	10
5	Report Writing on Life Cycle of a Civil Infrastructure Project	10
	Total	50

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224009						
Course Name	Project Phase II						
Type of Course	PSI						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	--	--	8	4			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	100	--	50	--	--	150

Prerequisites for the Course: Fundamentals in Civil Engineering.

The course aims to:

Course Objectives	Description
1	Identify latest technical/practical problems in the field of Civil Engineering.
2	Inculcate the ability to describe, interpret and analyze technical content.
3	Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Identify the problem and its impact on engineering systems and society.
CO2	Use the relevant literature for understanding status of research on the topic and research gap if any.
CO3	Organize various methodologies for achieving solutions to the problem.
CO4	Evaluate different alternatives and design of technically feasible and economical solutions.
CO5	Draw the conclusions for the practical applications in the field.
CO6	Demonstrate the ability of technical writing and presentation skills.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	01. Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations. 02. Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. Identification of research gaps. 03. Problem statement and methodology 04. Theoretical contents related to the chosen topic or case studies if applicable. 05. Experimentation/Field Work/Numerical Investigations on the identified problem. 06. Validation/ Interpretation of results and discussion. 07. Conclusion and future Scope 08. Cost analysis (if applicable) 05. References.	--



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Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand, 3-Apply, 4-Analyze, 5-Evaluate, 6-Create	CO1, CO2, CO3, CO4, CO5, CO6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12	PSO1, PSO2

Text Books:

1. Research Methodology: C. R. Kothari

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	3	3	3	3	3	3	3	3	3	3	1	1
CO 2	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO 3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



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SEMESTER VIII



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224011						
Course Name	Waste Water Engineering						
Type of Course	DCC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)				Total Credits
Weekly Working Hrs	3	--	--				3
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	40	--	--	--	--	60	100

Prerequisites for the Course: Basic Concepts of Engineering Sciences and Mathematics.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Describe the sources and characteristics of industrial waste water, select suitable methods for treatment for different industrial wastewater and reuse and recycle of treated wastewater.
CO2	Describe the fundamental concepts of wastewater engineering and design various primary treatment units on the basis of theory of primary treatment.
CO3	Design appropriate aerobic method for secondary treatment of sewage.
CO4	Explain the theory of anaerobic digestion, different anaerobic treatment processes and design of septic tank including disposal system.
CO5	Evaluate and propose suitable low-cost methods for sewage treatment

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Sewage treatment: Introduction to Waste water engineering and basic definitions. Pollution due to improper disposal of sewage, Introduction to sewage treatment, preliminary, primary, secondary and tertiary treatment, Unit operation and Process flow diagram for sewage treatment, Theory and design of screen chamber, Grit Chamber and Primary sedimentation tank as per the Manual of Central Public Health and Environmental Engineering Organisation (CPHEEO). Introduction to MBR, MBBR and FMBR.	8
2	Secondary treatment units: Theory and design of secondary treatment units: Introduction to unit operations and processes for secondary treatment. Principles of biological treatments, role of microorganism in wastewater treatment. Activated sludge process : Theory and design of ASP, sludge volume index, sludge bulking & control, modifications in ASP. Operational problems and maintenance in ASP. Concept of Sequential batch reactor (SBR) .Trickling filter : Biological principle, different T.F media & their characteristics, design of standard rate and high rate filters using National Research Council (NRC) formula, single stage & two stage filters, recirculation, ventilation, operational problems, control measures, theory of rotating biological contactors.	7
3	Low cost treatment methods:	7



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	Low cost treatment methods for rural areas Oxidation pond: Bacteria – algae symbiosis, design of oxidation pond as per the manual of CPHEEO, advantages & disadvantages of oxidation ponds. Aerated lagoons: Principle, aeration method, advantages & disadvantages of aerated Lagoons, design of aerated lagoon. Introduction and theory of Phytoremediation technology for wastewater treatment. Introduction and theory of root zone cleaning system.	
4	Anaerobic treatment process and sludge management: Onsite Sanitation Treatment systems: Septic tank, up-flow anaerobic filter. Anaerobic digester: Principle of anaerobic digestion, stages of digestion, bio – gas production its characteristics & application, factors governing anaerobic digestion,. Dewatering of sludge by gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal, advantages & disadvantages. Up-flow Anaerobic Sludge Blanket (UASB) Reactor– Principle, advantages & disadvantages.	7
5	Industrial waste water treatment: Equalization and neutralization. Application of preliminary, primary and secondary treatment for industrial wastewater as per the CPCB norms. Sources of waste water generation from manufacturing process, characteristics of effluent, different methods of treatment & disposal of effluent for the following industries: Sugar, dairy and distillery. Discharge standards as per CPCB norms. Recycle & reuse of treated wastewater: Gardening, sewage farming, W.C. Flushing, reuse in industry.	7

References Books:

