



Walchand Institute of Technology, Solapur
(An Autonomous Institute)

Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University,
Solapur

Choice Based Credit System (CBCS)
Structure and Syllabus

for
T. Y. B.Tech. Civil Engineering

W.E.F. 2025-26

Department of Civil Engineering

Vision

- To excel and lead in education, research, and innovation, contributing to the advancement of design, construction, and maintenance of infrastructure, to enhance the quality of life for humanity in a sustainable way.

Mission

- **M1:** To provide an outstanding learning experience through a rigorous curriculum of theory and practice that develops students' technical and professional skills to succeed in a wide range of careers.
- **M2:** To continually advance research through a culture of discovery, creativity, and innovation to benefit humankind.
- **M3:** To serve as highly capable resources to society, and the profession through professional organizations, consultancy, and continuing education.



Department of Civil Engineering

Program Educational Objectives (PEOs)

- Graduate will demonstrate peer-recognized technical competency in the analysis, design and construction of Civil Engineering Structures.
- Graduates will demonstrate leadership and initiative to advance professional and organizational goals with a commitment to ethical standards of profession, teamwork and respect for diverse cultural backgrounds.
- Graduates will be engaged in ongoing learning and professional development through pursuance of higher education and self-study.
- Graduates will be committed to create practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.

Knowledge and Attitude Profile (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.



WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking, and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behaviour, and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes.
Program Outcomes (POs)	
PO 1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO 2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 3	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO 4	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO 5	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO 6	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).



PO 7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning difference
PO 10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO 11	Life-long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)
Program Specific Outcomes (PSOs)	
<ul style="list-style-type: none"> • PSO 1: Graduates will be able to survey, conduct geotechnical investigations, plan, analyze, design, estimate, and construct residences, public buildings, industrial buildings, townships, and infrastructural projects by adopting appropriate construction methods. • PSO 2: Graduates will be able to analyze and design the water resources systems, and municipal and industrial waste treatment plants with due consideration to a pollution-free environment. • PSO 3: Graduates will be able to use appropriate application software, develop skills necessary for professional practice as a Civil Engineer, and prepare themselves for competitive examinations for higher education & for public service commissions 	



Department of Civil Engineering

Legends Used

L	Lecture Hours / week
T	Tutorial Hours / week
P	Practical Hours / week
FA	Formative Assessment
SA	Summative Assessment
ESE	End Semester Examination
ISE	In Semester Evaluation
ICA	Internal Continuous Assessment
POE	Practical and Oral Exam
OE	Oral Exam
MOOC	Massive Open Online Course
HSS	Humanity and Social Science
NPTEL	National Programme on Technology Enhanced Learning
F.Y.	First Year
S.Y.	Second Year
T.Y.	Third Year
B. Tech.	Bachelor of Technology



Department of Civil Engineering

Course Code Format

2	3	C	E	U/P	2	C	C	1	T/L
Year of Syllabus revision	Program Code			U-Under Graduate P-Post Graduate	Semester No./ Year 1/2/3/...8	Course Type	Course Serial No 1-9		T-Theory, L-Lab session A-Tutorial P-Programming / Design

Program Code

CE	Civil Engineering
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Course Type

BS	Basic Science
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ES	Engineering Science
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HU	Humanities & Social Science
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MC	Mandatory Course
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CC	Program Core Compulsory Course
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SN*	Self-Learning (<i>N* indicates the serial number of electives offered in the respective category</i>)
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EN*	Program Core Elective Course (<i>N* indicates the serial number of electives offered in the respective category</i>)
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SK	Skill-Based Course
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SM	Seminar
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MP	Mini project
PR	Project
IN	Internship
ON*	Open Elective (N* indicates the serial number of electives offered in the respective category)
MD	Multidisciplinary Minor
EM	Entrepreneurship/Economics/Management Courses
FP	Community Engagement Project / Field Project
AE	Ability Enhancement Course
VE	Value Education Course
IK	Indian Knowledge System
VS	Vocational & Skill Enhancement Course
RM	Research Methodology
HN	Honors' Degree Course
HR	Honors Research
Sample Course Code	
23CEU5CC1T	Design of Steel Structures



Department of Civil Engineering

B. Tech. Semester V

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/POE	ISE	ICA	
23CEU5CC1T	Design of Steel Structures	3	-	-	3	60		40	-	100
23CEU5CC2T	Geotechnical Engineering	2	-	-	2	60		40	-	100
23CEU5CC3T	Hydrology and Water Resources Engineering	3	-	-	3	60		40	-	100
23CEU5EN*4T	Programme Elective I	3	-	-	3	60		40	-	100
23CEU5IK5T	Indian Knowledge System II – Heritage Building of India	2	-	-	2	-		50	-	50
23CEU5MD6T	Multidisciplinary Minor III	3	-	-	3	60		40	-	100
23##U5OE7T	Open Elective III (MOOC)	-	-	-	2	50		-	-	50
23CEU5CC8T	Transportation Engineering	2	-	-	2	60		40		100
Subtotal		18	-	-	20	410		290	-	700
Laboratory Courses										
23CEU5CC2L	Geotechnical Engineering Lab	-	-	2	1		25		25	50
23CEU5EN*4L	Programme Elective I Lab	-	-	2	1		-		25	25
23CEU5CC8L	Transportation Engineering Lab	-	-	2	1		25		25	50
Subtotal		-	-	6	3	-	50		75	125
Grand Total		18	-	6	23	410	50	290	75	825

Note:

- N* indicates the serial number of electives offered in the respective category
- ## indicates the program code of the offering Programme.



Department of Civil Engineering

B. Tech. Semester VI

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/ POE	ISE	ICA	
23CEU6CC1T	Foundation Engineering	3	-	-	3	60	-	40	-	100
23CEU6CC2T	Engineering Economics, Estimation & Costing	3	-	-	3	60	-	40	-	100
23CEU6CC3T	Design of Concrete Structures	3	-	-	3	60	-	40	-	100
23CEU6EN*4T	Programme Elective Course – II	3	-	-	3	60	-	40	-	100
23CEU6EN*4A	Programme Elective Course – II (Tutorial)		1	-	1		-		25	25
23CEU6EN*5T	Programme Elective Course – III	3	-	-	3	60	-	40	-	100
23CEU6EN*5A	Programme Elective Course – III (Tutorial)	-	1	-	1	-	-	-	25	25
23CEU6MD6T	Multidisciplinary Minor IV	2	-	-	2	60	-	40	-	100
	Subtotal	17	2		19	360	-	240	50	650
Laboratory Courses										
23CEU6CC2L	Engineering Economics, Estimation & Costing Lab	-	-	2	1	-	25	-	25	50
23CEU6MD6L	Multidisciplinary Minor IV Lab	-	-	2	1	-	-	-	25	25
23CEU6VS7L	Steel Structural Design and Drawing Lab	1	-	2	2	-	25	-	50	75
	Subtotal	1	2	6	4	-	50	-	100	150
	Grand Total	18	2	6	23	360	50	240	150	800

- N* indicates the serial number of electives offered in the respective category
- ## indicates the program code of the offering Programme



- **List of Programme Elective-I**

List of Program Elective I (Semester-V)	
Course Code	Course Title
23CEU5E14T	Sanitary Engineering and Solid Waste Management
23CEU5E24T	Construction Engineering Materials
23CEU5E34T	Earth Retaining Structures

- **List of Program Elective II**

List of Program Elective II (Semester-VI)	
Course Code	Course Title
23CEU6E14T	Hydraulic Structures and Water Power Engineering
23CEU6E24T	Structural Analysis by Matrix Methods
23CEU6E34T	Railway, Airport, and Harbour Engineering

- **List of Program Elective III**

List of Program Elective III (Semester-VI)	
Course Code	Course Title
23CEU6E15T	Advanced Concrete Technology
23CEU6E25T	Design of RCC Bridges
23CEU6E35T	Total station and GPS surveying
23CEU6E45T	Open Channel Flow and River Hydraulics



- **For 23##U5OE7T: Open Elective III (MOOC) in Semester V:**

1. Students are required to enroll in one of the courses of a minimum duration of 8 weeks offered on the SWAYAM/NPTEL platform. The list of courses will be finalized and released by the Board of Studies each year.
2. A list of MOOCs will be provided by the department, depending on the availability of the courses in that semester under NPTEL / Swayam or Other recognized MOOC Platforms as per suggestions by the BoS.
3. Students may enroll for the course in Semester IV or V. They must complete all assignments and appear for the certification examination conducted by SWAYAM/NPTEL.
4. Students must pass the examination by the end of Semester V. The marks earned by the student in the final assessment of this MOOC will be appropriately scaled and transferred to **Open Elective III (MOOC)** in Semester V.

- **For Courses offered during Semester VIII for A.Y. 2026-27**

<i>Sr. No</i>	<i>Course Code</i>	<i>Option I</i>	<i>Option -II</i>
1	23CEU8CC1T	MOOC Certification*	'Life Cycle Analysis' course offered by the department during Semester VIII in Self-Learning / Online mode, and successfully passing the ESE for the same.
2	23CEU8EN*2T	MOOC Certification*	'Program Elective VI' course offered by the department during Semester VIII in Self-Learning / Online mode, and successfully passing ESE for the same. Program Elective VI options: Geosynthetics and soil structures Water Power Engineering Infrastructure Planning and Management

* Student has to complete this MOOC in any semester of V, VI, VII, or VIII. In semester VIII, the marks earned by the student in the final assessment of this MOOC will be appropriately scaled and transferred for 23CEU8CC1T and/or 23CEU8EN*2T along with the required credits.

The list of approved MOOCs will be finalized and released by the Board of Studies each year.



- **Multidisciplinary Minor (MDM) Courses**

Sr. No	MDM Program	MDM I (Sem III)	MDM II (Sem IV)	MDM III (Sem V)	MDM IV (Sem VI)	MDM V (Sem VII)
1	Computer Science and Engineering	Operating System	UI Technologies	Software Engineering	Big Data Technologies	Software Testing and Quality Assurance
2	Information Technology	Principles Of Operating Systems	Web Technology (UI/ UX)	Software Engineering Principles	DevOps	Cyber Security
3	Mechanical and Automation Engineering	Manufacturing Processes and Mechanisms	Machine Drawing and 3D Modeling	Automotive Engineering and Robotics	Additive Manufacturing	Thermal Engineering
4	Electronics and Telecommunication Engineering	Fundamentals of Electronic Circuits	Electronics Design and Prototyping	Introduction to Embedded Systems	Fundamentals of Communication Techniques	Enclosure and Communication Design for IoT
5	Electronics and Computer Engineering	Analog Electronics	Digital Electronics	Microcontrollers and Peripherals	Advanced Controllers and Interfacing	Electronic System Design





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5CC1T: Design of Steel Structures

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Credits	3	ISE	40 Marks

Introduction:

This course covers principles of limit state design for structural steel members, various types of rolled sections and its classifications. The curriculum includes the design of connections, tension members, compression members, beams, and column bases. Introduction to pre-engineered buildings.

Course Prerequisite:

Basic knowledge of structural mechanics and engineering mathematics.

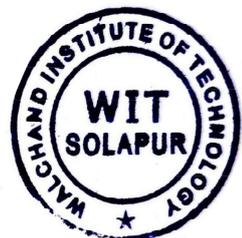
Course Objectives:

1. Apply Principles of limit state design in structural steel, apply safety factors to evaluate load resistance, and differentiate between various types of rolled sections and connections
2. Apply theoretical and practical knowledge to design tension members, analyse connections with gusset plates using bolts and welds
3. Analyse and design compression members and built-up columns
4. Design of laterally supported and unsupported beams under low/high shear, Design of column bases under axial load and uniaxial bending, including slab and gusseted bases
5. Design Industrial shed components, trusses, purlins, and Pre-engineered building parameters.

