Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CE6012 - Sustainability Engineering: Concepts and Applications

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:0

Course Type: Theory

Description: 1. To introduce the fundamental knowledge of issues, principles, concepts, processes, and practices related to sustainability engineering. 2. To build the capacity to consider sustainability factors in conceptualizing, designing and operating the engineering systems to create tomorrow's sustainable environment and sustainable products.

Course Content: Sustainability: Introduction, Need for sustainability, Concept of sustainability, social, environmental and economic sustainability concepts

Indicators of Sustainability: Sustainability Strategies- People-Planet-profit Concepts â€“ Environmental Carrying Capacity, Barriers to Sustainability â€“ Industrial activity and Environment â€“ Industrialization and sustainable development â€“ Industrial Ecology â€“ clean development mechanism, Cleaner Production (CP) in Achieving Sustainability â€“ Prevention versus Control of Industrial Pollution â€“ Environmental Polices and Legislations. Methods and Markers for Sustainability;

Examples towards Sustainability principles incorporation in design and operation of Environmental systems (8hours) Industrial Approaches to Sustainability: Need for

Sustainable Practices in Industry, Life Cycle Assessment and Environmental Management Systems: Elements of LCA â€“ Life Cycle Costing â€“ Eco Labelling â€“

Design for the Environment â€“ International Environmental Standards â€“ ISO 14001 â€“ Environmental audit, international accreditation of compliance (Forest

Stewardship Council, Extractive Industries Transparency Initiative), Polluterâ€™s pay principle, Green building & green energy concepts and management- LEED and GREGHA Ratings; biomimicking and its applications to Industrial Processes; Material Choice based on Sustainability- Ecoattributes of materials-embodied energy, carbon emission, Estimation of Eco-indicator of product; Materials Flow Analysis; Design for the Environment; Corporate managing for Sustainability; Sustainable Agriculture- Impact of Agriculture Pollution on water bodies; Principles of Green Engineering and Green Chemistry - Green Engineering Concepts and their applications in Bio-Tech and Textile industries; Role & responsibility of industries in implementing sustainability concepts in process design and operations. Strategies for implementing eco-development programs. Waste management - Sustainable solutions, Reduce Recycle and reuse - Impact on overall embodied energy of a product. (10hours) Cleaner Production towards Sustainability: Definition â€“ Importance â€“â€“ Benefits â€“ Promotion â€“ Barriers â€“ Role of Industries,

Environmental Management Hierarchy â€“ Source Reduction Techniques; CP Assessment Steps and Skills: Preparing for the Site Visit, Process Flow Diagram,

Material Balance, CP Option Generation â€“ Technical and Environmental Feasibility analysis â€“ Economic valuation of alternatives - Total Cost Analysis â€“ CP

Financing â€“ Establishing a Program â€“ Organizing a CP Project Development â€“ Preparing a Program Plan â€“ Measuring Progress â€“ Pollution Prevention and Cleaner Production Awareness Plan â€“ Waste audit â€“ Environmental Statement, Carbon / emission credits, carbon sequestration, carbon / water trading, biodiversity offsets, conservation compensation. Role of Stakeholders, clients, and insurance and financial services. (10 Hours) Case Studies: Industrial applications of CP, LCA, EMS and Environmental Audits, green energy and green process management. Cleaner Production (CP). Applications of Sustainability Engineering Principles for various case studies including (a) A culture of waste and consumption: Solid Waste Generation and management in the Developed and Developing World; Reduce Reuse Recycle principles; E-Waste, Our Plastic Footprint, novel entities (personal care products, nano-particles). (b) The Built Environment: Green Urbanism and

Green Economy; Community Sustainability; Urbanization in Poverty and Slums: Challenges for Sustainability. Mega-cities, Sustainable Cities including Sustainable Transportation, Sustainable Water Management, Sustainable Wastewater management, Sustainable Energy etc. (c) Sustainable Solutions for Water Resources: Global and Indian Water Resources / river basin management versus global water utilization (desalination, packaged water);Wastewater

Text Books

- David T. Allen and David R. Shonnard, â€œSustainability Engineering: Concepts, Design and Case Studiesâ€•, Prentice Hall, 2012.
- Nolberto Munier, Introduction to Sustainability: Road to a Better Futureâ€•, Springer; 1st edition; 456 pages; ISBN-10: 1402035578

Reference Books

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

Prerequisite: NIL