

**Punyashlok Ahilyadevi Holkar Solapur University,
Solapur**



NAAC Accredited-2015'B'
Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

**Structure & Syllabus:
Honors Degree in Sustainability Engineering
with
B. Tech. (Civil Engineering)**

**T.Y. B. Tech (Civil Engineering)
w. e. f. Academic Year 2022-23**



**PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Honors in Sustainability Engineering
(With B. Tech. Civil Engineering)
WEF batch of 2020-21
Effective to S. Y. B. Tech Hons. batch of 2021-22**

Course Code	Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ESE	ISE	ICA	Total
Semester - IV									
Hn411	Environmental Laws and Impact Assessment	3	1		4	70	30	25	125
Semester - V									
Hn512	Construction Materials: Sustainability and Usability	3		2	4	70	30	25	125
Semester - VI									
Hn613	Sustainable Materials and Green Buildings	4		2	5	70	30	25	125
	Seminar			2*	1			50	50
Semester - VII									
Hn714	Sustainable Engineering & Technology	3		2	4	70	30	25	125
	Mini Project			2*	1			50	50
Sub Total		13	1	10	19	280	120	200	600

* indicates contact hours



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S. Y. B. Tech. (Civil Engineering) – II, Semester- IV

Hn411: Environmental Laws and impact assessment

Teaching Scheme

Lectures – 3 Hrs/Week, 3 Credits

Tutorial – 1 Hr/Week, 1 Credit

Examination Scheme

ISE – 30 Marks

ESE –70 Marks

ICA – 25 Marks

Course outcomes:

Upon successful completion of course, the students will be able to:

1. Be familiar with the laws, policies and institutions in the field of environment.
2. Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective.
3. Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution
4. Identify environmental attributes for the EIA study and to identify methodology and prepare EIA reports.
5. Perform life cycle inventory analysis of products.
6. Develop strategies to bring energy efficiency in all stages of the product development cycle and Formulate plans for comprehensive environmental protection, in order to comply with environmental laws.

SECTION-I

Unit 1:

(08)

Introduction to environmental laws in India; Constitutional provisions, General principles in Environmental law: Precautionary principle; Polluter pays principle; Overview of legislations and basic concepts. Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence, statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Modulew leopard.

Unit 2:**(07)**

National Water Policy and some state policies, Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards, Ground water and law, judicial remedies and procedures, Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act, 1981; EPA, 1986, Legal framework: EPA and rules made thereunder; PLI Act, 199, Principles of strict and absolute liability, Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses

Unit 3:**(09)**

Introduction: The Need for EIA, Indian Policies Requiring EIA, EIA Cycle and Procedures, and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. List of projects requiring Environmental clearance, International agreements. Identifying The Key Issues: Key Elements of an Initial Project Description and Scoping, EIA Methodologies, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods

SECTION-II**Unit 4:****(07)**

Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS. Reviewing, EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact

Unit 5:**(08)**

Introduction, Life Cycle Assessment concepts. A brief history of Life-cycle Inventory analysis, overview of methodology, three components, Identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis, Procedural framework of Life-cycle inventory: Introduction, define the purpose and scope of inventory

Unit 6:**(06)**

General issues in Inventory analysis: Introduction, Using Templates, Data issues, special case boundary issues, Issues Applicable to specific life cycle stages: Introduction, Raw Material acquisition stage, Manufacturing stage, Use/Reuse/Maintenance stage, Recycle/Waste Management stage.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Internal Continuous Assessment (ICA) submission shall consist of the following –

1. Case study of the implications of environmental laws in developed and developing country (Any Two).
2. Case study of EIA and LCA for and material/product (Any Two)
3. Assignments (One Assignment on each unit)