Course Outcomes:

After completing the course, students will be able to

1. Categorize steel cross-sections based on their geometric properties, and evaluate bolted and welded connections under different loading and load combinations.
2. Evaluate load carrying capacities, design of tension members to ensure structural integrity and safety.
3. Calculate load capacities, design compression members and built-up columns, select appropriate sections for buckling resistance, and design effective connections
4. Analyse and design laterally supported and unsupported beams. Design column bases to resist axial load and uniaxial bending, ensuring structural stability and safety through robust slab, and gusseted bases



5. Design components of industrial sheds, trusses members, loads on purlin, Pre-engineered building components and design parameters		
Unit – I	Introduction to Design of Steel Structures	4 Hours
Steel as a structural member, Philosophy of limit state design for strength and serviceability, partial safety factor, Loading and load combinations, Types of standards rolled sections, Types of connections (Flexible, rigid, semi-rigid connection), IS codes provisions, specifications, and section classification as plastic, compact, semi-compact, and slender.		
Unit – II	Design of Connections	5 Hours
Bolted Connections, Types of bolts, Failure of bolted joints, IS Specifications of bolted connections, type of connections (Lap and Butt joints), Efficiency of bolted connections, design of eccentric bolted connection subjected to in-plane and out-of-plane loading. Welded connections, Types of welded joints, Design strength of fillet weld, Design strength of butt weld, design of eccentric welded connections subjected to in-plane and out-of-plane loading.		
Unit – III	Tension Members	6 Hours
Types of Tension members, Gross and net effective area, Limit strength due to yielding, rupture, and block shear, Load carrying capacity, Design of tension member, Connections design of the member with gusset plate by bolts and welds.		
Unit – IV	Compression Members-Struts	5 Hours
Common sections used for compression members, buckling classification as per geometry of cross-section, buckling curves, Effective length and slenderness ratio, Load carrying capacity, design of struts, Connections of members with gusset plate by bolts and welds.		
Unit – V	Columns	7 Hours
Simple and built-up section, Design of built-up column, lacing and battening, connection of lacing/battening with main components by bolts and welds, column subjected to axial force and bending moment, column splices, design of eccentrically loaded column subjected to uniaxial bending (check for section strength only), design of beam-to-column connections using bolt/weld.		
Unit – VI	Beams	6 Hours
Laterally supported and unsupported beams, Design of laterally supported/ laterally unsupported beams subjected to low/ high shear. Secondary and main beam arrangement for the floor of the building, design of beam-to-beam connections using bolt/weld.		



Unit – VII	Column Bases	5 Hours
Column base under axial load: design of slab base, gusseted base, design of anchor bolts, design of a pedestal, Column base for axial load and uniaxial bending		
Unit – VIII	Introduction to Industrial Roof Trusses and Pre-Engineered Building	7 Hours
Various components of an industrial shed, Types of trusses, load calculation and combination, design of purlins, design of members of a truss. Advantage and application of PEB, Difference between conventional steel building and PEB, Design parameters of PEB frames		
Note: Use of IS: 800-2007, IS 875 latest codes, IS: Handbook for steel section and steel table is permitted in ESE examination.		
Text Books		
<ol style="list-style-type: none"> 1. Design of Steel Structures, by N. Subramanian, Oxford, 2008 2. Limit State Design of Steel Structures, by S. K. Duggal 3. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. K 4. International Publishing House, New Delhi 5. Limit state design in Structural Steel by Dr M. R. Shiyekar 6. Design of Steel structures by K. S. Sai Ram 7. Design of Steel structures by L. S. Jayagopal and D. Tensing 		
Reference Books		
<ol style="list-style-type: none"> 1. Limit state design of Steel Structure by V. L. Shah & Gore, Structures Publication, Pune 2. Limit State Design of Steel Structures by D. Ramchandra & Virendra Gehlot, Scientific Publishers 3. Structural Design and Drawing Reinforced Concrete and Steel by N. Krishnaraju, 4. Universities Press (India) Pvt. Ltd. Hyderabad. 5. Bureau of Indian Standards, IS800-2007, IS875-latest. 6. Steel Tables SP: 6(1) and SP: 6(6) 		
e-Resources		
<ol style="list-style-type: none"> 1. Web links and Video Lectures (e-Resources): https://nptel.ac.in/courses/105105162 2. Teaching Resource Material by INSDAG 		





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5CC2T: Geotechnical Engineering

Teaching Scheme		Examination Scheme	
Lectures	2 Hours/week	ESE	60 Marks
Practical	2 Hours/week	ISE	40 Marks
Credits	3	ICA	25 Marks
		POE	25 Marks

Introduction:

This course covers Geotechnical Engineering fundamentals, concentrating on assessing soil evaluation indices, engineering properties, and classification systems. It also covers soil permeability and seepage employing hydraulic flow principles. Moreover, it covers fundamentals of soil shear strength, soil compaction, consolidation settlement and the evaluation of earth pressure.

Course Prerequisite:

Basic knowledge of Fluid Mechanics, Mechanics of Structure, and Engineering Mathematics

Course Objectives:

1. To introduce geological formations and the geological structure of a region
2. To impart knowledge of soil index properties, their evaluation, and classification.
3. To provide the basics of soil permeability and seepage using hydraulic flow principles.
4. To provide a basic understanding to assess soil shear strength through laboratory experimentation under different drainage conditions.
5. To impart the knowledge of compaction and consolidation settlement of soil.
6. To introduce the various types of earth pressure and their evaluation

Course Outcomes:

After completing the course, students will be able to

1. Describe geological formations and the geological structure of a region.
2. Evaluate various index properties, their interrelationship, and classify the soil.
3. To apply hydraulic flow principles to estimate permeability and seepage through the soil mass.
4. Determine shear strength through laboratory processes under different drainage conditions.
5. Evaluate compaction and consolidation settlement of soil for given loading conditions.
6. Apply earth pressure theories to estimate the earth pressure for earth retaining structure.



Unit – I	Introduction to Geology	3 Hours
Branches of geology useful to civil engineering, the scope of geological studies in various civil engineering projects. Identification of major rock-forming minerals, Classification of igneous, sedimentary, and metamorphic rocks, Engineering properties of rocks and their relevance to construction. Faults, folds, joints, and their engineering significance.		
Unit – II	Index properties of soil	5 Hours
Definition of soil and soil engineering, Application areas of soil mechanics, 3-phase soil system. Terminology used in basic soil properties (Voids ratio, Porosity, Degree of saturation, Percentage air voids, air content, different densities & unit weights) and their interrelationship, field density. Specific gravity and its determination methods, Density index. Atterberg's limits and their significance. Grain size distribution by mechanical & sedimentation analysis, I.S. classification system of soil,		
Unit – III	Permeability and seepage analysis of soil	5 Hours
Permeability – head, gradient and potential, Darcy's law and its validity, Factors affecting permeability, Field and laboratory methods of determining permeability, seepage pressure, Quicksand condition, critical hydraulic gradient, Derivation of Laplace's equation, flow net and its application,		
Unit – IV	Shear Strength of soil	6 Hours
Concept of shear strength, Mohr's strength theory, Mohr-Coulomb theory, conventional and modified failure envelopes, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils. Measurement of shear parameters- Direct shear test, unconfined compression test, Triaxial compression test, and vane shear test, Test under different drainage conditions.		
Unit – V	Compaction and consolidation of soil	6 Hours
<p>Compaction: Theory of compaction, Laboratory Light and Heavy compaction test, Compaction properties, factors influencing compaction Method and measurement of field compaction, field compaction control.</p> <p>Consolidation: - Definition, compressibility of the laterally confined soil, compression of sand and clay, e-p curve, e-log p curve, compression index.</p> <p>Basic terminology, Terzaghi's theory of one-dimensional consolidation, consolidation test, determination of coefficient of consolidation, degree of consolidation, relevance of one-dimensional consolidation to field conditions, time factor.</p>		
Unit – VI	Earth pressure theory	5 Hours



Concepts, Area of application, Earth pressure at rest, active and passive conditions. Rankine's and Coulomb's theory of earth pressure, Graphical Solution-Trial wedge method, Rehman's construction and modification. Critical depth of open cut in cohesive soil.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Term work shall consist of at least eight of the following experiments in the laboratory:

1. Specific gravity determination of coarse- and fine-grained soil
2. Particle size distribution- Mechanical sieve analysis
3. Determination of Atterberg's consistency limits
4. Determination of the coefficient of permeability
5. Determination of Field density by Sand replacement & Core cutter method.
6. Proctor compaction test: Light & Heavy
7. Direct box shear test
8. Unconfined compression test
9. Tri-axial test
10. Laboratory Vane Shear Test.
11. One-dimensional consolidation test

Text Books

1. Soil Mechanics and Foundation Engineering- B.C. Punmia (Laxmi Publications (Pvt) Ltd, New Delhi)
2. Basic and Applied Soil Mechanics (Revised Edition) – Gopal Rajan and Rao A.S.R. (New Age, New Delhi, 1998)

Reference Books

1. Geotechnical Engineering- Purushottam Raj [Tata McGraw-Hill Company Ltd, New Delhi]
2. Soil Mechanics and Foundation Engineering - Dr. K. R. Arora, [Standard Publication]
3. Soil Mechanics and Foundation Engineering -V.N.S. Murthy [UBS publishers and distributors, New Delhi]
4. Geotechnical Engineering- Kasamalkar B.J. [Pune Vidyarthi Griha Prakashan, Pune]
5. Geotechnical Engineering - C. Venkatachalam [New Age International (I) Ltd, New Delhi]
6. Principles of Geotechnical Engineering- Braja M. Das (Cengage Learning India Pvt. Ltd, New Delhi)
7. I.S.:2720-(Part-III) and (Part-IV), I.S.2720-1966(Part-XXIX), I.S.2720-1974(Part-XXVIII), I.S.2720-(Part-V)-1985, I.S.2720-1972 (Part-VI).

E-resource:

1. <http://nptel.ac.in/courses/105101084/>
2. <http://nptel.ac.in/courses/105106142/>





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

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Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5CC3T: Hydrology and Water Resources Engineering

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Credits	3	ISE	40 Marks
Introduction:			
This course deals with the study of the Hydrological cycle from the aspect of measurement of rainfall and runoff for quantification the availability of Surface water and groundwater resources. National and State water policies are discussed along with Irrigation techniques, water conservation methods, and water management strategies.			
Course Prerequisite:			
The course requires a basic knowledge of statistics.			
Course Objectives:			
<ol style="list-style-type: none">1. To learn techniques of measurement of rainfall and corresponding runoff estimation2. To acquire knowledge of flood estimation3. To know about groundwater water its availability, and harnessing methods4. To know about National and State Water Policies and Water Resources Projects5. To study various irrigation techniques6. To learn watershed management principles for soil and water conservation			
Course Outcomes:			
At the end of the course, students will be able to			
<ol style="list-style-type: none">1. Estimate runoff, based on rainfall data and watershed characteristics.2. Estimate design flood for Civil Engineering Projects.3. Calculate the yield of open well and tube well for various types of aquifers using knowledge of Groundwater Hydrology.4. Elaborate on National and State Water Policies and upcoming Water Resources Projects.5. Select the appropriate water application technique of irrigation, depending upon type of crop, soil moisture and water availability.6. Select suitable soil & water conservation techniques for particular watersheds.			



Unit – I	Introduction to Hydrology	7 Hours
<p>Definition, History, and importance of hydrology, The hydrological cycle, Weather, and its precipitation potential. Precipitation: Forms and types of precipitation, Different methods of measurement, Factors affecting precipitation at a location, correcting precipitation data, Estimating missing data, Estimation of extreme values, Rain gauge network, Determination of average precipitation over the catchments, Analysis of precipitation data, Mass rainfall curves, Intensity-duration curves, Concept of depth-area- duration analysis, Frequency analysis.</p> <p>Evaporation and Evapotranspiration: Factors affecting evaporation, Measurement, and control of evaporation upon reservoirs. Evapotranspiration- definition and measurement</p> <p>Infiltration: Process of Infiltration, Factor affecting infiltration, Infiltration indices, Effect of infiltration on runoff and groundwater recharge.</p>		
Unit – II	Rainfall-runoff Relationship	6 Hours
<p>Factors affecting runoff, Catchment yield calculations, Rainfall-runoff relationship Hydrograph: Base flow, Separation of base flow, Unit hydrograph – theory, assumptions, and limitations, Derivation and use of unit hydrograph, S-curve hydrograph.</p>		
Unit – III	Stream gauging	5 Hours
<p>Selection of a site, various methods of discharge measurements, Area velocity method, Slope Area method, S.W.F., and other modern methods.</p> <p>Floods: Definition, Factors affecting, Estimation of peak flow, Rational and other methods, Design flood, hydrograph components, Recurrence period.</p>		
Unit – IV	Groundwater Hydrology	5 Hours
<p>Occurrence and distribution of groundwater, Specific yield of aquifers, Movements of groundwater, Darcy’s law, Permeability, Safe yield of the basin, Hydraulics of well under steady flow condition in confined and unconfined aquifers, Specific capacity of a well, Well irrigation: tube wells, open wells, their design, and construction</p>		
Unit – V	Water Resources Development in India and Maharashtra	6 Hours
<p>Water Resources Development in India & Maharashtra: National water policy of India, Water Policy of Maharashtra State, Development of irrigation potential through five-year plans, Water resources potential of India, Water Resources development in India, Problems in water resources developments in country and Maharashtra state. Inter-basin transfer of water: Concept of inter-basin transfer of water, proposed inter-basin transfer of water from surplus regions of India to</p>		