- 1 Waste Water Engg. – B.C. Punmia& Ashok Jain - Arihant Publications.
- 2 Water Supply & Waste Water Engg.- B.S.N. Raju – TMH publication.
- 3 Sewage Disposal & Air Pollution Engg. – S. K. Garg – Khanna Publication.
- 4 Environmental Engg. – Davis - McGraw Hill Publication.
- 5 Manual on sewerage and sewage treatment – Public Health Dept., Govt. of India.
- 6 Standard Methods by American Public Health Association (APHA)

Text Books:

- 1 Environmental studies by Rajgopalan- Oxford University Press.
- 2 Waste Water Treatment & Disposal – Metcalf & Eddy - TMH publication.
- 3 Environmental Engg. - Peavy, Rowe - McGraw Hill Publication.
- 4 Waste Water Treatment – Rao&Dutta.

e Resources

- 1 <http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras>.
- 2 <http://cpcb.nic.in>
- 3 <http://moef.nic.in>

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224012 A						
Course Name	Elective VI- Geo Synthetic Engineering						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
	3	--		--		3	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	40	--	--	--	--	60	100

Prerequisites for the Course: Basic understanding of the principles based on geotechnical engineering and concepts.

The course aims to:

Course Objectives	Description
1	To describe the raw materials, manufacturing processes, and properties of geosynthetics.
2	Identify the different types of Geosynthetics and its functions.
3	Evaluate the different engineering properties of Geosynthetic for its applications in civil engineering
4	To follow detailed procedures for using geosynthetics in retaining walls, roads, and railways.
5	To study the geosynthetics in ground improvement techniques.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand the definition, types, functions and raw materials used in geosynthetics.
CO2	Describe different properties (physical, mechanical, and hydraulic) and application areas of geosynthetics.
CO3	Illustrate the use of geosynthetics in roadway and railway applications and construction considerations.
CO4	Demonstrate the reinforced soil structures using Geosynthetics.
CO5	Choose different Techniques for the ground improvement.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction: Types of geo-synthetics: geo-textile, geo-grid, geo-nets, geo-membranes, geo-foam, geo-composite, introduction of geo-synthetic clay liners, primary functions of each geo-synthetics material, manufacturing of geo-synthetics, raw materials used, different types of geo-synthetics manufacturing system.	8
2	Testing methods for Geo-synthetics: Geo-synthetics testing, various properties of geo-synthetics, physical properties, mechanical properties, hydraulic properties and endurance properties. Apparent Opening Size, assessment of construction induced damage and extrapolation of long-term strength properties from short term tests.	7
3	Geo-synthetics for Pavement:	7



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	Pavement application: Geo-synthetics for separation and reinforcement in flexible pavements, design by Giroud-Noiray approach (design steps only), reflection cracking and control using geo-synthetics. Use of geo-synthetics for construction of heavy container yards and railway lines (Concept and design steps only).	
4	Geo-synthetics in reinforced soil retaining wall: Different types of walls like wrap-around walls, full-height panel walls, discrete facing panel walls, modular block walls. Design methods (design steps only) as per BS-8006 and FHWA methods, Construction methods for reinforced soil retaining walls.	7
5	Innovations in Ground improvement: Consolidation technique and prefabricated vertical drain, new applications and emerging technologies, environmental impact of geo-synthetics, Regulatory requirements for various applications. Future directions in geosynthetic research and application. Potential challenges and opportunities in the field.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand	CO1	1, 3,6	1
2	2-Understand	CO2	1, 7, 8, 9, 10,12	-
3	3-Apply	CO3	3, 11	2
4	3-Apply	CO4	3, 4, 11	2
5	3-Apply	CO5	5,6, 7	2

References Books:

- 1 Sanjay Kumar Shukla and Jian-Hua Yin, Fundamentals of Geosynthetic Engineering, CRC Press.
- 2 Jones, C.J.F.P, Earth Reinforcement and Soil Structures, Butterworth, 1985.
- 3 Koerner, R.M, Designing with Geosynthetics, Prentice Hall, 1993.
- 4 Robert M. Koerner, Designing with Geosynthetics, fifth edition 1933.
- 5 Rao G. V. and Rao, G. V. S. Text Book on Engineering with Geotextiles, Tata McGraw Hill
- 6 Han, J., Principles and Practice of Ground Improvement, John Wiley and Sons, New Jersey, Canada 2015.

