WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(AN AUTONOMOUS INSTITUTE)

Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Civil Engineering

CHOICE BASED CREDIT SYSTEM (CBCS)

Structure and Syllabus for
Honors Degree in
Sustainability Engineering

T.Y. B. Tech. Civil Engineering W.E.F. 2024-25
Final Year B. Tech. Civil Engineering W.E.F. 2025-26

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Chairman, BOS in Civil Engg.
W.I.T. (Autonomous), Solapur

WALCHAND INSTITUTE OF TECHNOLOGY WIT SOLAPUR

Department Vision

The Department of Civil Engineering, Walchand Institute of Technology Solapur, will 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.

Department Mission

1. 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.
2. To continually advance research through a culture of discovery, creativity, and innovation to benefit humankind.
3. To serve as highly capable resources to society, and the profession through professional organizations, consultancy, and continuing education.

Civil Engineering
Undergraduate Program
Program Educational Objectives (PEOs)

The Program Educational Objectives for B. Tech. Civil Engineering program are designed to produce competent civil engineers who are ready to contribute effectively to the advancement of Civil Engineering and to fulfill the needs of the community. These objectives are as follows:

1. Graduate will demonstrate peer-recognized technical competency in the analysis, design and construction of Civil Engineering Structures.
2. Graduate 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.
3. Graduate will be engaged in ongoing learning and professional development through pursuance of higher education and self-study.
4. 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.

Program Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet

the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities, relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

Program Specific Outcomes (PSOs)

Engineering graduates in Civil Engineering Programme will be able to do-

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.
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.
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.

Legends used–

L	Lecture Hours/week
A	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	Humanities and Social Sciences
NPTEL	National Program on Technology Enhanced Learning
F.Y.	First Year
S.Y.	Second Year
T.Y.	Third Year
B.Tech.	Bachelor of Technology

Course Code Format for Honors:

2	1	C	E	U/P	2	H	S	1	T / L
Batch Entry Year		Program Code		U-Under Graduate, P-Post Graduate	Semester No. / Year 1/2/3/…8	Honors Code		Course Serial No. 1-9	T-Theory, L-Lab session

Program Code	
CE	Civil Engineering
Course Types	
BS	Basic Science
ES	Engineering Science
HU	Humanities & Social Science
MC	Mandatory Course
CC	Core Compulsory Course
SN*	Self-Learning N* indicates the serial number of electives offered in the respective category
EN*	EN* Core Elective N* indicates the serial number of electives offered in the respective category
SK	SK Skill-Based Course
SM	Seminar
MP	Mini project
PR	Project
IN	Internship

Program Code	
CE	Civil Engineering
Honors Code	
HS	Honors in Sustainability Engineering

Sample Course Code:

22CEU4HS1T	Environmental Laws and Impact Assessment

Walchand Institute of Technology, Solapur
Civil Engineering
Honors in Sustainability Engineering

Structure of T. Y. B. Tech. Civil Engineering
(W.E.F. 2024-2025)

Semester- V

Course Code	Course Name	Engagement Hours			Credits	FA	SA		
		L	T	P		ESE	ISE	ICA	Total
22CEU5HS1T	Construction Materials: Sustainability and Usability	3	-	-	3	60	40	-	100
22CEU5HS1A	Construction Materials: Sustainability and Usability	-	1	-	1	-	-	25	25
	Grand Total	**3**	**1**		**4**	**60**	**40**	**25**	**125**

Structure of T. Y. B. Tech. Civil Engineering.,
(W.E.F. 2024-2025)

Semester- VI

Course Code	Course Name	Engagement Hours			Credits	FA	SA		
		L	T	P		ESE	ISE	ICA	Total
22CEU6HS1T	Sustainable Materials and Green Buildings	3	-	-	3	60	40	-	100
22CEU6HS1A	Sustainable Materials and Green Buildings	-	1	-	1	-	-	25	25
	Grand Total	**3**	**1**		**4**	**60**	**40**	**25**	**125**

Walchand Institute of Technology, Solapur
Civil Engineering
Honors in Sustainability Engineering

Structure of Final Year B. Tech. Civil Engineering
(W.E.F. 2025-2026)

Semester- VII

Course Code	Course Name	Engagement Hours			Credits	FA	SA		
		L	T	P		ESE	ISE	ICA	Total
22CEU7HS1T	Sustainable Engineering & Technology	3	-	-	3	60	40	-	100
22CEU7HS1A	Sustainable Engineering & Technology	-	1	-	1	-	-	25	25
22CEU7HS2L	Mini Project			4	2	50		50	100
	Grand Total	**3**	**1**	**4**	**6**	**110**	**40**	**75**	**225**

Note: -These courses are to be completed by the student in addition to the courses of B. Tech Civil Engineering.