deficit regions of India, National perspective plan of India-Himalayan rivers component and peninsular rivers components.		
Unit – VI	Irrigation	6 Hours
<p>Irrigation: Definition and necessity of Irrigation, Different systems of irrigation-Flow, Lift, Inundation, Storage. Sources of water-river, well, tanks.</p> <p>Water Application Methods: Methods of lifting water and application of water to soils, Sprinkler, Drip, Basin, Furrow. Layout of Drip Irrigation System.</p> <p>Lift Irrigation: Necessity, General Layout, Main Components of a lift irrigation scheme, Elementary design of Lift Irrigation Scheme.</p> <p>Minor Irrigation System: Necessity and general layout of percolation tanks, Bandhara irrigation, Kolhapur type weirs</p>		
Unit – VII	Soil and Crop Water requirement	5 Hours
<p>Soils: Types of Soils, Suitability of soils for different crops, Soil moisture, Wilting coefficient, Texture and physical structure, Harmful components in soil, Preparation of soil for irrigation.</p> <p>Crop Water requirements: Cash crops and food crops, Water requirement of different crops, Duty and Delta, Factors affecting duty and delta, Crop Seasons in Maharashtra and India, Command Area- Gross, Culturable, Irrigable, Calculation of water required</p>		
Unit – VIII	Water Management	5 Hours
<p>Watershed Management: Need of Watershed Management, Importance of soil and water conservation measures, Reservoir sedimentation. Techniques for Rainwater harvesting and groundwater harvesting.</p> <p>Water Management: Application of water, Water management and distribution, cooperative water users' organizations, Warabandi, Rotational applications, Assessment of canal revenue- various methods.</p> <p>Applications of Remote Sensing and Geographic Information Systems in Water Resources Engineering.</p>		
Text Books		
<ol style="list-style-type: none"> 1. Irrigation Engineering and Hydraulic Structures-S. K. Garg, Khanna Publishers, Delhi. 2. Irrigation and Water Power Engineering- Dr. Punmia, Dr. Pande, Laxmi Publications. 3. Engineering hydrology- K. Subramanya, Tata McGraw- Hill Publishers. 4. Efficient Use of Irrigation Water-G. H. Sankara Reddi, Kalyani Publishers, Noida. 5. Water Management in India-J. V. S.Murthy. 		



Reference Books

1. Irrigation theory & Practice – Michael, Vikas Publishing House
2. Irrigation Structures- Milos Holy-CBIP
3. Water Management-Jaspal Singh, M. S. Acharya, Arun Sharma. Pub- Himanshu Publication
4. Design of Minor Irrigation and Canal Structure- Satyanarayan and R. Murthy
5. Efficient Use of Irrigation Water-G. H. Sankara Reddi, Kalyani Publishers, Noida.
6. Water Management in India-J. V. S.Murthy
7. Water Management, Conservation, Harvesting and Artificial Recharge- Dr. A. S. Patel, Dr. D. L. Shah, New Age International Publishers
8. Applied Hydrology, K.N. Muthreja, McGraw Hill Publications

e-Resources:

1. Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation:<http://mowr.gov.in/policies-guideline/policies/national-water-policy>
2. Maharashtra water resources regulatory authority: <https://mwrra.org/>
3. National Remote Sensing Center: <https://www.nrsc.gov.in/>
4. National Water Development Agency: <https://nwda.gov.in>
5. India Water Resources Information System: <https://indiawris.gov.in/wris>





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5E14T: Programme Elective Course I-Sanitary Engineering and Solid Waste Management

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Practical	2 Hours/week	ISE	40 Marks
Credits	4	ICA	25 Marks
Introduction:			
The course covers scientific and engineering principles for environmental sustainability, focusing on wastewater management, quality analysis, and treatment system design.			
Course Prerequisite:			
Environmental Engineering, and Fluid Mechanics			
Course Objectives:			
<ol style="list-style-type: none">1. To familiarize students with concepts of wastewater engineering & solid waste processing.2. To provide students with the pertinent knowledge for the design and operation of waste management facilities.3. To prepare students for higher studies and research in the field of waste management and pollution control.4. To make students aware of recent advances in waste management.			
Course Outcomes:			
After completing the course, students will be able to			
<ol style="list-style-type: none">1. Classify the sources, characteristics, and collection systems of wastewater and solid waste, and design sanitary and storm sewers.2. Describe the philosophy, processes, and design aspects of primary and secondary wastewater treatment methods.3. Analyze decentralized wastewater treatment technologies and recent innovations in treatment methods.4. Evaluate effluent disposal techniques, self-purification processes in streams using DO sag analysis, and apply treatment strategies for sludge and solid waste processing.			
Unit – I	Wastewater and Collection	6 Hours	



Wastewater: Sources, Flow rate and variations, Quantitative estimation, Characteristics Gravity sewer collection system: Nomenclature, Pumping station, Design of sanitary and storm sewer.		
Unit – II	Introduction to Wastewater treatment	6 Hours
Wastewater treatment: Philosophy, Unit operations and unit processes, Primary treatment: Screening, Grit removal, settling, Biological/Secondary treatment: Fundamentals of aerobic and anaerobic treatment, Classification.		
Unit – III	Aerobic Wastewater Treatment	8 Hours
Aerobic attached growth: Conventional Trickling filter (TF) and modifications, Process design and operating parameters (TF), Aerobic suspended growth: Conventional Activated Sludge Process (ASP) and modifications, Process design and operating parameters (ASP), Operational problems (ASP), Process design of oxidation ditch and Waste stabilization pond.		
Unit – IV	Decentralized treatments	8 Hours
Decentralized treatment: Concept, Septic tank and soakage pit, Anaerobic baffled reactor (ABR), Anaerobic filter (AF), Constructed wetland (CW), Fluidized aerobic bed Technology, Root zone Technology, Duckweed ponds, UASB, Typical system Advances in wastewater treatment: Moving bed bioreactor (MBBR), Membrane bioreactor (MBR), Sequential Batch Reactor (SBR)		
Unit – V	Effluent Disposal Techniques	6 Hours
Disposal of wastewater: Methods, Effluent standards, Stream pollution: Self- Purification (Stream rejuvenation), DO sag curve, Streeter Phelps's equation for point source, Stream classification, Sludge: Characteristics, thickening, dewatering, digestion, disposal.		
Unit – VI	Solid Waste	6 Hours
Solid Waste: Characteristics, Generation, Collection and transportation, Engineered systems for solid waste processing: Mechanical, Thermal, Biological, Sanitary land fill: Location, Components.		
<p>(A) List of Experiments (Any 6):</p> <ol style="list-style-type: none"> 1. Characteristics of sewage <ol style="list-style-type: none"> i. Bio-chemical oxygen demand (BOD) ii. Chemical oxygen demand (COD) 		



2. Estimation of BOD rate constant
 3. Determination of mixed liquor suspended solids, mixed liquor volatile suspended solids
 4. Determination of sludge volume index and sludge density index
 5. Sludge characterization
 - i. Moisture content
 - ii. Total, fixed and volatile solids
 6. Effect of sewage disposal on stream
 7. Design of sewerage system for a housing colony/Part of city
 8. Decentralized treatment system for a household/Apartment/housing colony
- (B)** Six assignments per unit, where students are required to develop wastewater treatment plant (WWTP) applications for real-world scenarios, along with a report on the wastewater treatment units at the plant visited.

Text Books

3. Engineering (Environmental Engineering I)", Standard Book House, 6th Edition, 2018.
4. Nathanson, J. A., "Basic Environmental Technology", PHI Learning private limited, 5th Edition, 2009.
5. Modi, P. N., "Wastewater Engineering" Standard Book House, 6th Edition, 2018.
6. Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian Edition, 2017.

Reference Books

1. Hammer M, J and Hammer M, J, "Water and Wastewater Technology", PHI learning private limited, 7th Edition, 2018.
2. Davis, M, L, and Cornwell, D.A., "Introduction to Environmental Engineering", Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.
3. Nathanson, J. A., "Basic Environmental Technology", PHI Learning private limited.

e-Resources

1. NPTEL, Course: Environmental Engineering: Wastewater Treatment
2. NPTEL, Course: Solid Waste Management





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5E24T: Programme Elective Course I-Construction Engineering Materials

Teaching Scheme

Lectures 3 Hours/week

Practical 2 Hours/week

Credits 3

Examination Scheme

ESE 60 Marks

ISE 40 Marks

ICA 25 Marks

Introduction:

This course introduces a wide range of construction engineering materials, including natural and engineered materials, focusing on the selection and use of materials like rocks, geosynthetics, timber, metals, steel, glass, and plastics in Civil Engineering.

Course Prerequisite:

Basic knowledge of Construction Materials.

Course Objectives:

1. To provide foundational knowledge of rocks and geosynthetics, focusing on their types, properties, and applications as essential construction materials in civil engineering.
2. To know the classification, its properties, types of wood and applications of timber in civil engineering construction.
3. Recognize the properties and applications of common ferrous and nonferrous metals and steel, with its application in construction.
4. To impart knowledge on the manufacturing processes, classifications, and construction applications of the glass and plastic materials in modern civil Engineering.

Course Outcomes:

After completing the course, students will be able to

1. Identify and evaluate suitable rock types and geosynthetic materials based on their properties and functionality for various civil engineering applications
2. Differentiate between types of timber and metals, and select appropriate wood products and metallic materials for specific structural and construction applications.
3. Select the appropriate ferrous and non-ferrous metals and steel for a specific civil engineering project.
4. Identify and explain the types, production methods, and practical applications of glass and plastics, and select suitable materials for structural and architectural purposes.



Unit – I	Rocks	6 Hours
<ul style="list-style-type: none"> ▪ Introduction. ▪ Rock engineering applications: Rocks as construction Materials and Other Civil Engineering applications. ▪ Common rocks in construction: Granite, Basalt, Sandstone, Limestone, and Marble. 		
Unit – II	Geosynthetics	10 Hours
<ul style="list-style-type: none"> ▪ Introduction of Geosynthetics, Types of Geosynthetics. ▪ Functions, Mechanisms, and Engineering Applications. ▪ Selection of Geosynthetics 		
Unit – III	Timber and Wood	6 Hours
<ul style="list-style-type: none"> ▪ Classification of timber: Hardwood and Softwood ▪ Structure of wood. ▪ Types of wood ▪ Engineered wood: Plywood, Medium Density Fiber board (MDF), High Density Fibreboard (HDF), Oriented Strand Board (OSB). ▪ Bamboo as a construction material. 		
Unit – IV	Metals and Alloys	6 Hours
Metals and Alloys <ul style="list-style-type: none"> ▪ Introduction. ▪ Ferrous alloys: Iron-Carbon Diagram, Steels, Cast Irons, Stainless Steel. ▪ Nonferrous metals and alloys: Copper, Aluminium and Magnesium. 		
Unit – V	Steel	8 Hours
<ul style="list-style-type: none"> ▪ Introduction. Advantages of steel. Limitations of steel. ▪ Iron- and steel-making: Basic Oxygen Steel making (BOS). Electric Arc Furnace (EAF), Wrought iron. Cast iron. Carbon steel. ▪ Structural steel: Hot Rolled Steel, Cold formed Steel and Reinforcing Steel. 		
Unit – VI	Glass and Plastics	6 Hours
<ul style="list-style-type: none"> ▪ Introduction to Glass and Plastics. ▪ Advantages and limitations. ▪ Types of Glass: Sheet Glass, Float Glass, Toughened (Tempered) Glass, Laminated Glass and Wired Glass. 		



- PVC – Polyvinyl Chloride, HDPE – High-Density Polyethylene, uPVC – Unplasticized Polyvinyl Chloride, Acrylic (PMMA – Polymethyl Methacrylate).
- Applications in Building.

Internal Continuous Assessment (ICA) shall consist of a minimum of six assignments based on the entire curriculum which will be assessed by faculty.

Text Books

1. Civil Engineering Materials, Nagaratnam Sivakugan, Carthigesu T Gnanendran, Rabin Tulashar, and M Bobby Kannan, Cengage.
2. Building Materials, S.K. Duggal, New Age International Publishers.
3. Building Materials, P.C. Varghese, PHI Learning Pvt. Ltd.
4. Engineering Materials, Rangwala S.C., Charotar Publishing House.

Reference Books

1. Civil Engineering Materials, P D Kulkarni, R. Subramanian, P S Gahlot, A. Juneja, V. P. Puri, S. K. Likhi and A. K. Duggal, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Civil Engineering Materials, Shan Somayaji, Pearson
3. Building Construction, Dr. B.C. Punmia et al., Laxmi Publications.

e-Resources

Web links and Video Lectures (e-Resources):
<https://nptel.ac.in/courses/>





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5E34T: Programme Elective Course I- Earth Retaining Structures

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Practical	2 Hours/week	ISE	40 Marks
Credits	3	ICA	25 Marks

Introduction:

This course on Earth Retaining Structures provides comprehensive knowledge of the principles, theories, and design methods used in geotechnical engineering. It emphasizes the application of classical and modern earth pressure theories under both static and dynamic conditions. Students will learn to analyse and design various types of retaining walls, ensuring stability against common failure modes. The course also introduces reinforced soil structures and their advantages over conventional systems. Special focus is given to the design of Mechanically Stabilized Earth (MSE) walls using geosynthetics and metallic reinforcements.