Text Books:

1. Advanced Soil Mechanics, Das. B. M. 2008, Taylor and Francis group, London
2. An Introduction to Soil Reinforcement and Geosynthetics ,G.L.Siva Kumar babu, Universities Press (India) Pvt. Ltd. 2005)

e Resources

1. <https://www.geosynthetic-institute.org>
2. <https://www.astm.org>
3. <https://www.fhwa.dot.gov>

Useful websites / Video

1. https://youtube.com/playlist?list=PLLy_2iUCG87DbCEc59ZqW7pMQxXzjL2iI
2. https://www.youtube.com/watch?v=g7E_x2-FQ2M

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
 • Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping		
Strength	PO	PSO



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of COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	3	-	-	3	-	-	-	-	-	-	3	-
CO 2	3	-	-	-	-	-	3	3	3	3	-	2	-	-
CO 3	-	-	3	-	-	-	-	-	-	-	2	-	-	2
CO 4	-	-	3	3	-	-	-	-	-	-	2	-	-	2
CO 5	-	-	-	-	2	2	1	-	-	-	-	-	-	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224012 B						
Course Name	Elective VI- Airport and Bridge Engineering						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)		TU(Hrs.)		PR(Hrs.)		Total Credits
	3		--		--		3
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	40	--	--	--	--	60	100

Prerequisites for the Course: The basic knowledge of Highway Engineering, Engineering Mathematic, Physics.

The course aims to:

Course Objectives	Description
1	Introduce the fundamentals of airport planning, classification, and infrastructure requirements
2	Provide knowledge on aircraft characteristics and their impact on airport geometric design
3	Discuss bridge engineering concepts, design loads, and structural components.
4	Examine different types of bridges, their classifications, and suitability for various conditions.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Explain the fundamentals of bridge engineering, including design loads, IRC loading standards, and substructure components.
CO2	Classify different types of airports based on functions, size, and regulatory standards.
CO3	Apply digital visualization tools such as BIM, AR, and VR in airport planning and infrastructure modeling.
CO4	Analyze aircraft characteristics and their influence on airport site selection and geometric design.
CO5	Differentiate various types of bridges, including temporary, movable, and fixed-span bridges, and understand their suitability based on site conditions.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction and Classification of Airport: General, transportation systems, typical air trip, the air age, world civil air transport, geographic distribution of world air transport, air ports characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons and hangers. zoning requirements regarding permissible heights of constructions and landing within the airport boundary, airport landslide planning, navigation and landing aids – ILS, air traffic control (ATC). Airport classification: community size and airport types, airport classification according to types of services, functional classification of airports, airport classification for the purpose of	8



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	stipulating geometric standards, ICAO, FAA.	
2	Aircraft Characterizes and Geometric design: Introduction to Aircraft Characterizes: related to airport design characterizes of principle transport aircrafts, trends size, speed and productivity of transport aircraft, turning radii. airport planning, size and type of airport, selection of site for the airport. Geometric design: element of an airport, runway and taxi way width, runway profile and runway length, runway orientation, corrections and calculation, introduction to analytical methods for air travel demand for planning and casting, case study- airport master plan.	7
3	Airport Visualizing, Airport Capacity and Airport Pavements: Airports visualizing: introduction to visualizing airports in a virtual environment, building information modelling (BIM) for air ports, introduction to augmented reality (AR) and virtual reality (VR) in airport planning and design, Airport capacity: ultimate and practical runway capacity, runway 28 arrangement factors effecting runway capacity, practical annual capacity and practical hourly capacity, Airport pavements: comparison- highway and airfield pavement, design of rigid airport pavements, design of rigid pavement and design of flexible pavement, junction of flexible and rigid pavements, airport drainage.	7
4	Bridge Engineering: Introduction to design loads for bridges, IRC loading standards, load distribution theory, bridge slabs, substructure: abutment, piers, and wing walls with their types based on requirement and suitability.	7
5	Types of Bridges: Culvert: definition, location, waterway of culvert and types, design of pipe culverts, design of box culvert (Single vent only). Temporary bridges: definition, materials used, brief general ideas about timber, floating- pontoon bridges. (Introduction only), Movable bridges: bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability. (Introduction only), Fixed span bridges: simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure. Bearing: definition, purpose and importance, types of bearings with their suitability (Introduction only).	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	3 Apply	CO2	1,12	1,2
2	4 Analyze	CO4	1,3,12	--
3	3 Apply	CO3	1,3,5,12	1,2
4	2 Understand	CO1	1,12	1,2
5	4 Analyze	CO5	1,12	--

References Books:

- 1 Airport Engineering, Ashford, N., and P. H. Wright. 1992. 3rd ed. New York: John Wiley & Son
- 2 Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. L



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Text Books:

- 1 Airport Engineering, by Saxena S.C., CBS Publishers & Distributors
- 2 Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, R
- 3 Bridge Engineering by Rangwala, Charotar Publication
- 4 Aiport Engineering by Rangwala, Charotar Publication

e Resources

1. https://onlinecourses.nptel.ac.in/noc22_ce63/preview?utm_source=chatgpt.com.
2. https://onlinecourses.nptel.ac.in/noc20_ce40/preview?utm_source=chatgpt.com

Useful websites / Video

- 1 <https://youtu.be/RB2k5hSYO3U?si=6ghNU-3kYZPLpG5y>
- 2 <https://youtu.be/5k8vdDSK6jU?si=UGviK137c7XW8n9X>
- 3 <https://youtu.be/U4a0q4hYUWw?si=rOBxrx21-MVqeaBk>

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
• Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	-	-	-	-	-	-	-	-	-	3	1	1
CO 2	3	-	-	-	-	-	-	-	-	-	-	3	1	1
CO 3	3	-	1	-	2	-	-	-	-	-	-	3	1	1
CO 4	3	-	1	-	-	-	-	-	-	-	-	3	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	3	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224012 C						
Course Name	Elective VI- Earthquake Engineering						
Type of Course	DEC						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
Weekly Working Hrs	3	--	--	3			
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	40	--	--	--	--	60	100

Prerequisites for the Course: Structural Analysis, Structural Design, Engineering Physics.