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T. Y. B. Tech. Civil Engineering - Semester- V

22CEU5HS1T

CONSTRUCTION MATERIALS: SUSTAINABILITY AND USABILITY

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Practical: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 60 marks
ISE: 40 marks
ICA: 25 marks

The course explores the balance between the environmental impact and practical application of various building materials. It delves into the evaluating materials production, use, and disposal phases to assess their ecological footprint. It covers traditional materials like concrete and steel, as well as innovative, eco-friendly alternatives such as recycled composites and bio-based materials.

Course Prerequisite:

Student has completed a course in Environmental Laws & Impact Assessment, & Building Construction Planning of Civil Engineering and has an adept knowledge of basic construction Materials. The student should also have insights of concepts of Sustainability.

Course Objectives:

1. To equip students with knowledge of the physical, chemical, and mechanical properties of various construction materials.
2. To make students explore and assess sustainable and innovative materials, such as recycled, renewable, and low-impact options.
3. To make students instill the importance of reducing carbon footprints, conserving resources, and enhancing energy efficiency in construction practices.
4. To make students address usability factors such as durability, adaptability, and compliance with regulatory requirements to ensure the successful implementation of sustainable practices in the construction industry.

Course outcome: At the end of the course, students will be able to,

1. Predict the use of sustainable building materials.
2. Categorize material indices and select the best materials (with optimum mechanical, durability, and eco-performances for a project.
3. Apply the knowledge of eco-materials in the civil engineering field
4. Outline efficient cross sections for structural members, and explain various techniques for designing green concrete materials.

SECTION-I

Unit 1: Introduction to sustainable building materials: No of Lectures-06

Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials, biomaterials - Salvaged and recycled materials - Nontoxic materials: low VOC paints, coating, and adhesives.

Unit 2: Concept of Embodied Energy and Carbon Footprint: No of Lectures-08

The idea of embodied energy - Development of the concept, factors to be considered, calculation techniques for embodied energy - Data sets available for calculation of embodied energy - Case studies of embodied energy calculations - Sample embodied energy calculations for a material - Concept of embodied carbon or carbon footprint of material, calculation techniques, methods to off-set high embodied energy - Cradle to cradle material, whole life cycle and life cycle costing analysis techniques.

Unit 3: Sustainable construction techniques: No of Lectures-06

Alternative construction techniques such as SMB, CSEB, steam cured blocks, composite beam and panel, funicular shells, filler slabs, reinforced concrete masonry, vaulted roofs, Ferro-cement walls, etc., - Case studies

SECTION-II

Unit 4: Innovative use of materials: No of Lectures-06

Use of waste materials such as paper, glass bottles, tires, and shipping containers - Use of post-consumer and industrial waste such as fly ash, bags, and building demolition waste – use of salvaged materials from flooring, columns, beams, timber, glass, etc.

Unit 5: Eco-audits and eco-audit tools: No of Lectures-08

Eco auditing of Reusable and disposable cups, Grocery bags, and Family cars - comparing material energy with the use of energy Legal framework, the material selection strategy: choosing a car, Principles of materials selection, Selection criteria and property charts, using indices for scaling, Resolving conflicting objectives: trade-off methods, seven useful charts, Computer-aided selection.

Unit 6: Eco-informed materials selection: No of Lectures-06

Eco-informed materials selection introduction, Selection per unit of function, Systematic eco-selection: carbonated water bottles, Structural materials for buildings, Initial and recurring embodied energy of buildings, Transportation -introduction, crash barriers—matching material to purpose, materials for lightweight structures, material substitution for the eco-efficient design.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Internal Continuous Assessment (ICA) submission shall consist of:

1. Assignments on each unit based on the syllabus.

- **Text Books**

1. M.F. Ashby (2012) “Materials and the Environment: Eco-Informed Material Choice”, 2nd Ed., Elsevier, Burlington.
2. M.F. Ashby (2011) “Materials Selection in Mechanical Design”, 4th Ed., Elsevier, Burlington
3. A New Era of Sustainable Technology Development 2nd edition, M.M. Khan, Scrivener Publishing LLC.