Course Prerequisite:

Geotechnical Engineering, Shear strength of soils, Stress distribution of soils, and basic engineering mathematics are used to derive the equations.

Course Objectives:

1. To understand the importance of retaining structures and the fundamental concepts of lateral earth pressure, including classical theories such as Rankine and Coulomb.
2. To study the behavior of earth pressures under dynamic and seismic conditions and understand the impact of wall movement and wall friction.
3. To develop the ability to design and check the stability of different types of retaining walls using earth pressure theories.
4. To introduce the concept of reinforced soil structures, understand the need for geosynthetics, and explore the basic mechanisms of reinforcement.
5. To equip students with design methodologies for Mechanically Stabilized Earth (MSE) walls and other advanced retaining wall systems

Course Outcomes:

After completing the course, students will be able to

1. Apply the underlined concepts, facts, and principles of earth retaining structures.
2. Analyze and determine earth pressures based on various methods and field conditions.



<p>3. Design retaining walls and evaluate their stability against sliding, overturning, and bearing failure using appropriate design principles.</p> <p>4. Understand the fundamentals, necessity, and behavior of reinforced soil structures, including geosynthetics, and compare them with conventional reinforced cement concrete systems.</p> <p>5. Design Mechanically Stabilized Earth (MSE) walls including metallic strip reinforcement, and evaluate their applicability in different scenarios.</p>		
Unit – I	Introduction to Earth Pressure Theories	6 Hours
<p>Importance of retaining structures in geotechnical engineering; Lateral earth pressures and earth pressure coefficients; Variation of lateral earth pressure at a certain depth. Lateral earth pressure at rest; Classical theory of earth pressure proposed by Rankine; Rankine active pressure: Derivation and Problems; Rankine passive pressure; Rankine passive pressure: Vertical back face and inclined backfill; Coulomb's active earth pressure; Coulomb's passive earth pressure; Active earth pressure due to surcharge-Line load and Strip load.</p>		
Unit – II	Dynamic Earth Pressure	8 Hours
<p>Dynamic earth pressures, Monopole-Okabe method; Active earth pressure for seismic conditions; Passive pressure for seismic conditions; Active earth pressure for wall rotation about top: Braced cut; Active earth pressure for translation of retaining wall – Granular backfill; Influence of wall friction on the shape of the surface of sliding.</p>		
Unit – III	Design and Stability of Retaining Walls	8 Hours
<p>Types of retaining walls; Proportioning of retaining walls; Application of lateral earth pressure theories to design; Stability of retaining walls; Check for sliding along the base; Check for overturning; Check for bearing capacity failure; Construction joints and drainage from backfill; Design problems of cantilever and gravity retaining walls.</p>		
Unit – IV	Introduction to Reinforced Soil Structures	8 Hours
<p>Historical background – Introduction to reinforced soil structures; Need for Geosynthetics; Comparison with reinforced cement concrete structures, Principles, Concepts, and Mechanisms of reinforced earth.</p>		
Unit – V	Design of Mechanically Stabilized Earth (MSE) Walls	10 Hours
<p>Mechanically Stabilized retaining walls – Basic concepts and step by step design procedure for stabilized reinforced and metallic strip reinforced retaining walls; Other types of retaining walls – Modular gravity walls, In situ reinforced walls, chemically stabilized retaining walls; Design problems on MSE walls.</p>		
INTERNAL CONTINUOUS ASSESSMENT (ICA)		
<p>One assignment on each topic of the above syllabus</p>		
Text Books		



1. Terzaghi, K and Peck, R. B., and Mesri, G (1996), “Soil Mechanics in Engineering Practice”, 3rd Edition, John Wiley.
2. Koerner R M., “Designing with geosynthetics”, Prentice-Hall pub 1994

Reference Books

1. Terzaghi, K and Peck, R. B., and Mesri, G (1996), “Soil Mechanics in Engineering Practice”, 3rd Edition, John Wiley.
2. Das, B.M. (2011), “Principles of Foundation Engineering”, 7th Edition, Cengage Learning.
3. Budhu, M. (1981), “Soil Mechanics and Foundations”, 3rd Edition, John Wiley and Sons.
4. Lambe, T. W. and Whitman, R. V. (1969), “Soil Mechanics”, John Wiley.
5. Clayton, Woods and Bond,” Earth pressure and Earth retaining structure”, CRC Press (2014).





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5IK5T: Indian Knowledge System II-Heritage Building of India

Teaching Scheme		Examination Scheme	
Lectures	2 Hours/week	ISE	50 Marks
Credits	2		
Introduction:			
This course covers the classification of heritage, case studies of key heritage structures, and structural systems in Heritage Buildings. The curriculum includes Damage Assessment and Structural Health Monitoring, Principles of conservation, Retrofitting techniques for heritage structures, and Heritage regulations in India.			
Course Prerequisite:			
Primary knowledge of water management, transportation systems, ecology, and the environment.			
Course Objectives:			
<ol style="list-style-type: none">1. To make the students learn to identify & classify heritage buildings with its importance.2. To make students aware of the historical architecture of India.3. To make students to learn about structural systems in heritage buildings.4. To make students to equip with damage assessment and structural health monitoring of heritage buildings.5. To make the students to learn about conservation principles and techniques used in heritage structures.6. To make students to know about heritage regulations in India.			
Course Outcomes:			
After completing the course, students will be able to			
<ol style="list-style-type: none">1. Identify & classify heritage buildings with its importance.2. Describe the historical architecture of India.3. Describe structural systems in heritage buildings.4. Explain damage assessment techniques and structural health monitoring of heritage buildings.5. Explain conservation principles and techniques used in heritage structures.6. Interpret heritage regulations in India.			
Unit – I	Introduction to Heritage and Conservation	5 Hours	



Definition and classification of heritage, Types of heritage: Cultural, Natural, Tangible, Intangible, Importance of heritage buildings in India, Overview of heritage zones and UNESCO World Heritage Sites in India.		
Unit – II	Historical Architecture of India	5 Hours
Evolution of Indian architecture (Indus Valley, Mauryan, Gupta, Indo-Islamic, Colonial), Case studies of key heritage structures: - Taj Mahal, Qutub Minar, Sun Temple, Konark, Brihadeshwara Temple, Gol Gumbaz, Victoria Memorial		
Unit – III	Structural Systems in Heritage Buildings	5 Hours
Traditional construction materials and techniques (lime mortar, stone masonry, timber roofs, arches, domes), Load-bearing systems in historic buildings.		
Unit – IV	Damage Assessment and Structural Health Monitoring	5 Hours
Types of deterioration: physical, chemical, and biological. Structural audit of heritage buildings, Non-destructive testing (NDT) methods for assessment, Case studies of damage and intervention.		
Unit – V	Conservation Principles and Techniques	5 Hours
Principles of conservation (e.g., minimal intervention, reversibility), Materials and methods for repair and restoration, Documentation and condition mapping, Retrofitting techniques for heritage structures.		
Unit – VI	Laws, Policies, and Organizations	5 Hours
Heritage regulations in India (e.g., ASI, INTACH guidelines), The Ancient Monuments and Archaeological Sites and Remains Act (AMASR), Role of agencies like UNESCO, ICOMOS, ASI, INTACH.		
ICA consists of a minimum of 06 assignments based on the above syllabus		
Text Books		
<ol style="list-style-type: none"> 1. "Conservation of Historic Buildings" by Bernard M. Feilden 2. "Indian Architecture: Hindu and Buddhist" by Percy Brown 3. Vernacular Architecture of India by Tejinder S. Randhawa 4. Conservation of Built Heritage in India by Vijayalaxmi J. 5. A Guide to Risk Management of Cultural Heritage, Published by ICCROM 		
Reference Books		
<ol style="list-style-type: none"> 1. Alchin, B., Allchin, F.R., Thapar, B.K., Conservation of the Indian Heritage, Cosmo Publication, 1989, New Delhi. 2. Batra, N.L., Heritage Conservation, Aryan Books International, New Delhi, 1996, Felldon, Bernard, Conservation of Historical Buildings, Butterworth Scientific series 3. Handbook of Chemical Conservation of Museum Objects, Department of Museology, and Maharaja Sayajirao University of Baroda 4. INTACH Guidelines for Heritage Structures. 5. Manual on Conservation by ASI (Archaeological Survey of India). 6. India Code related to conservation and heritage structures. 7. Handbook of Conservation of Heritage Buildings. 		





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-V

23CEU5CC8T: Transportation Engineering

Teaching Scheme		Examination Scheme	
Lectures	2 Hours/week	ESE	60 Marks
Practical	2 Hours/week	ISE	40 Marks
Credits	3	ICA	25 Marks
		POE	25 Marks

Introduction:

This course focuses on highway engineering, covering geometric design, traffic analysis, pavement materials, and construction methods. It prepares students to understand the principles behind efficient and sustainable road networks, incorporating modern tools like remote sensing and intelligent transportation systems.

Course Prerequisite:

Basic knowledge of civil engineering materials, surveying, and geotechnical engineering concepts.

Course Objectives:

1. Explain the historical background, classification, and development of highways in India and globally.
2. Apply geometric design principles to plan highway alignments and profiles.
3. Conduct and interpret traffic surveys for volume, speed, and parking analysis.
4. Evaluate and select appropriate materials for highway pavement construction.
5. Design flexible and rigid pavements based on standard guidelines and assess their performance.

Course Outcomes:

After completing the course, students will be able to

1. Describe the historical development, classification, and current status of road transportation systems in India and worldwide.
2. Apply geometric design principles to develop highway alignments and cross-sectional elements for rural and urban roads.
3. Analyze traffic flow characteristics and interpret data from volume, speed, parking, and accident studies.
4. Evaluate the suitability of various pavement materials based on laboratory test results and performance characteristics.



5. Design flexible and rigid pavement structures using IRC and AASHTO guidelines, considering traffic and environmental factors.		
Unit – I	Introduction to Highways	3 Hours
Classification of Roads, Road Patterns. Brief History of Road Development around the World, Road Development Plans of India, Present Status of Roads in India. Alignment Design, Requirements and Controlling Factors, Use of Aerial Photography and Remote Sensing, Other surveys.		
Unit – II	Geometric Design of Highways	6 Hours
Typical Cross Sections in Urban and Rural roads, Various Cross Sections Elements, Width of Carriage-way, Shoulders, Medians, Width of Roadways, Right of Way, Camber, Design Speed, Sight Distance, Stopping Sight Distance, Passing Sight Distance, Sight Distance at Inter-Section, Passing Zones, Super Elevations, Set Back, Extra Widening on Horizontal Curve, Transition Curve, Design of Horizontal and Vertical Alignment, Combinations of Horizontal and Vertical Alignment.		
Unit – III	Traffic Engineering	5 Hours
Basic characteristics of Traffic, Volume, Speed, and Density; Definitions and their interrelationships; Traffic Volume studies - Objectives, Methods of Volume counts, Presentation of Volume Data; Speed studies- Types of Speeds, Objectives, Methods of speed studies, Presentation of speed data. Delay Studies, Origin and Destination Studies, Parking Studies: parking parameters, definitions, Accident data analysis. Intelligent Transportation Systems.		
Unit – IV	Pavement Materials	5 Hours
Sub-grade Soil Characterization: Density and Compaction Requirement, CBR Test, Plate Load Test, and DCPT test. Aggregate Characterization: Tests on Aggregate, Stone Polishing Value Test, Gradation of Aggregate, Bitumen Characterization, Properties of Bitumen, Elastic modulus, Dynamic modulus, stiffness modulus using shell nomographs, Resilient modulus, Complex (Dynamic) Moduli of Bituminous Mixes. Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Marshall Mix Design, and Super Pave Mix Design.		
Unit – V	Pavement Design	6 Hours
Design of Flexible Pavements, Factors Affecting Design, IRC guidelines for Flexible Pavement Design, Deflection Studies in Flexible Pavements, Overlay Design as per IRC guidelines, Design of Rigid Pavements, Factors Affecting Design, Design of Rigid Pavements as per IRC guidelines, AASHTO method of Flexible and Rigid Pavement Design.		
Unit – VI	Highway Construction & Maintenance	5 Hours
Embankment Construction, Granular Sub-Base, Wet Mix Macadam, Bituminous Concrete, Dense Bituminous Macadam, Prime Coat, Tack Coat, Quality Control Tests, Construction of Rigid Pavements,		



Dry Lean Concrete, Pavement Quality Concrete. Quality Control Tests. Maintenance of Flexible and Rigid Pavements.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

From the Below tests, a Minimum of 10 tests have to be performed:

A. Test on Aggregates:

1. Impact test on aggregate,
2. Abrasion Test on aggregate,
3. Crushing strength test on aggregate,
4. Soundness test on aggregate,
5. Shape test on aggregate

B. Test on Soil:

1. CBR and Compaction test on soil

C. Test on Bitumen:

1. Penetration test,
2. Ductility test,
3. Softening Point test,
4. Specific gravity test,
5. Flash and Fire point test and
6. Viscosity Test on Bitumen.