The course aims to:

Course Objectives	Description
1	Introduce the basic concepts of seismology and earthquake characteristics for understanding seismic hazards.
2	Analyze the dynamic response of structures subjected to seismic forces using single and multi-degree-of-freedom systems.
3	Assess building performance during earthquakes and apply seismic design concepts as per IS 1893.
4	Compute design lateral forces on buildings using code-based static and dynamic analysis methods.
5	Design and detail RC buildings for earthquake resistance in compliance with IS 13920.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Describe various parameters related to earthquake and learning from failures due to past earthquakes.
CO2	Understand the derivations of damped/undamped SDOF systems by applying the concept of mathematical model and extend the concept for MDOF systems.
CO3	Analyze multistoried structure by seismic coefficient method.
CO4	Analyze and design the multistory frame structure for the combined effect of lateral and gravity forces.
CO5	Comprehend planning and design requirements of earthquake resistant features of RCC and Masonry structures thorough exposure to different IS-codes of practices.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Engineering Seismology: Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Major past earthquakes and their consequences; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India; (Problems on computation of wave velocities. Location of epicenter, Magnitude of earthquake).	6
2	Structural Dynamics: Basics of structural dynamics; Free and	8



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	forced vibration of SDOF system; Effect of frequency of input motion and Resonance; Numerical evaluation of response of SDOF system (Linear acceleration method), Earthquake Response spectrum: Definition, construction, Characteristics and application; Elastic design spectrum, Modeling of multi degree of freedom (MDOF) systems, solution to MDOF systems, Eigen values and Eigen vectors	
3	Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Torsional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.	8
4	Determination of Design Lateral Forces: Equivalent lateral force procedure and dynamic analysis procedure. Step by step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods (maximum of 4 storeys and without infill walls).	6
5	Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings	8

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand	CO1	1,2,3,4,5,6,8,10,12	1
2	2-Understand	CO2	1,2,3,4,12	-
3	3. Applying	CO3	1,2,3,4,5,6,8,9,10,12	1
4	4. Analyzing	CO4	1,2,3,4,5,6,8,10,12	1
5	3-Apply	CO5	1,2,4,5,6,7,8,9,10,11,12	1,2

References Books:

- David Dowrick, "Earthquake resistant design and risk reduction", John Wiley and Sons Ltd.
- C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta, "Some Concepts in Earthquake Behaviour of Buildings", Published by Gujarat State Disaster Management Authority, Government of Gujarat.
- IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces New Delhi.
- IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi
- IS- 4326 – 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.
- IS-13828 – 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings, BIS, New Delhi.

Text Books:

- Pankaj Agarwal and Manish Shrikande, "Earthquake resistant design of structures", PHI India.
- S.K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press
- Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", I



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Education, Inc.

- 4 T. K. Datta, “Seismic Analysis of Structures”, John Wiley & Sons (Asia) Ltd.

e Resources

1. <https://archive.nptel.ac.in/courses/105/104/105104189/>
2. <https://archive.nptel.ac.in/courses/105/101/105101006/>
3. <https://www.scribd.com/document/706383709/CE-809-Lecture-0-Course-4>

Useful websites / Video

1. https://youtu.be/ieMWws9_0ms?si=hjy9oNslCiXtnaGu
2. <https://youtu.be/uXh9FMpJ9wU?si=KndOjhHPnVpSmGkL>
3. <https://youtu.be/setphyUnUu4?si=c7NY7jP2vNt4oEe8>
4. https://youtu.be/M_HN8g_lEgM?si=bHl56pnVNlg2Sc09
5. https://youtu.be/Qr_Jn10RXLk?si=dMrbLNZV9MS9Pddf

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	1	3	3	3	3	3	-	2	-	2	-	3	3	-
CO 2	3	3	1	2	-	-	-	-	-	-	-	2	-	-
CO 3	3	3	3	3	3	3	-	1	1	1	-	3	3	-
CO 4	3	3	3	3	3	3	-	1	-	2	-	3	3	-
CO 5	2	1	-	1	1	3	2	2	2	2	3	3	2	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224012 D						
Course Name	Elective VI- Engineering Materials for Sustainability						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)				Total Credits
	3	--	--				3
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	40	--	--	--	--	60	100

Prerequisites for the Course: Structural Analysis, Structural Design, Engineering Physics.