- **References**

1. William McDonough, Michael Braungart, “Cradle to Cradle: Remaking the way we make things”, North Point Press, 2002.
2. Lawrence D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003
3. Environmental Assessment Source book-Vol. III: Guidelines for environmental assessment of energy and industry projects, World Bank,1998
4. Petts J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999
5. Canter L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
6. Nick Harvey, Beverley Clarke, Environmental Impact Assessment: Procedures and Practices, Oxford University Press, USA, 2012.

Walchand Institute of Technology, Solapur

T. Y. B. Tech. Civil Engineering - Semester- VI

22CEU6HS1T

SUSTAINABLE MATERIALS AND GREEN BUILDINGS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Practical: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 60 marks
ISE: 40 marks
ICA: 25 marks

The course examines the use of eco-friendly materials and practices in the construction of environmentally responsible buildings. It covers a range of sustainable materials, including recycled, renewable, and low-emission options, and discusses their benefits and limitations. Key topics include the principles of green building design, energy efficiency, water conservation, and indoor environmental quality. The course also explores certifications and standards, such as LEED and GRIHA, that guide and measure the sustainability of buildings.

Course Prerequisite:

Student has completed a course in Building Construction Planning, and Construction Materials: Sustainability & Usability of Civil Engineering and has an adept knowledge of basic construction Materials. The student should also have insights of concepts of Sustainability.

Course Objectives:

1. To equip students with comprehensive knowledge of various sustainable building materials, including their properties, benefits, and limitations.
2. To make students aware about the fundamental principles and practices of green building design, focusing on energy efficiency, water conservation, and indoor environmental quality.
3. To provide students an in-depth understanding of green building certifications and standards such as LEED, GRIHA, and others.
4. To emphasize students about the importance of green buildings in promoting environmental sustainability, resource efficiency, and human health.

Course outcome: At the end of the course, students will be able to,

1. Appraise the appropriateness and sustainability of materials for construction projects.
2. Explain innovative sustainable systems in construction.
3. Examine the green building rating systems and its contribution to sustainability.
4. Select sustainable technologies based on international standard practices and certification.

SECTION-I

Unit 1: Sustainability: No of Lectures-06

Definition of Sustainability, Dimension of Sustainability, Three Pillars of Sustainability, Principles of Sustainability - 5R- case studies of urban areas and industrial areas, Construction Materials Resource Efficiency and operational Reuses of the Construction Materials,

Sustainability Goals for Construction Industry and green building - Energy and water, Construction and Demolition Waste, Building Stock Management.

Unit 2: Various green construction materials: No of Lectures-06
Natural and manmade, CLC Blocks (Cellular Light Weight Concrete), Fly ash Bricks, AAC blocks, Cement Fiberboards, chemicals/admixtures.

Unit 3: Special Concrete: No of Lectures-06
Fly ash and its use in concrete, Silica fume concrete, Self-compacting concrete, Fiber Reinforced plastics and concrete, and Lightweight concrete, High-performance concrete, Nanotechnology in cement concrete, Ferrocement Technology.

SECTION-II

Unit 4: Green Building Technologies: No of Lectures-06
Introduction- Necessity - Concept of Green building, Principles of green building, Applications of 5R in green building, Application of renewable energy resources in green building, Structure of green building.

Unit 5: Orientation of the Building: No of Lectures-08
Selection of site and Orientation of the building – usage of low energy materials – effective cooling and heating systems – effective electrical systems – effective water conservation systems.

Unit 6: Certification systems: No of Lectures-08
Certification systems, Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), case studies.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Internal Continuous Assessment (ICA) submission shall consist of:
2. Assignments on each unit based on the syllabus.

- **Text Books**

4. M.F. Ashby (2012) "Materials and the Environment: Eco-Informed Material Choice", 2nd Ed., Elsevier, Burlington.
5. M.F. Ashby (2011) "Materials Selection in Mechanical Design", 4th Ed., Elsevier, Burlington
6. A New Era of Sustainable Technology Development 2nd edition, M.M. Khan, Scrivener Publishing LLC.