D. Field Visit to Highway Construction site, Pug Mill Plant, Hot Mix Plant, and RMC Plant

Internal Continuous Assessment (ICA) submission shall consist of a journal containing:

1. Above mentioned Experiments
2. Visit report describing the Highway Construction Site and the plants visited.
3. Assignments on each unit based on the syllabus.

Text Books

1. Highway Engineering by C.E.G. Justo, A. Veeraragavan & S.K. Khanna., Nemchand Bros.
2. Harbour, Dock and Tunnel engineering By R. Shrinivasan, Charotar Publishing House.
3. Transportation Engineering by Subramanian. K.P Scitech Publications, Chennai.
4. Principles of Transportation and Highway Engineering By Rao, G.V., McGraw – Hill Publishing Company Limited, New Delhi.
5. Highway Engineering, Kadiyali L.R, Khanna Publishers, New Delhi

Reference Books

1. Principles of Transportation Engineering, Partha Chakroborty and Animesh Das, PHI Publication.
2. Transportation Engineering – An Introduction, Khistry, C.J., PHI Publication.
3. Specifications of Road and Bridge Works (MoRTH) Publication – 5th Revision. New Delhi.
4. IRC: 37-2018, IRC: 58-2015, and other relevant IRC codes.



e-Resources

1. <https://nptel.ac.in/courses/105105107>
2. <https://nptel.ac.in/courses/105105108>
3. <https://nptel.ac.in/courses/105106203>
4. <https://nptel.ac.in/courses/105101008>
5. <https://www.irc.nic.in/>
6. <https://morth.nic.in/>
7. <https://www.pavementinteractive.org>
8. <https://hcm.trb.org/>





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6CC1T: Foundation Engineering

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ISE	40 Marks
Credits	3	ESE	60 Marks

Introduction:

This course introduces foundation engineering principles with a focus on soil exploration and foundation design. It covers shallow and deep foundations, including isolated, combined, raft, pile, and caisson types. Students will learn to assess soil-bearing capacity using analytical and experimental methods. Slope and embankment stability and ground improvement techniques are also addressed.

Course Prerequisite:

Basic knowledge of Geotechnical Engineering, Engineering Geology, Structural Engineering Fundamentals, and Engineering Mathematics

Course Objectives:

1. To enable students to evaluate the bearing capacity of soil through various analytical and experimental methods using data obtained from soil exploration.
2. To provide students with expertise in designing shallow foundations, such as isolated footings, combined footings, and raft foundations.
3. To provide students with how to apply appropriate ground improvement techniques for constructing footings in challenging soil conditions.
4. To prepare students to design deep foundations, such as pile foundations and caisson foundations.
5. To provide students with the knowledge to investigate and assess the stability of slopes.

Course Outcomes:

1. Evaluate the bearing capacity of soil by various analytical and experimental approaches by obtaining the data from soil exploration.
2. Perform geotechnical design of shallow foundations such as isolated footing, combined footing, and raft foundation.
3. Apply suitable ground improvement techniques for the construction of a footing in difficult soil.
4. Perform geotechnical design of deep foundation, such as Pile foundation and Caisson foundation
5. Investigate the slope stability of embankments.



Unit – I	Introduction to Soil Exploration	6 Hours
Necessity, Planning, Exploration methods, Different types of boring- Hand and continuous flight augers, Wash boring, Rotary drilling. Soil sampling- Disturbed and Undisturbed. Rock drilling and sampling. Core barrels, Core boxes, Core recovery, RQD.		
Unit – II	Bearing Capacity of Shallow Foundation	8 Hours
Ultimate, safe, and allowable. Modes of failure, Terzaghi's bearing capacity equation with derivation, I S code method of bearing capacity (IS 6403 -1981), Effect of water table, Eccentricity of load. Plate load test, Standard Penetration test, and Pressure meter test. Test procedures and limitations Immediate settlement – computations as per IS 8009 – 1976 (part– I) approach and from the plate load test observations. Consolidation settlement, Total settlement, Differential settlement, Tolerable settlement, Angular distortion.		
Unit – III	Ground Improvement Techniques	9 Hours
Pre-compression, Sand drains, Vibro-floatation, Grouting, Soil reinforcement, Foundations on filled-up soils. Contamination of soils and foundation problems. Geotextiles and their applications: - Geotextiles- Definition and Types, Functions of Geotextiles, Different applications in Civil Engineering (Roads, Railways, Embankments, Earth Retainment, Erosion control, etc.).		
Unit – IV	Shallow foundations	6 Hours
Design of Isolated, Combined, Strap footing (Rigid analysis), Raft foundations (Conventional method), and Floating foundations (RCC design is not expected)		
Unit – V	Deep foundation	8 Hours
Pile foundation: Classification, Single pile capacity for RCC cast in situ pile in Cohesive, non-cohesive, and mixed soils by Static method, Dynamic formulae, Negative skin friction. Underreamed piles- equipment, construction, and precautions. Load carrying capacity of pile group, Group action of piles- Spacing of piles in a group, group efficiency- empirical formulae. Caisson Foundations: Box, Pneumatic, open (well) caissons, Shapes of well, components. Forces on a caisson, grip length, well sinking, practical difficulties, and remedial measures		
Unit – VI	Slope Stability	5 Hours
Stability of finite slopes- slip circle method, Semi-graphical and graphical methods- Swedish slip circle method, Method of slices, Friction circle method. Fellenius construction to locate critical slip center, Stability No, and its use.		
FIELD TESTS		
A. Field tests: a. Standard penetration test b. Plate load test B. Visit to foundation construction sites and preparation of the report.		



C. Laboratory work:

- a. Swelling pressure test
- b. Vane shear test

Text Books

1. Soil Mechanics and Foundation Engineering- B.C. Punmia [Laxmi Publications (Pvt) Ltd, New Delhi]
2. Principles of Foundation Engineering – Braja M. Das (Cengage Learning India Pvt. Ltd, New Delhi)

Reference Books

1. Geotechnical Engineering- Purushottam Raj [Tata McGraw-Hill Company Ltd, New Delhi]
2. Soil Mechanics and Foundation Engineering - Dr. K. R. Arora, [Standard Publication]
3. Soil Mechanics and Foundation Engineering -V.N.S. Murthy [UBS publishers and distributors, New Delhi]
4. Geotechnical Engineering- Kasamalkar B.J. [Pune Vidyarthi Griha Prakashan, Pune]
5. Geotechnical Engineering - C. Venkatachalam [New Age International (I) Ltd, New Delhi]
6. Principles of Geotechnical Engineering- Braja M. Das (Cengage Learning India Pvt. Ltd, New Delhi)





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Civil Technology), Semester-VI

23CEU6CC2T: Engineering Economics, Estimation & Costing

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Practical	2 Hours/week	ISE	40 Marks
Credits	4	ICA	25 Marks
		POE	25 Marks

Introduction:

This course provides a skillset essential to exhibit at the time of project planning, execution, and appraisal stages to enable the Civil Engineer to manage the resources.

Course Prerequisite:

Understanding of construction materials, components of buildings, and basic drawing and reading. Knowledge of loads, stresses, and behavior of structural members is essential for preparing estimates and understanding BOQs. Familiarity with components of buildings, types of construction, methods of execution, and drawing interpretation. Required for Earthwork estimation and Mass Haul diagrams.

Course Objectives:

1. **To introduce engineering economic principles** relevant to civil engineering projects, including cost control, investment analysis, and depreciation methods.
2. **To develop the ability to prepare technical specifications** for various civil engineering works such as buildings, roads, bridges, and industrial structures.
3. **To equip students with practical skills in estimation and costing**, including quantity take-offs, rate analysis, preparation of bills of quantities, and cost assessment using market rates and standard documents.
4. **To familiarize students with tendering and contracting procedures**, including types of contracts, tender documentation, bidding strategies, and legal considerations.
5. **To train students in the preparation of valuation reports** for land, buildings, and civil engineering assets, using accepted methods and principles of valuation.
6. **To integrate the use of software tools** for computer-aided estimation, drafting, and preparation of detailed cost abstracts and BOQs.

Course Outcomes:

- After completing the course, students will be able to,
1. Analyze and evaluate economic alternatives for civil engineering projects.
 2. Write technical specifications for civil engineering works.



<p>3. Carry out rate analysis based on market rates, schedule of rates and other relevant standard documents and codes.</p> <p>4. Take off quantities of items of construction for civil engineering works.</p> <p>5. Prepare the valuation reports for land and buildings.</p>		
Unit – I	Engineering Economics	8 Hours
<p>Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Time value of money (present and future worth of cash flows). Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Depreciation and different methods of calculating depreciation (straight line method, declining balance method, sinking fund method, quantity survey method), Depreciated cost, Obsolescence.</p>		
Unit – II	Specifications	6 Hours
<p>Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.</p>		
Unit – III	Rate analysis	6 Hours
<p>Purpose, importance and necessity of the rate analysis, factors affecting, task work, daily output from different equipment/ productivity.</p>		
Unit – IV	Estimation for various items and costing	4 Hours
<p>Introduction to the process of Estimation; taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs Adding equipment costs; labour costs; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying.</p>		
Unit – V	Valuation	8 Hours
<p>a) definition of value, price and cost. Attributes of value, Different types of values- Book value, salvage value, scrap value, replacement value, reproduction value, earning value, Market value, Potential value, Distress value, Speculation value, Sentimental value. Accommodation value, Essential characteristics of market value.</p> <p>b) Valuer and his duties, purpose of valuation and its function. Factors affecting the valuation of properties-tangible and intangible properties, Landed properties- free hold and leasehold properties, different types of lease.</p> <p>a) Rental method of valuation. Form of rent, different types of rent, standard rent.</p> <p>b) Value of land, belting method of valuation, Valuation based on land and building-item wise, carpet area basis, unit basis, cubic content basis.</p> <p>c) Development method of valuation for building estate.</p> <p>d) Valuation on profit basis for lodges, cinema theatres, hotels, motels etc. valuation for compulsory acquisition of land, structure by the Government. Valuation for rating purpose, Methods for assessing ratable value of property, Rental method, Comparison method, fundamental principles of rating valuation.</p>		



e) Valuation from yield and from life, gross yield and net yield, outgoing, capitalized value, Year's Purchases-Single rate and dual rate, reversion value of land, annuity-perpetual, whole life, deferred, Sinking fund.

Unit – VI	Tender and Acts	8 Hours
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Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions. Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

ICA consists of following assignments:

- 1) Reading the Drawings (Plan and section) Minimum 3- drawings need to be given for (reading only) such as
 - a) Watchman's cabin
 - b) Compound wall.
 - c) Septic tank / water tank.
 - d) Building drainage system.
 - e) Kitchen platform.
 - f) Cement godown.
 - g) Staircase block.
 - h) A small culvert
- 2) Market survey of basic material rates and labour wages
- 3) Detailed specification for minimum five civil engineering items. (One each from Roads, Irrigation works, Water Supply & Sanitation & three from buildings)
- 4) Computer aided
 - a) Detailed estimate for a two storied building
 - i) Selecting the items from drawing.
 - ii) Preparing abstract as per DSR or standard building items.
 - iii) Take of quantities related to buildings (all items need to be taken)
 - iv) Preparing the bill of quantity (BOQ).

Note: Estimate shall include compound wall with gate, sanitary schedule and electrification schedule.
- b) Estimate for structural steel shed.
- 5) Rate Analysis: (Civil engineering items.)
One each from (Road, Irrigation work, Water supply and sanitation) and five from buildings.
- 6) Schedule of reinforcement any two of the following
 - a) Column and column footing.
 - b) Beam and Slab
 - c) Staircase.
- 7) Valuation reports for any two of the following:
 - a) A building for residential purpose or commercial purpose.
 - b) A hotel.
 - c) A theater
 - d) Any one construction machine.

The report shall include valuation certificate also.