TEXT BOOKS

1. Divan S. and Rosencranz A. (2005) *Environmental Law and Policy in India*, 2nd ed., Oxford, New Delhi
2. Leelakrishnan P. (2008) *Environmental Law in India*, 3rd ed., Lexis Nexis, India.
3. Canter, L.W., *Environmental Impact Assessment*, McGraw Hill Pub. Co., 1997
4. David P. Lawrence, *Environmental Impact Assessment: Practical Solutions to Recurrent Problems*, John Wiley & Sons, 2003
5. Hosetti, B. B., Kumar A, Eds, *Environmental Impact Assessment & Management*, Daya Publishing House, 1998
6. Ciambrone , D.F., *Environmental Life Cycle Analysis*, CRC Press, 1997

REFERENCE BOOKS

1. Birnie P. (2009) *et al., International Law and the Environment*, 3rd ed., Oxford.
2. Desai A. (2002) *Environmental Jurisprudence*, 2nd ed., Modern Law House, Allahabad.
3. Gadgil M. and Guha R. (1995) *Ecology and Equity*, Oxford, New Delhi.
4. Gadgil M. and Guha R. (1997) *This Fissured Land*, Oxford, New Delhi.
5. Guha R. (2000) *Environmentalism: A Global History*, Oxford, New Delhi.
6. Kamala S. and Singh U.K. (eds.) (2008) *Towards Legal Literacy: An Introduction to Law in India*, Oxford, New Delhi.
7. Leelakrishnan P. (2006) *Environmental Law Case Book*, 2nd ed, Lexis Nexis, India.

8. Sands P. (2002) *Principles of International Environmental Law*, 2nd ed, Cambridge.
9. Singh C. (1986) *Common Property and Common Poverty*, Oxford, New Delhi.
10. Upadhyay S. and Upadhyay V. (2002) *Hand Book on Environmental Law- Forest Laws, Wildlife Laws and the Environment*; Vols. I, II and III, Lexis Nexis- Butterworths-India, New Delhi.
11. UNESCO, *Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development*, UNESCO/UNEP, Paris, 1987
12. Anjaneyulu.Y., and Manickam. V., *Environmental Impact Assessment Methodologies*, B.S. Publications, Hyderabad, 2007
13. Wathern.P., *Environmental Impact Assessment- Theory and Practice*, Routledge Publishers, London, 2004
Handbook on Life Cycle Assessment: Operational guide to the ISO standards, Kluwer Academic Publishers, 2004



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T. Y. B. Tech. (Civil Engineering) – I, Semester- V

Hn512: Construction Materials: Sustainability and Usability

Teaching Scheme

Lectures – 3 Hrs/Week, 3 Credits

Practical – 2 Hr/Week, 1 Credit

Examination Scheme

ISE – 30 Marks

ESE – 70 Marks

ICA – 25 Marks

Course Outcomes:-

Upon successful completion of course, the student's will be able to:

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

SECTION-I

Unit1: Introduction to sustainable building materials (07)

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

Unit 2: Concept of Embodied Energy and Carbon Footprint (08)

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 (07)

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

SECTION-II**Unit4: Innovative use of materials (07)**

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

Unit5:-Eco-audits and eco-audit tools (08)

Eco auditing of Reusable and disposable cups, Grocery bags, Family car - comparing material energy with use 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

Unit6:-Eco-informed materials selection (08)

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 light weight structures, material substitution for eco-efficient design

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Internal Continuous Assessment (ICA) submission shall consist of the following –
Assignments (One Assignment on each unit)

TEXTBOOKS

1. M.F. Ashby (2012) “Materials and the Environment: Eco-Informed Material Choice”, 2ndEd., 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.