The course aims to:

Course Objectives	Description
1	Provide foundational knowledge of sustainability, its key principles across social, environmental, and economic dimensions, and familiarize students with global goals and government initiatives aimed at promoting sustainable development.
2	Understand the concepts of embodied, operational, and life-cycle energy in buildings, and assess human impact on the environment through ecological footprint and bio capacity calculations.
3	Examine the environmental impact of conventional construction materials, especially cement and concrete, and explore sustainable alternatives and methods to minimize carbon emissions and resource consumption.
4	Evaluate advanced sustainable construction materials and technologies that reduce energy use and environmental impact during the lifecycle of a building, with focus on concrete innovations, recycled materials, and alternative resources like fly ash, bamboo, and ferrock.
5	Analyze the role of coatings such as paints, adhesives, and sealants in sustainable construction, emphasizing low-VOC materials and their impact on indoor air quality and occupant health

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Understand need, term and goals of sustainability
CO2	Describe the importance of energy and minimization of energy consumption by Altering the building materials.
CO3	Understand role of building material and its impact of environment.
CO4	Describe the importance of sustainable material and its benefit as building material.
CO5	Describe the importance of sustainable coating material and its benefit.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Introduction to Sustainability: Sustainability: Introduction, Terms of Sustainability, Need for sustainability, Concept of sustainability, social, environmental and economic sustainability concepts, Introduction to Sustainable Goals, Government initiative for sustainable Development.	6
2	Introduction to Energy: Introduction, Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity and calculation of planet equivalent	8



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3	Building Material: Role of Material: Carbon from Cement, alternative cements and cementations material, Alternative fuel for cements for reduction in carbon emission. Concrete: Sustainability issues for Concrete, Role of quality, minimization of natural resource utilization, Aggregates, Concrete Blocks	8
4	Sustainable construction material: Concrete: High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability 'Reduction in water consumption in concrete, Recycled Aggregate: Energy for grinding crushing of cement aggregate etc. and reduction. Operational energy of building: role of materials and thermal conductivity Bricks: Clay Bricks, Types of kilns, Comparative energy performance, emission performance and financial performance, Fly ash Bricks Bamboo, Hemcrete, Ferrock etc.	6
5	Sustainable Coating Material: Paints, Plaster, ,Varnish, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard	8

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand	CO1	1,2,3,4,5,6,7,8,9,10,12	1
2	2-Understand	CO2	1,2,3,4,5,6,7,10,12	1,2
3	2-Understand	CO3	1,2,3,4,5,6,7,10,12	1,2
4	2-Understand	CO4	1,2,3,4,5,6,7,10,12	1,2
5	2-Understand	CO5	1,2,3,4,5,6,7,10,12	1,2

References Books:

- 1 Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.
- 2 Systems Analysis Sustainable Engineering: Theory and Applications, Ni bin Chang, McGraw Hill, 2011.
- 3 S.S Purohit ,Green Technology-An approach for sustainable Environment, Agrobio publication, 2011.
- 4 Meadows, D. Randers, J., Meadows. D. (2004) Limits to growths. The 30-year update. Chelsea Green Publishing.
- 5 Meadows, D. (2008) Thinking in systems. Chelsea Green Publishing.

Text Books:

- 1 David T. Allen and David R. Shonnard, Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2012.
- 2 Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer; 1st edition; 4th printing, 2014. ISBN-10: 1402035578

Electronic Resources

1. https://archive.nptel.ac.in/courses/127/105/127105018/?utm_source=chatgpt.com
2. https://www.coursera.org/learn/sustainability/?utm_source=chatgpt.com

Useful websites / Video



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1. <https://youtu.be/X5zHBCsz42I?si=EXSKm3Tmtgz-9C2e>
2. <https://youtu.be/s7eFQfIRCjY?si=F3vBO5x2ObMWi0UZ>
3. <https://youtu.be/0Pvp4zT9x3I?si=JEEsSj0hrk9iVIGs>
4. <https://youtu.be/UMxcEQ61gZU?si=YJ6kxSro9IPRnCCQJ>
5. https://youtu.be/g2K6PXxtyB4?si=Vxcw_JyvqRRF4dxR

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	1	2	1	1	2	3	1	1	2	–	2	2	–
CO 2	3	2	2	2	2	2	3	–	–	2	–	2	3	2
CO 3	3	2	2	2	2	2	3	–	–	2	–	2	3	2
CO 4	3	2	3	2	2	2	3	–	–	2	–	2	3	2
CO 5	2	1	2	1	1	2	3	–	–	2	–	2	2	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224012 E						
Course Name	Elective VI- Geoinformatics						
Type of Course	DEC						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
	3	--	--	3			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	40	--	--	--	--	60	100

Prerequisites for the Course: Remote Sensing & GIS.