- **References**

7. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.

8. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010.
9. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.
10. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.
11. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
12. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison "Green Building Handbook" Volume I, Spon Press, 2001.
13. Mili Majumdar, "Energy-efficient buildings in India" Tata Energy Research Institute, 2002.
14. TERI "Sustainable Building Design Manual- Volume I & II" Tata Energy Research Institute, 2009
15. Concrete Technology by M. S. Shetty, Pub.-S. Chand & Co. Ltd.
16. Concrete Technology by A.M. Neveille, Pub.- Pearson Education Ltd.

Walchand Institute of Technology, Solapur

Final Year B. Tech. Civil Engineering - Semester- VII

22CEU7HS1T

SUSTAINABLE ENGINEERING & TECHNOLOGY

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Practical: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 60 marks
ISE: 40 marks
ICA: 25 marks

The course explores the intersection of engineering practices with environmental stewardship and resource conservation. The subject focuses on integrating sustainable principles into engineering processes and technologies to mitigate environmental impacts and promote long-term viability. It covers topics such as renewable energy systems, green manufacturing techniques, waste reduction strategies, and lifecycle assessments of products and processes.

Course Prerequisite:

The student has completed a course in Construction Materials: Sustainability & Usability & Sustainable Materials & Green Buildings of Civil Engineering and has an adept knowledge of Environmental Laws and their impact assessment. The student should also have insights of concepts of Sustainability.

Course Objectives:

1. To educate students on the principles of sustainability as they apply to engineering and technology.
2. To make students understand sustainable design methodologies and techniques, such as life cycle assessment and eco-design principles.
3. To make students explore renewable energy systems, green manufacturing processes, and other sustainable technologies.
4. To make students develop skills in assessing the economic feasibility and environmental impacts of engineering projects and technologies.

Course outcome: At the end of the course, students will be able to,

1. Figure out the relevance and the concept of sustainability and the global initiatives in this Direction.
2. Aquent and explain different types of environmental pollution problems and their sustainable Solutions.
3. Apply the environmental regulations and standards.
4. Observe and incorporate the concepts related to conventional and non-conventional energy.
5. Implement the broad perspective of sustainable practices by utilizing engineering knowledge and principles.

SECTION-I

Unit 1: Sustainability: No of Lectures-06

Sustainability: Introduction, concept, the evolution of the concept; Social, environmental, and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Unit 2: Environmental Pollution: No of Lectures-06

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 5R concepts in solid waste management; case studies, Greenhouse effect, Global warming.

Unit 3: Climate Change: No of Lectures-06

Climate change, Ozone layer depletion, Carbon credits, Carbon trading, and Carbon footprint, Legal provisions for environmental protection.

SECTION-II

Unit 4: Environmental management standards: No of Lectures-06

Environmental management standards: ISO 14001:2015 framework and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology, and industrial symbiosis.

Unit 5: Resources and its utilization: No of Lectures-08

Resources and its utilization: Basic concepts of Conventional and non-conventional energy, General ideas about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, and Geothermal energy.

Unit 6: Sustainability Practices: No of Lectures-08

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Internal Continuous Assessment (ICA) submission shall consist of:

3. Assignments on each unit based on the syllabus.

- **Text Books**

7. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
8. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
9. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis

Publication, London, 1998.

- **References**

17. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
18. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
19. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
20. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
21. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication.

Walchand Institute of Technology, Solapur

Honors in Sustainability Engineering

Final Year B.Tech. (Civil Engineering),
Semester VII

22CEU7HS2L
MINI PROJECT

Teaching Scheme:
Practical: 4 hrs/week, 2 credit

Examination Scheme:
ICA: 50 Marks
ESE: 50 Marks

Student/s shall carry out a 'Mini Project' in any one of the following subjects: Sustainable materials, Green Buildings, Applications of SDGs, Sustainable systems, engineering materials for Sustainability, EIA, LCA, Impact of Environmental Policies, etc.

The project shall consist of Sustainable Engineering Prototype design, working models, Laboratory experiments, Process modification/development, Simulation, Software development, Data analysis, Survey, etc.

The student is required to submit a 'Project Report' based on the work. The Mini project shall be assessed by the domain subject teachers for ICA.

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