Text Books

1. A Textbook of Estimating, Costing & Accounts (Civil), R.C.Kohli, S. Chand
2. Publishing New Delhi
3. Civil Estimating and Costing, A. K. Upadhyay, S. K. Katuria and Sons
4. Civil Engineering Contracts and Estimates – B. S. Patil- Orient Blackswan publication



5. Professional Practice (Estimating and Valuation) – Roshan Nanavati – Lakhani Book Depot.
6. Estimating, Costing, Specification and valuation in civil engineering, Chakroborty
7. M, Khanna Publishers
8. Valuation of real Properties – S. C. Rangwala- Charotar Publishing House Ltd.

Reference Books

1. Relevant Indian Standard Specifications (IS 1200)
2. World Bank Approved Contract Documents.
3. FIDIC Contract Conditions.
4. Acts Related to Minimum Wages, Workman’s Compensation, Contract, and Arbitration.

e-Resources

1. C.P.W.D. schedule of rates.
2. C.P.W.D. specifications / Standard specifications Volumes I & II (P.W.D. Maharashtra)





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6CC3T: Design of Concrete Structures

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Credits	3	ISE	40 Marks

Introduction:

Design of Concrete Structures is a comprehensive course covering the principles and practices of designing various concrete elements. The curriculum includes the design of one-way and two-way slabs, analysis and design of singly and doubly reinforced sections, and the analysis of prestress systems. Students will also explore the structural design of columns & footings, focusing on safety, stability, and compliance with industry standards.

Course Prerequisite:

Solid Mechanics, Structural Analysis, and Engineering Mechanics

Course Objectives:

1. Understand and apply various design approaches for different types of slabs.
2. Analyze and design the waist slab of staircases, considering structural requirements.
3. Identify and evaluate suitable types of beams based on loading and support conditions.
4. Demonstrate the ability to design axially loaded columns and their footings.
5. Explore and compare different methods and techniques used in prestressing systems.

Course Outcomes:

After completing the course, students will be able to

1. Design one-way, two-way slabs for given loadings.
2. Design cantilever & staircase waist slabs for given loadings.
3. Design rectangular beams for given conditions.
4. Design columns subjected to axial loading.
5. Design an isolated column footing.
6. Analyse the prestressed concrete members.

Unit – I	Design of Slabs	6 Hours
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One-way, Two-Way slabs with different end conditions as per the IS code.



Unit – II	Design of Staircases	8 Hours
Types of stairs, design of simply supported and Dog-legged stairs with solid waist slab, cantilever slab.		
Unit – III	Limit State of Collapse (Flexure, Shear, and Bond)	6 Hours
Analysis and Design of singly and doubly reinforced rectangular sections.		
Unit – IV	Design of Columns	6 Hours
Analysis and Design of Axially Loaded Square and Rectangular Columns.		
Unit – V	Design of Column Footings	6 Hours
Design of isolated square and rectangular column footings, column footings subjected to axial load.		
Unit – VI	Prestressed Concrete	8 Hours
Introduction, concepts, systems, and methods of prestressing. Analysis of Symmetrical and unsymmetrical sections, thrust line, and cable profile by the Stress concept.		
INTERNAL CONTINUOUS ASSESSMENT (ICA)		
<ul style="list-style-type: none"> • One assignment on each topic of above syllabus. 		
Text Books		
<ol style="list-style-type: none"> 1. Limit State Theory & Design –Karve & Shah Structures Pub., Pune 2. Reinforced Concrete Design (Limit State) - A.K.Jain 3. Reinforced Cement Concrete - B.C.Punmia 4. Design of R.C.C. structural elements by S.S. Bhavikatti (Volume I &II). 5. Design of Reinforced Concrete Structures by S. Ramamrutham 		
Reference Books		
<ol style="list-style-type: none"> 1. IS: 456-2000 (Reaffirmed 2021) 2. Fundamentals of Reinforced Concrete- Sinha & Roy 3. Limit State Design of Reinforced Concrete - P.C. Varghese, Prentice Hall of India, New Delhi. 4. Handbook of Reinforced Concrete: SP-16 		
e-Resources		



1. <https://www.classcentral.com/course/swayam-design-of-reinforced-concrete-structures-13995>
2. <https://www.udemy.com/course/reinforced-concrete-beam-design>
3. <https://nptel.ac.in/courses/105105105>
4. https://www.academia.edu/5041739/DESIGN_OF_REINFORCED_CONCRETE_STRUCTURES



**WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR****(An Autonomous Institute)****Third Year B.Tech. (Civil Engineering), Semester-VI****23CEU6E14T: Programme Elective Course - II- Hydraulic Structures and Water Power Engineering**

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/Week	ESE	60 Marks
Tutorial	1 Hour/Week	ISE	40 Marks
Credits	4	ICA	25 Marks

Introduction:

This course deals with the planning of dam reservoirs as well as the elementary design of gravity dams, earth dams, and dam spillways. It also imparts knowledge of canal systems, canal structures, river training works, and harnessing Water power from storage dams and runoff river plants.

Course Prerequisite:

The course needs knowledge of Hydrology, ‘Surveying’ for reservoir planning and ‘Engineering Mechanics’ and ‘Solid Mechanics’ and for the Design of Gravity dams.

Course Objectives:

1. To learn principles of dam reservoir planning
2. To know design principles of Gravity dams and Earth dams
3. To get acquainted with design methodology of dam spillways
4. To know about alignment of Irrigation Canals and suitability of canal structures
5. To gain knowledge of river behavior and river training
6. To learn about harnessing hydropower from storage dams and runoff river plants.

Course Outcomes:

- At the end of the course, students will be able to,
1. Plan and design the reservoirs depending upon the water resources potential.
 2. Analyze and design Gravity dams and Earth Dams (Simple Designs).
 3. Carry out Hydraulic Design of spillways.
 4. Select proper alignment of Irrigation Canals and adopt suitable canal structures
 5. Select appropriate method of river training depending upon river characteristics.
 6. Estimate water power potential at a site of storage dams and runoff river plants.

Unit – I	Dams and Reservoir Planning	5 Hours
Dams – Necessity, types of dams, selection of site for dams, selection of type of dam, Introduction to dam instrumentation		



Planning of Reservoirs: Storage calculations, Control levels, silting of reservoirs, reservoir sedimentation surveys, reservoir losses. Use of remote sensing for reservoir sedimentation surveys		
Unit – II	Gravity and Arch Dams	6 Hours
Gravity Dams - Forces acting on dam, design criteria, theoretical and practical profile, high and low dam, stability calculations, materials and methods of Construction, Galleries, joints, Dam Instrumentation, Computer Application for Design of Dam. Decommissioning of dams Arch Dams – Types, Layout of Constant angle and Constant radius arch dam, Forces acting on arch dams.		
Unit – III	Earth Dams	5 Hours
Components and their functions, Design Criteria; Seepage through and below earth dam, Application of Slip circle method, Inverted Filters, Downstream Drainage, relief wells, Construction of earth dam		
Unit – IV	Spillways and Outlets through Dams	5 Hours
Spillways: Necessity and different types, factors affecting choice and type of spillway, elementary hydraulic design, jump height and tail water rating curve, energy dissipation below spillway, gates for spillway. Spillway operations for different discharge values. Outlets through Dams: types and energy dissipation in outlets transition.		
Unit – V	Weirs on Permeable Foundations	6 Hours
Weirs on Permeable Foundations: Theories of seepage, Bligh's creep theory, Khosla's theory of exit gradient, Piping and undercutting, Concept of flow net etc. Kolhapur type weirs- working principles, suitability and construction.		
Unit – VI	Canals and Canal Structures	6 Hours
Canals: Types, Alignment, Design – Kennedy's and Lacey's Silt theories, Canal losses, Typical canal sections, canal lining – Necessity and types, Economics of canal lining. Canal Structures (Introduction): Cross drainage works and canal regulatory works – Aqueduct, Culvert, Super passage, Level Crossing, Cross and Head regulator, Canal Siphon, Canal Escape, canal fall, canal outlets.		
Unit-VII	River Training Works ad Water logging	5 Hours
River and River Training Works: Types of rivers, Meandering phenomenon, Types of river training works, river navigation. Water Logging and Drainage: Causes, effects, preventive and curative measures, alkaline soils, soil efflorescence, drainage arrangements.		
Unit-VIII	Hydropower Engineering	7 Hours



Elements of Hydropower Engineering: Power crisis and competing uses of water, the need of harnessing solar energy. Types of water power plants, small hydropower plants, layout and components of each type, Intakes, Conveyance system, Surge tanks, Power house types, components and layout, tail race. Managing power demand using various sources of power.

ICA consists of a minimum of 05 assignments based on the above syllabus

Textbooks:

1. Irrigation Engineering – S. K. Garg , Khanna Pub. Delhi
2. Irrigation and Water Power Engineering - Priyani , Charoter pub. House, Anand
3. Irrigation and Water Power Engineering – Punmia, B. C.
4. Irrigation – Bharat Singh, NEW CHAND & bros. Roorkee
5. Irrigation Engineering Vol. I – Varshhey and Gupta
6. Irrigation Water Power & Water Resource Engineering, Arora, Standard Publishers

Reference Books:

1. Design of Small Dam – U. S. B. R., OXFORD & IBH pub.co.
2. Engineering for Dam Vol. I, II, III – Justinn, Creager and Hinds
3. Design of Hydraulic Structures Vol. I & II – Leliavsky
4. River Behavior, Management and Training - CBIP Publication
5. Engineering Hydrology - K. Subramanya
6. Design of Canals – Circular of Government of Maharashtra, 18 February 1995

e-Resources:

1. Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation:<http://mowr.gov.in/policies-guideline/policies/national-water-policy>
2. Maharashtra water resources regulatory authority: <https://mwrra.org/>
3. National Remote Sensing Center: <https://www.nrsc.gov.in/>
4. National Water Development Agency: <http://nwda.gov.in>
5. India Water Resources Information System : <https://indiawris.gov.in/wris/#/>



**ALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR****(An Autonomous Institute)****Third Year B.Tech. (Civil Engineering), Semester-VI****23CEU6E24T: Programme Elective Course - II- Structural Analysis by Matrix Methods****Teaching Scheme****Lectures** 3 Hours/week**Tutorial** 1 Hour/week**Credits** 4**Examination Scheme****ESE** 60 Marks**ISE** 40 Marks**ICA** 25 Marks**Introduction:**

This course provides the knowledge of the matrix method of analysis of Beams and Trusses

Course Prerequisite:

Fundamentals of Mathematics, Structural Analysis and Strength of Materials

Course Objectives:

1. To introduce the concept of flexibility and stiffness method of analysis for simple problems
2. To study the analysis of continuous beams, rigid frames and trusses by using element flexibility method.
3. To study the analysis of beams, rigid frames and trusses by using element stiffness method.
4. To introduce the concept of analysis of continuous beams, trusses by direct stiffness method.
5. To understand the process of evaluation of secondary stresses

Course Outcomes:

After completing the course, students will be able to

1. Develop flexibility and stiffness method of analysis for simple problems.
2. Analyze continuous beams, rigid frames and trusses by using element flexibility method.
3. Analyze continuous beams, rigid frames and trusses by using element stiffness method.
4. Analyze continuous beams, trusses by direct stiffness method.
5. Evaluate secondary stresses in members.

Unit – I**Introduction****6 Hours**

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

Unit – II**Element Flexibility Method****8 Hours**

Force transformation matrix, global flexibility matrix, analysis of continuous beams, rigid frames and trusses.		
Unit – III	Element Stiffness Method	8 Hours
Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames and trusses.		
Unit – IV	Effects of Temperature Changes and Lack of Fit	6 Hours
Related numerical problems by flexibility and stiffness method as in Unit 2 and Unit 3		
Unit – V	Direct Stiffness Method Beams	8 Hours
Local and global coordinates systems, global stiffness matrices of beam, analysis of continuous beams.		
Unit – VI	Direct Stiffness Method Trusses:	8 Hour
Local and global coordinates systems, global stiffness matrices of truss element. Analysis of trusses.		
ICA consists of a minimum of 05 assignments based on the above syllabus		
Text Books		
<ol style="list-style-type: none"> 1. Weaver W. and Gere J. H., “Matrix Analysis of Framed Structures”, CBS Publications, New Delhi. 2. Rajasekaran S., “Computational Structural Mechanics”, PHI, New Delhi. 3. Madhujit Mukhopadhyay and Abdul Hamid Sheikh, “Matrix and Finite Element Analysis of Structures”, Ane Books Pvt. Ltd. 		
Reference Books		
<ol style="list-style-type: none"> 1. Godbole P. N. et.al, “Matrix Method of Structural Analysis”, PHI ltd, New Delhi. 2. Pundit and Gupta, “Theory of Structures Vol II”, TMH publications, New Delhi 3. A K Jain, “Advanced Structural Analysis”, Nemchand Publications, Roorkee. 4. Manikaselvam, “Elements of Matrix Analysis and Stability of Structures”, Khanna Publishers, New Delhi. 5. H. C. Martin, “Introduction to Matrix Methods in Structural Analysis”, International textbook company, McGraw Hil 		
e-Resources		
<ol style="list-style-type: none"> 1. https://archive.nptel.ac.in/courses/105/105/105105180/ 		





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6E34T: Programme Elective Course – II-Railway, Airport and Harbour Engineering

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Tutorial	1 Hour/week	ISE	40 Marks
Credits	4	ICA	25

Introduction:

This course on **Railway and Airport Engineering** introduces students to the fundamentals of planning, design, operation, and maintenance of rail and air transport systems. It covers the technical aspects of railway track components, geometric design, signalling systems, and interlocking methods, along with the planning and design of modern airports and an overview of dock and harbour engineering.