The course aims to:

Course Objectives	Description
1	To familiarize students with fundamental concepts and tools in geoinformatics applied to civil infrastructure.
2	To introduce applications of UAV, LiDAR, BIM-GIS integration, and digital twins in civil engineering.
3	To apply geoinformatics in areas like disaster management, asset monitoring, urban planning, and smart city infrastructure.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Describe the fundamentals of geoinformatics and its significance in civil engineering.
CO2	Acquire, process, and manage geospatial data using modern surveying technologies.
CO3	Interpret satellite imagery, UAV data, and LiDAR outputs for civil infrastructure planning.
CO4	Apply GIS-based spatial analysis, terrain modelling, and decision support systems in civil engineering projects.
CO5	Integrate geoinformatics for smart infrastructure management, disaster resilience, and digital infrastructure modelling.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Fundamentals of Geoinformatics for Civil Engineering: Introduction to Geoinformatics: Definition, components, and evolution, Role of geoinformatics in civil engineering projects: Highways, dams, pipelines, bridges. Geodetic principles and coordinate systems: Local, national, and global systems (WGS84, UTM, India-specific grids). Map projections: Importance in infrastructure mapping. Overview of spatial data types: Vector, raster, point clouds, DEM/DSM. Data quality parameters: Accuracy, precision, scale, Introduction to GIS, GPS, Remote Sensing, LiDAR, UAV. Case studies: Highway alignment, urban zoning, water resource mapping, National and international geospatial data policies (Geospatial Data Policy 2022).	8
2	Geospatial Data Acquisition for Civil Projects:	7



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	LiDAR surveying: Terrestrial and aerial LiDAR applications, Mobile Mapping Systems (MMS) for road inventories, Satellite Remote Sensing: IRS, Cartosat, Sentinel, Landsat applications, Field data collection mobile apps (KoboToolbox, QField) , Data pre-processing: Radiometric, geometric corrections, DEM generation for earthworks, drainage, and road profile analysis, Legal, safety, and operational guidelines for UAVs and LiDAR in India.	
3	Remote Sensing for Civil Infrastructure and Environmental Applications: Basics of remote sensing: EM spectrum, sensors, and platforms, Image interpretation and feature extraction, Change detection for urban growth and infrastructure monitoring, Multispectral, Hyperspectral, and Thermal imaging applications, Remote sensing for groundwater, hazard mapping, and pavement monitoring, Urban Heat Island mapping and mitigation, Soil erosion modelling and terrain analysis, Case studies: Dam reservoir monitoring, urban planning.	7
4	GIS Analysis and Infrastructure Decision Support: GIS components and data structures, Thematic mapping for infrastructure planning, Spatial analysis: Buffer, overlay, proximity, network analysis, Terrain modelling: Contours, slope, aspect, watershed analysis, DEM-based volume estimation for earthworks, Asset management using GIS, Disaster risk and vulnerability mapping, Urban traffic analysis and route optimization, MCDA for site selection.	7
5	Emerging Technologies in Geoinformatics for Civil Engineering: BIM and GIS integration for infrastructure projects, Digital Twin models for infrastructure, IoT-GIS integration for real-time monitoring, UAV-LiDAR integration for corridor mapping, Smart City GIS implementation, AI and Machine Learning in geospatial analysis, Web GIS applications and asset dashboards, Real-time monitoring with geospatial IoT, Geospatial data governance and privacy, Future trends: 3D city models, AR/VR in planning.	7

Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2 Understand	CO1	1,2,8,10,12	2
2	3 Apply	CO2	1,2,3,4,5,9,10,12	2
3	3 Apply	CO3	1,2,3,4,5,9,10,12	2
4	4 Analyze	CO4	1,2,3,4,5,8,9,10,11,12	2
5	4 Analyze	CO5	1,2,3,4,5,7,8,9,10,11,12	2

References Books:

Pinliang Dong, LiDAR Remote Sensing and Applications, CRC Press.
Houbing Song, Smart Cities: Foundations, Principles, and Applications, Wiley.
Jason Amadori, BIM and GIS Integration, CRC Press.

Text Books:

- 1 P.K. Garg, Remote Sensing and GIS for Civil Engineers, Khanna Publishers.
- 2 M. Anji Reddy, Geoinformatics for Natural Resource Management, BS Publications.