REFERENCE BOOKS

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
7. Gursharan Singh Kainth, Climate Change, Sustainable Development and India, LAP Lambert, 2011
8. Janis Birkeland, Positive Development: From Vicious Circles to Virtuous Cycles through Built Environment Design, Routledge, 2008
9. Sustainable Building - Design Manual: sustainable building design practices- TERI 2004
10. Ross Spiegel, Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition, John Wiley & Sons, 2010
11. K.S. Jagadish, Alternative building materials and technologies, New Age International, 2013
12. The Barefoot Architect: A Handbook for Green Building, Shelter Publication, 2007



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T. Y. B. Tech. (Civil Engineering) – II, Semester- VI

Hn613: Sustainable materials & Green buildings

Teaching Scheme

Lectures – 4 Hrs/Week, 4 Credits

Tutorial – 2 Hr/Week, 1 Credit

Examination Scheme

ISE – 30 Marks

ESE –70 Marks

ICA – 25 Marks

Course outcomes:

Upon successful completion of course, the students will be able to:

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

SECTION I

Unit 1:

(10)

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:

(10)

Various green construction materials: natural and manmade, CLC Blocks (Cellular Light Weight Concrete), Fly ash Bricks, AAC blocks, Cement Fibre boards, chemicals/admixtures,

Unit 3:

(9)

Fly ash and its use in concrete ,Silica fume concrete ,Self-compacting concrete, Fiber Reinforced plastics and concrete ,Light weight concrete. High performance concrete, Nano technology in cement concrete, Ferrocement Technology.

SECTION II

Unit 04: (10)

Green Building Technologies: 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

Units 05: (10)

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

Units 06: (9)

Certification systems- Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), case studies

REFERENCE BOOKS

1. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.
2. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010.
3. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.
4. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.
5. Michael Bauer, Peter Mösle and Michael Schwarz “Green Building – Guidebook for Sustainable Architecture” Springer, 2010.
6. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison “Green Building Handbook” Volume I, Spon Press, 2001.
7. Mili Majumdar, “Energy-efficient buildings in India” Tata Energy Research Institute, 2002.
8. TERI “Sustainable Building Design Manual- Volume I & II” Tata Energy Research Institute, 2009
9. Concrete Technology by M. S. Shetty, Pub.-S. Chand & Co. Ltd.
10. Concrete Technology by A.M. Neveille, Pub.- Pearson Education Ltd.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T. Y. B. Tech. (Civil Engineering) – II, Semester- VI Seminar

Teaching Scheme

Practical– 2 Hrs/Week, 1 Credits

Examination Scheme

ICA – 50 Marks

Objectives:

- 1) To expose the students to a variety of projects and research activities in sustainable Engineering in order to enrich their academic experience.
- 2) To acquaints department members with Third year students within the department and learn about each students' seminar activities.
- 3) To give an opportunity for students to develop skills in presentation and discussion of various topics in a public forum.

The topic for the Seminar may be related to sustainable Engineering area and inter-disciplinary area related to sustainable Engineering such as

- Sustainable Development Goals (SDGs)
 - Carbon Footprints
 - Climate change
 - Pillars of Sustainable development
 - Circular economy
 - Sustainable city
 - Water treatment
 - Green Technology
 - Life cycle analysis
 - E- audit
 - Environmental Audit
 - Sustainable materials
 - Industrial clusters
 - Alter effects of urbanization
 - Societal problems of smart city
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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Final. Y. B. Tech. (Civil Engineering) – I, Semester- VII

Hn714: Sustainable Engineering and Technology

Teaching Scheme

Lectures – 3 Hrs/Week, 3 Credits

Practical – 2 Hr/Week, 1 Credit

Examination Scheme

ISE – 30 Marks

ESE – 70 Marks

ICA – 25 Marks

Course outcomes:

Upon successful completion of course, the 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:

(08)

Sustainability: Introduction, concept, 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:

(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:

(06)

Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

SECTION-II

Unit 4: (08)

Environmental management standards: ISO 14001:2015 frame work 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: (06)

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

Unit 6: (06)

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 the following –
Minimum 6 Assignments (One Assignment on each unit)

TEXT BOOKS

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

REFERENCE BOOKS

1. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final. Y. B. Tech. (Civil Engineering) – I, Semester- VII
Mini Project

Teaching Scheme

Practical – 2 Hr/Week, 1 Credit

Examination Scheme

ICA – 25 Marks

Student/s shall carry out ‘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.