Course Prerequisite:

Familiarity with Civil Engineering Materials, and knowledge of Surveying and Geomatics.

Course Objectives:

1. To impart knowledge of different modes of transportation with a focus on railways and airports.
2. To develop an understanding of the design and components of the permanent railway way and related systems.
3. To provide insights into the planning, design, and layout of airports according to international standards.
4. To explain signalling, interlocking, and traffic control systems in railways.
5. To introduce basic concepts of dock and harbour engineering for coastal transport and marine facilities.

Course Outcomes:

After completing the course, students will be able to,

1. Describe the significance and sustainability of various transport modes and analyze key components of permanent way with respect to their performance under stresses.
2. Design the geometric layout of railway tracks, including gradients, superelevation, and turnouts, using appropriate standards and principles.
3. Compare different types of signalling and interlocking systems and demonstrate their role in safe railway operation.
4. Apply ICAO guidelines to develop basic airport layout plans, calculate runway lengths, and design taxiway elements.
5. Describe the fundamental concepts of docks and harbours, and outline the planning and design procedures for coastal structures



Unit – I	Railway Planning and Design	8 Hours
Significance of Road, Rail, Air, and Water transports – Coordination of all modes to achieve sustainability – Elements of the permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, Various resistance and their evaluation, Hauling capacity, Tractive effort, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods- – Soil suitability analysis – Geometric design of railways, gradient, superelevation, widening of gauge on curves. High-Speed Rail (HSR), Bullet Train projects, and semi-high-speed rail (Vande Bharat). Use of LiDAR and drone technology in route alignment and survey		
Unit – II	Points and Crossings	8 Hours
Important terms, crossings, types of crossings, switch, types of switches, Number and angle of crossings, Layout of turnout, Design of Turnout.		
Unit – III	Signalling and Interlocking:	8 Hours
Signalling and Interlocking: Objects of signalling, types of signals, Interlocking, and devices used in interlocking. Modern Signalling Methods. Centralized Traffic Control (CTC), ETCS (European Train Control System), CBTC (Communication-Based Train Control). Automatic block signalling, Train Protection and Warning System (TPWS).		
Unit – IV	Airport Planning	4 Hours
Air transport characteristics-airport classification-airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, criteria for airport site selection and ICAO stipulations, Typical airport layouts, Case studies, Parking and circulation area.		
Unit – V	Airport Design	8 Hours
Runway Design: Orientation, Wind Rose Diagram - Runway length - Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings and lighting.		
Unit – VI	Dock and Harbours Engineering	7 Hour
Definition of Basic Terms: Harbor, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Dredging – Maintenance of Ports and Harbours – Navigational aids.		
ICA consists of a minimum of 06 assignments based on the above syllabus		
Text Books		
<ol style="list-style-type: none"> 1. Railway Engineering by Satish Chandra and Agarwal M.M., Oxford University Press, New Delhi 2. Airport Engineering by Khanna & Arora – Nemchand Bros, New Delhi. 3. Docks and Harbour Engineering by Bindra S.P. – Dhanpathi Rai & Sons, New Delhi. 4. Research Designs and Standards Organisation (RDSO) Codes 		



Reference Books

1. 'Railway Engineering' by Saxena & Arora – Dhanpat Rai, New Delhi.
2. 'Transportation Engineering Planning Design' by Wright P.H. & Ashfort N.J. – John Wiley & Sons.
3. 'Airport Engineering' by Virendra Kumar, Dhanpat Rai Publishers, New Delhi.
4. 'Transportation Engineering' by Srinivasa Kumar R, University Press, Hyderabad
5. Railway and Track Engineering- by Mundrey J.S.- Tata McGraw-Hill Education
6. Docks and Harbour Engineering Oza, Charotar Publication House

e-Resources

1. <https://nptel.ac.in/courses/105107123>
2. <https://nptel.ac.in/courses/105105208>
3. <https://www.youtube.com/watch?v=IqkhTe6u9UI>
4. <https://nptel.ac.in/courses/105107207>





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6E15T: Programme Elective Course – III- Advanced Concrete Technology

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Tutorial	1 Hour/week	ISE	40 Marks
Credits	4	ICA	25 Marks

Introduction:

This course is designed to reflect current developments and advances being made in the field of cement-concrete technology and in the production, use, and performance of cement-based construction materials. In addition to novel aspects of conventional concrete materials, the course covers a wide range of Special concrete, such as high-performance, high-strength, and ready-mixed concrete.

Course Prerequisite:

Basic Knowledge of Concrete Technology.

Course Objectives:

1. To make students aware of Special Advanced Concrete.
2. To make students learn the behaviour of fresh and hardened special concrete.
3. To make students apply concrete processes based on the purpose of the application.
4. To make students aware of the Proportioning of Advanced concrete.

Course Outcomes:

After completing the course, students will be able to,

1. Use of additives in concrete to enhance properties
2. Select the proper special concrete to obtain the desired properties
3. Adopt an appropriate type of technology/special process for achieving quality concrete.
4. Design a concrete mix of required strength and workability properties
5. Adopt an appropriate method for the repair and rehabilitation of concrete structures

Unit – I	Introduction	4 Hours
Review of cement, including blended cement, chemical, and physical processes of hydration. Aggregates-Coarse aggregates, Natural sand, Crushed sand.		
Unit – II	Ingredients of Concrete	6 Hours
Review of types covering pulverized fuel ash, ground granulated blast furnace slag and silica fume, Rice husk Ash, manufacture, physical characteristics, and effects on properties of concretes. Admixtures: - Plasticizers, Superplasticizers, retarders, accelerators, Curing compounds and their effects on the properties of concrete.		



Unit – III	Properties of Fresh Concrete	6 Hours
Workability setting, bleeding, and segregation. Theory and application principles governing in concrete placing and compaction of concrete. Durability & impermeability, microstructure and carbonation of concrete, fire resistance.		
Unit – IV	Special Concretes	6 Hours
High-performance concrete, High Strength concrete, fiber reinforced concrete, Lightweight concrete, High density, and radiation shielding concrete, High volume fly ash concrete, Self-compacting concrete, Recycled concrete		
Unit – V	Types of Concrete	6 Hours
Special Processes & technology for particular types of structures: Mass concrete, Sprayed concrete, Ferro-cement concrete, pumped concrete, Roller compacted concrete, Sustainability of the concrete industry.		
Unit – VI	Ready Mixed Concrete	3 Hours
Types of plants, Concrete specification, Process adopted for central RMC plant, Distribution & transport, Code recommendations, quality control.		
Unit-VII	Mix Design of Special Concrete	10 Hours
Review of methods & philosophies, mix design with revised IS 10262:2019 for special purpose grade concrete, proportioning of concrete using fly ash as part replacement of OPC, mix proportioning for self-compacted concrete. Quality concepts: Definitions, principles & standards, quality control in concrete.		
Unit-VIII	Repairs and Rehabilitation	4 Hours
Visual inspection of concrete structure, distress in concrete, Non-destructive test, crack repair techniques, damage assessment procedure, and deterioration-causes, prevention, strengthening techniques.		
ICA consists of a minimum of 08 assignments based on the above syllabus		
Text Books		
<ol style="list-style-type: none"> 1. Concrete Technology (Theory and Practice) by Shetty, M. S., & Jain, A. K. S. Chand Publishing. 2. Concrete Technology by Neville, A. M., & Brooks, J. J. England: Longman Scientific & Technical. 3. Concrete Technology by A.R. Santhakumar. Oxford University Press, New Delhi. 		
Reference Books		



1. Concrete Technology by Job Thomas, CENGAGE Learning.
2. Handbook on Advanced Concrete Technology by Nayak, N. V., & Jain, A. K. Alpha Science International.
3. Concrete-Microstructure, Property and Materials by Kumar Mehta. P and Paulo J.M. Monteiro. McGraw-Hill Education.
4. I.S. 456- 2000 (reaffirmed 2021). Indian Standard Code of Practice for Plain & Reinforced Concrete.
5. I.S.10262-2019. Guidelines for Concrete Mix Design.
6. Relevant I.S. codes for Testing and specifications of different building materials.
7. Specifications of EFNARC



WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6E25T: Programme Elective Course – III- Design of RCC Bridges

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Tutorial	1 Hour/week	ISE	40 Marks
Credits	4	ICA	25 Marks

Introduction:

This course provides Basic knowledge of Types of Bridge, Forces acting on bridges, Analysis and design of various elements of Bridge

Course Prerequisite:

Fundamentals Structural Analysis and Design, Transportation Engineering, Geotechnical Engineering

Course Objectives:

1. To introduce the different types of bridges, their classifications, and the importance of various structural elements.
2. To Study the different loads acting on bridges.
3. To analyze and design reinforced concrete Deck slab culverts, T-beam bridges
4. To understand the design principles of piers, abutments
5. To explore the importance of bearings, types of bearing and their design
6. To explore various construction techniques along with inspection and repair of Bridges

Course Outcomes:

After completing the course, students will be able to

1. Identify the various elements of bridges along with evaluation of various loads acting on the bridges as per the IRC bridge code
2. Design the Solid Deck slab and T Beam Bridge superstructure.
3. Design various components of substructure such as Pier, Abutments, foundations
4. Design Bearing and expansion joint
5. Implement erection of Bridge deck and carry out maintenance and repair of the bridge.



Unit – I	Introduction to Bridge	6 Hours
Components of bridges, Classification, importance of bridges, Investigation for Bridges, I.R.C. bridge code, Loading on Bridges - IRC loading, Impact load, wind load, Earthquake load, Longitudinal force, Centrifugal force, buoyancy, Earth pressure, water current force, thermal force		
Unit – II	Design of RC Solid Deck Slab	6 Hours
Analysis of slab decks for the solid slab, effective width method, design of slab culvert		
Unit – III	Design of T Beam Bridge	10 Hours
Analysis Methods, Courbon's theory, design of longitudinal and cross girders, design of RC slabs supported on all sides for T-beam, Pigeaud's method		
Unit – IV	Design of Sub Structure:	8 Hours
Piers and Abutments- type, shape, and their suitability, Design of Abutments & Piers. well foundation		
Unit – V	Bearing and expansion joints	8 Hours
Bearings - Types, functions, and requirements as per IRC, Forces on bearings, design of elastomeric bearings, expansion joints		
Unit – VI	Construction Techniques:	6 Hour
Components of bridges, Classification, importance of bridges, Investigation for Bridges, I.R.C. bridge code, Loading on Bridges - IRC loading, Impact load, wind load, Earthquake load, Longitudinal force, Centrifugal force, buoyancy, Earth pressure, water current force, thermal force		
ICA consists of minimum 05 assignments based on above syllabus of analysis and design of Bridge superstructure and substructure		
Text Books		
<ol style="list-style-type: none"> 1. Essentials of Bridge Engg. by D. Johnsons Victor, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 2. Design of RCC Bridges- Jagdish Jayaram 3. Reinforced Concrete Structures – Vol. II by Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications. 		
Reference Books		



1. Concrete Bridge Practice by Dr. V. K. Raina, Tata McGraw Hill
2. Bridge Engg. by S. Ponnuswamy, Tata McGraw Hill
3. K. S. Rakshit, Design and Construction of Highway Bridges, New Central Book

IRC CODES

1. IRC 6 – 1966 —Standard Specifications and Code of Practice for Road Bridges|- Section II Loads and Stresses, The Indian Road Congress New Delhi
2. IRC 21 – 1966 —Standard Specifications and Code of Practice for Road Bridges|-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
3. IS 456 – 2000 —Indian Standard Plain and Reinforced Concrete Code of Practice|- (Fourth Revision) BIS New Delhi.
4. IS 1343 – Indian Standard Prestressed Concrete Code of Practice|- BIS New Delhi

e-Resources

2. [NPTEL :: Civil Engineering - NOC:Bridge Engineering](#)
3. [Bridge Infrastructure Design | Coursera](#)



WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6E35T: Programme Elective – III - Total Station and GPS Surveying

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Tutorial	1 Hours/week	ISE	40 Marks
Credits	4	ICA	25 Marks

Introduction:

This course provides a skill set essential for mapping of project sites during construction

Course Prerequisite:

Basic knowledge of surveying and primary instruments used for surveying

Course Objectives:

1. To provide in-depth knowledge of Total Station and its field applications.
2. To introduce principles and functioning of GPS for geospatial data collection.
3. To train students in modern surveying techniques used in infrastructure and GIS projects.
4. To develop the skills required for data acquisition, processing, and mapping using Total Station and GPS.
5. To promote understanding of real-time data integration and error reduction in modern surveying.