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3 N. Sateesh Gopi, Introduction to Geomatics, McGraw-Hill.

e Resources

1. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
2. https://onlinecourses.nptel.ac.in/noc20_ce20/preview

Useful websites / Video

- 1 <https://www.esri.com/training/catalog/57630434851d31e02a43ef28/getting-started-with-gis/>
- 2 https://onlinecourses.nptel.ac.in/noc22_ce78/preview
- 3 https://onlinecourses.nptel.ac.in/noc22_ce84/preview

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	-	-	-	-	-	2	-	2	-	2	-	2
CO 2	3	3	3	2	2	-	-	-	2	2	-	2	-	2
CO 3	3	3	3	3	2	-	-	-	3	3	-	2	-	2
CO 4	3	3	3	3	2	-	-	2	3	2	2	2	-	2
CO 5	3	3	2	2	2	2	-	2	2	3	2	2	-	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Four Assignments on unit-1 to 4.	20
2	LMS Tests	20
	Total	40

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
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Course Code	CIV224013						
Course Name	Contract Tenders & Valuation						
Type of Course	LHSM						
Teaching Scheme and Credits Weekly Working Hrs	TH(Hrs.)	TU(Hrs.)	PR(Hrs.)	Total Credits			
	2	--	--	2			
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	50	--	--	--	--	--	50

Prerequisites for the Course: The basic knowledge of quantity surveying.

The course aims to:

Course Objectives	Description
1	To introduce valuation concepts, methodologies and factors influencing property valuation.
2	To develop the ability to analyze tenders, contracts, and valuation methods for effective decision-making in the construction industry.
3	To impart knowledge of arbitration procedures as per the Indian Arbitration & Conciliation Act (1996) for dispute resolution.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	Interpret depreciation, obsolescence, and other financial concepts related to valuation.
CO2	Analyze the legal aspects of contracts in construction projects.
CO3	Assess property values using appropriate valuation methods.

Course context, Relevance, Practical Significance:

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Tenders: Tenders: Definition, detailed tendering process and procedure, conditions regarding earnest money, security deposit, retention money, pre and post qualification of contractors, 3 bid, 2 bid and single bid system, qualitative and quantitative evaluation of tenders, comparative statement, pre-bid conference, acceptance/ rejection of tenders, BOT & Global Tendering, E-tendering. PWD procedure for executing, works piecemeal, rate list and daily labor, introduction to registration as a contractor in PWD.	8
2	Contracts: Definition, objectives & essentials of a valid contract as per Indian Contract Act (1872), types of contracts, conditions of contract- defective work, subletting, etc. termination of contract, defect liability period, liquidated damages, interim payment or running account bills, advance payment, secured advance, final bill. Arbitration: Introduction to arbitrations as per Indian Arbitration & Conciliation Act (1996) - meaning and need of arbitration, qualities and powers of an arbitrator.	8
3	Valuation: Introduction, valuation- purpose, types of property-real property and personal property, meaning of price, cost and value, factors affecting value, gross income, net income, outgoings, various forms of values.	8



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	concept of free hold and lease hold property, depreciation, methods of calculating depreciation, obsolescence, sinking fund, years purchase, annuity. Methods of valuation of land and building: rental basis, direct comparison method, profit based method, development method, and rent fixation for building. Methods of Valuation of land: belting method of land valuation and other methods.	
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Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	3 Apply	CO1	1,6,8,11,12	-
2	4 Analyze	CO2	1,6,8,11,12	1,2
3	5 Evaluate	CO3	1,2,3,4,5,6,8,11,12	1,2

References Books:

- 1 Valuation Principles and Procedures, Ashok Nain, Dewpoint Publication

Hand books and Indian Standards

- 1 Standard contract clauses for domestic bidding contracts: ministry of statistics and implementation, Government of India.
- 2 Document: Federation International Des Ingenieurs Conseils (FIDIC) i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.
- 3 Indian Practical Civil Engineers Handbook: P. N. Khanna, UBS Publication Distrib. Pvt. Ltd.
- 4 PWD Redbooks, Vol 1 & 2.

Text Books:

- 1 Civil Engineering Contracts and Estimates, B. S. Patil, Universities press
- 2 Estimating, Costing Specifications & valuation in Civil Engineering, M. Chakraborty
- 3 Theory and Practice of Valuation, Dr. Roshan Namavati, Lakhani Publications

e Resources

1. https://onlinecourses.nptel.ac.in/noc22_lw06/preview?utm_source=chatgpt.com
2. https://archive.nptel.ac.in/courses/105/104/105104161/?utm_source=chatgpt.com

Useful websites / Video

1. <https://youtu.be/a2DygWmJefo?si=kCzETNUPVHMN5baX>
2. https://youtu.be/waTs8Td8c_E?si=EEb1-W1hTKKb4pEN

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped
 • Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	-	-	-	2	-	1	-	-	1	3	-	-
CO 2	3	-	-	-	-	2	-	1	-	-	1	3	2	2
CO 3	3	2	1	1	1	2	-	1	-	-	1	3	2	2



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Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Three Assignments on unit-1 to 3.	15
2	LMS Tests	05
3	Preparing valuation report of a Residential and Commercial building and writing report	20
4	Preparation of tender documents for G+ 1 frame structure (Preparation of schedule A & B, conditions of contract regarding time, labour payment, etc.) and collection of tender notice for different government construction works (minimum 3)	10
	Total	50

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. K. Wagh Institute of Engineering Education and Research, Nasik
Final Year B. Tech. (Autonomous Syllabus 2022 Pattern)

Course Code	CIV224014						
Course Name	Internship						
Type of Course	PSI						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	--	--		24		12	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	--	200	--	100	--	--	300

Prerequisites for the Course: Fundamentals of Civil Engineering, basic knowledge of civil engineering softwares.