Course Outcomes:

After completing the course, students will be able to

1. Describe the working principles and components of Total Station and GPS.



<ol style="list-style-type: none"> 2. Perform field surveying operations using Total Station and GPS receivers. 3. Process and analyze field data for mapping and engineering applications. 4. Apply Total Station and GPS for various civil engineering projects including topographic and control surveys. 5. Identify and minimize errors in modern surveying instruments and procedures. 		
Unit – I	Total Station Surveying	8 Hours
<ul style="list-style-type: none"> • Concept and evolution of Total Station <ol style="list-style-type: none"> a) Components and types b) Instrument specifications c) Field adjustments and setup 		
Unit – II	Measurement Principles	6 Hours
<ul style="list-style-type: none"> • Measurement of angles and distances • Electronic Distance Measurement (EDM) principles • Automatic target recognition and reflector less mode • Coordinate determination and data logging 		
Unit – III	Field Operations and Data Management	6 Hours
<ul style="list-style-type: none"> • Traversing, triangulation, and topographic survey • Setting out curves, alignments, and control points • Area and volume calculation • Data downloading, post-processing, and plotting using software (e.g., AutoCAD, GIS) 		
Unit – IV	GPS Surveying	6 Hours
<ul style="list-style-type: none"> • Concept of GNSS and GPS • Segments: space, control, user • GPS signal structure and codes • Types of receivers and accuracy classes 		
Unit – V	GPS Surveying Methods	8 Hours
<ul style="list-style-type: none"> • Static, Rapid-static, Kinematic, RTK methods • Differential GPS (DGPS) • Sources of error and correction techniques • Applications in land surveying, construction, and geotechnical monitoring 		
Unit – VI	Integration and Applications	6 Hours
<ul style="list-style-type: none"> • Use of GPS with Total Station for control surveys • GIS mapping using GPS data • Mapping of utilities, road corridors, and infrastructure • Case studies: construction layout, highway surveys, land parcel mapping 		
<p>ICA consists of following assignments:</p> <ol style="list-style-type: none"> 1. Hands-on sessions with Total Station (setting up, measurement, data storage) 2. Practice of coordinate computation from field data 		



3. Survey Project: Conducting a topographic survey using Total Station and GPS
4. Data transfer and plotting using software tools
5. Preparation of maps and reports using actual field data
6. Error analysis and adjustment methods
7. Mini-assignment: Field application case study or GPS tracking analysis

Text Books

1. Basak, N. N. – *Surveying and Levelling*, Tata McGraw Hill
2. R.Agor – *Surveying and Levelling Vol. II*, Khanna Publishers
3. Sathesh Gopi – *Advanced Surveying: Total Station, GPS, GIS & Remote Sensing*, Pearson Education
4. Madan Mohan – *GPS Surveying*, ISRO/NRSC Publication

Reference Books

1. Kavanagh, B.F. – *Surveying with Construction Applications*, Pearson
2. Arora, K.R. – *Surveying Vol. III*, Standard Book House
3. Leica, Topcon, or Sokkia – *Manufacturer User Manuals*
4. IS 14925:1992 – *Electronic Total Station – Guidelines*
5. *GPS & GNSS Surveying Guidelines – Survey of India/NRSC/ISRO*

e-Resources

NPTEL Courses on Total Station and GPS







WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6E45T: Programme Elective – III-Open Channel Flow and River Hydraulics

Teaching Scheme		Examination Scheme	
Lectures	3 Hours/week	ESE	60 Marks
Tutorial	1 Hours/week	ISE	40 Marks
Credits	4	ICA	25 Marks

Introduction:

The study of Open Channel and River Hydraulics is fundamental for civil engineering students specializing in water resources and hydraulic engineering. This course provides essential knowledge of fluid mechanics applied to open channels, natural streams, and river systems. Emphasis is placed on flow classifications, sediment transport, river gauging, hydraulic structures, and river training techniques.

Course Prerequisite:

To effectively grasp the concepts in this course, students should have prior knowledge of Fluid Mechanics, Engineering Hydrology, Basic Mathematics, Differential Calculus, and Strength of Materials (for understanding forces in channels and structures).

Course Objectives:

1. To introduce the fundamental principles of open channel flow and river hydraulics.
2. To analyze different types of flow regimes, including uniform, non-uniform, gradually varied, and rapidly varied flows.
3. To study sediment transport mechanics and river morphology.
4. To equip students with knowledge of river gauging and training works.
5. To impart understanding of similitude and hydraulic model studies in channel design and analysis.

Course Outcomes:

After completing the course, students will be able to

1. Demonstrate basic principles of the open channel flow.
2. Analyze the various types of flows viz. uniform and non-uniform flow, gradually varied flow, rapidly varied flow, etc.
3. Describe the mechanics of sediment transport
4. Apply the knowledge of open channel hydraulics to river engineering.
5. Apply the knowledge of dimensional analysis to develop different hydraulic models.



Unit – I	Basic fluid flow concepts	5 Hours
Classification of open channel flow, Velocity, and pressure distribution. Energy and Momentum Equation applied to open channel flow, Energy and momentum coefficients, Channel Geometry, and geometrical elements.		
Unit – II	Uniform and critical flow computations:	5 Hours
Energy depth relationships, Resistance formulae, Concepts of first and Second hydraulic exponent, Determination of critical and normal depth, hydraulically most efficient channel sections, Channel transitions.		
Unit – III	Gradually varied flow:	6 Hours
Different equations governing GVF, Classification analysis, and control sections of profiles, Computation of GVF profiles by different methods.		
Unit – IV	Rapid Varied flow:	6 Hours
Type, Analysis and characteristics of Hydraulic jump in rectangular channels, Location of jump, Introduction to jump in non-rectangular channel and on sloping floor, Use of jump as Energy dissipater. Flow Measurement –Weir, spillways, critical depth flumes.		
Unit – V	River gauging:	5 Hours
Dominant discharge, Methods of gauging, current meter rating curve, automatic water level recorder, stage discharge relationship of a river.		
Unit – VI	Fluvial Hydraulics-	7 Hours
Sediment transport, Mode of sediment motion and formation, Threshold movement, Total sediment load, Suspended and bed load Theories, Reservoir Sedimentation.		
Unit – VII	River Management and Training:	6 Hours
Type of river, river morphology, meandering and braiding of River training work- Classification Types-Guide banks, Groynes, Deflectors, Embankments, Cut-offs, Bank Protection, Stable channel nature river training works, river morphology.		
Unit – VIII	Similitude and model analysis:	5 Hours
Basic principles, fixed bed and models, distorted models.		
ICA consists of a minimum of 06 assignments based on the above syllabus of analysis and design of Bridge superstructure and substructure		
Text Books		
<ol style="list-style-type: none"> 1. Open channel Hydraulics – Ven Te Chaw, McGraw Hill book Co. New York. 2. Flow through open channel – Ranga Raju 3. Flow in open channel –K. Subramanya, Tata McGraw Hill Publications 4. Mechanics of Sediment transport and alluvial river problems-R. J. Garde New Age Publications New Delhi 		
Reference Books		



1. Open Channel Flow-F. M. Henderson.
2. River Gauging –Chitale and Hiranandani
3. River Mechanics-Vol. I &II, Hsieh Wen Shen.

e-Resources

Flow through Open Channels by Prof. Subhashish Dey (IIT Kharagpur)
Sediment Transport and River Engineering





WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Third Year B.Tech. (Civil Engineering), Semester-VI

23CEU6VS7L: Steel Structural Design and Drawing

Teaching Scheme		Examination Scheme	
Lectures	1 Hour/week	ESE	-----
Practical	2 Hours/week	ISE	-----
Credits	2	ICA	50 Marks
		POE	25 Marks

Introduction:

This course will provide detailed knowledge of the design and detailing of an Industrial shed. The curriculum includes load calculation on various members, the design of Industrial shed components, tension members, compression members, beams, and column bases. Pre-engineered buildings parameters. Precise and correct detailing of structural drawing.

Course Prerequisite:

The student has completed a course in structural mechanics I & II and Design of Steel Structures, Familiarity with the design of axial member, flexural member, slab base, and gusseted base.

Course Objectives:

1. This course provides students with the knowledge and skills to design structural layouts for industrial steel structures.
2. To enable students to determine various types of loads acting on steel structures such as plate girders, foot-over bridges, and pre-engineered buildings, and to identify typical structural failure modes
3. To apply engineering principles, standard design procedures, and current Indian codal provisions for the analysis and design of industrial steel structures.
4. To enable students to apply engineering principles, standard design procedures, and current Indian codal provisions for the analysis and design of plate girder or foot-over bridge.

Course Outcomes:

After completing the course, students will be able to

1. Prepare structural layout of Industrial steel structures, plate girder, foot-over bridge, and pre-engineered building
2. Evaluate the loads acting on steel structures as mentioned above and identify the typical failure modes.
3. Apply the principles, procedures and current Indian codal provisions to the analysis and design of Industrial structures and pre-engineered buildings.
4. Analysis and design plate girder or foot-over bridge using IS provisions.



Unit – I	INDUSTRIAL SHED	9 Hours
<p>Structural layout of industrial building, Various types of trusses and their selection, effect of wind loads on purlin and trusses, bracing systems, columns, foundations, gantry girder – static and moving loads, selection & design of section as per IS code</p> <p>Stiffened and unstiffened, moment & shear resisting structural connections, design and detailing of various connection - roof truss to column, column to beam, beam to beam and truss to bed block</p>		
Unit – II	DESIGN	6 Hours
<p>a) Welded Plate Girder: Design of welded plate girder, design of cross section, curtailment of flange plates, stiffeners and their connections</p> <p>b) Design of foot-over bridges: Structural system of through & deck type bridges, design of foot-over bridge & its Supporting system.</p> <p>c) Pre-Engineered Buildings Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads</p>		
<p>Note:</p> <ol style="list-style-type: none"> 1. Sample verification of analysis results shall be made by using software and analysis. 2. Maximum number of students in a group is not more than five for design. 		
<p>INTERNAL CONTINUOUS ASSESSMENT (ICA)</p>		
<ol style="list-style-type: none"> 1. Carry out full design of Industrial shed and prepare design report & detailed drawings in A2 size drawing sheet 2. Design of any Industrial shed using any open-source / professional software and/or self-developed spreadsheet/programs. 3. Prepare a structural detailing drawing with connections of any one unit using any open source / professional software 4. Site visit related to construction stages and report preparation 		
<p>Text Books</p>		
<ol style="list-style-type: none"> 1. Design of Steel Structures, by N. Subramanian, Oxford, 2008 2. Limit State Design of Steel Structures, by S. K. Duggal 3. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S. K 4. International Publishing House, New Delhi 5. Limit state design in Structural Steel by Dr M. R. Shiyekar 6. Design of Steel structures by K. S. Sai Ram 7. Design of Steel structures by L. S. Jayagopal and D. Tensing 		
<p>Reference Books</p>		



1. Limit state design of Steel Structure by V. L. Shah & Gore, Structures Publication, Pune
2. Limit State Design of Steel Structures by D. Ramchandra & Virendra Gehlot, Scientific Publishers
3. Structural Design and Drawing Reinforced Concrete and Steel by N. Krishnaraju,
4. Universities Press (India) Pvt. Ltd. Hyderabad.
5. IS 800:2007, General Construction In Steel - Code of Practice, Bureau of Indian Standards, New Delhi.
6. IS 875 (Part 1): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 1 Dead Loads - Unit Weights of Building Materials and Stored Materials, Bureau of Indian Standards, New Delhi.
7. IS 875 (Part 2): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 2 Imposed Loads, Bureau of Indian Standards, New Delhi.
8. IS 875 (Part 3): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 3 Wind Loads, Bureau of Indian Standards, New Delhi.
9. IS 1893: Part 1: 2016: Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings
10. Steel Tables SP: 6(1) and SP: 6(6)

e-Resources

1. Web links and Video Lectures (e-Resources):
<https://nptel.ac.in/>
2. Teaching Resource Material by INSDAG
3. elearning.vtu.ac.in