The course aims to:

Course Objectives	Description
1	Identify latest technical/practical problems in the field of Civil Engineering.
2	Inculcate the ability to describe, interpret and analyze technical content.
3	Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

On completion of the course, learner will be able to–

Course Outcomes	Description
CO1	To understand professional practices and workplace dynamics through industry internship.
CO2	To apply professional, societal ethics in their day to day life and theoretical knowledge in real-world scenarios through industry internship.
CO3	To analyze professional workflows and industry challenges through internship experience.
CO4	To evaluate industry standards and practices to enhance professional competence through internship
CO5	To design innovative solutions and contribute to industry projects through internship experience.

Course context, Relevance, Practical Significance:.

Course Contents:

Unit and Chapter	Contents	Lecture Hours
1	Guidelines of Internship: - Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales. Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations. Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The	



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following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

1. Duration:-

Internship to be completed after semester VII at least 24 weeks. It is to be assessed and evaluated in semester VIII.

2. Internship work Identification:

Student may choose to undergo Internship at Industry/Govt./NGO/MSME/Rural

Internship/Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry [1]. Contacting various companies for Internship and Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their VIIth semester examination. Student can take internship work in the form of online/onsite work from any of the following but not limited to:

- a. Working for consultancy/ research project
- b. Participation at events (technical/business) in innovation related completions like Hackathon
- c. Contribution in incubation/innovation/entrepreneurship cell/institutional innovation council/startups cells of institute
- d. Learning at departmental lab/tinkering lab/institutional workshop
- e. Development of new product/business plan/registration of start-up
- f. Participation in IPR workshop/leadership talks/ideal design/innovation/business completion/technical expos
- g. Industry/government organization internship
- h. Internship through Internshala
- i. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship
- j. Research internship under professors, IISC, IIT's, research organizations
- k. NGOs or social internships, rural internship
- l. Participate in open source development
- m. Development of Physical and/or numerical, mathematical, soft computing model
- n. Carrying out surveys related to society related but Engineering problems. For example, a survey of solid waste management in a particular area/town/village, survey of water supply network in a locality, town, village etc. , survey of air quality etc.

[1] <https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf>

3. Internship Diary/ Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered



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and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working. Internship diary/workbook and internship report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the institute immediately after the completion of the training. Internship diary/workbook may be evaluated on the basis of the following criteria.

- i. Proper and timely documented entries
- ii. Adequacy & quality of information recorded
- iii. Data recorded
- iv. Thought process and recording techniques used
- v. Organization of the information

4. Internship Work Evaluation:

Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by programme head/cell in-charge/project head/ faculty mentor or Industry Supervisor based on overall compilation of internship activities, sub-activities, level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and evaluation is to be done in consultation with internship supervisor (internal and external) and a supervisor from place of internship.

Recommended evaluation parameters:

Post internship internal evaluation 50 Marks and internship diary/workbook and internship report 50 Marks. Evaluation through Seminar Presentation/Viva-Voce at the Institute.

The student will present a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria.

Depth of knowledge, communication skills, presentation skills, team work, creativity, planning & organizational skills, adaptability, analytical skills, attitude and behavior at work, societal understanding, ethics, regularity and punctuality, attendance record, log book, student's feedback from external internship supervisor.

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact industrial supervisor/faculty mentor/TPO for assigning special topics and problems and should prepare the final report on the student's presence physically, if the student is found absent without prior intimation to the department/institute/concern authority/T & P Cell, entire training can be cancelled.

The report shall be presented covering following recommended fields but not limited to:

Title/cover Page

Internship completion certificate

Internship place details: Company background-organization and



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	activities/scope and object of the study/personal observations Index/table of contents Introduction Title/problem statement/objectives Motivation/scope and rationale of the study Methodological details Results/analysis/inferences and conclusion Suggestions/recommendations for improvement to industry, if any Attendance record Acknowledgement List of reference (books, magazines and other sources) 5. Feedback from internship supervisor (external and internal): Post internship, faculty coordinator should collect feedback about student with following recommended parameters. Technical knowledge, discipline, punctuality, commitment, willingness to do the work, communication skill, individual work, team work and leadership	
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Course Mapping :

Unit and Chapter	Bloom's Taxonomy Level	CO Mapped	PO Mapped	PSO Mapped
1	2-Understand, 3-Apply, 4-Analyze, 5-Evaluate, 6-Create	CO1, CO2, CO3, CO4, CO5, CO6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12	PSO1, PSO2

Strength of CO - PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	3	3	3	3	3	3	3	3	3	3	1	1
CO 2	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO 3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson