

Sardar Patel College of Engineering,
Andheri (West), Mumbai 400058



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
Government Aided Autonomous Institute under Mumbai University
Andheri (W), Mumbai - 400058



COURSE CONTENTS

Minor in Sustainability Engineering and Management

Regulation 23

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Introduction to Sustainability and Sustainable Development (MI-BT031)

Course Code	Course Name	
MI-BT031	Introduction to Sustainability and Sustainable Development	
Course pre-requisites	NA	
Course Objectives		
1. This course provides an in-depth understanding of sustainability and sustainable development goals to create a better- informed engineer, which will lead to a more sustainable action by all and for all.		
Course Outcomes		
At the end of the course, students will be able to:		
1. Explain the basic concept of Sustainability and Sustainable Development (SD), history of SD, the environmental, social and economic dimensions of SD and be able to discuss the SD concept on the national as well as on the global scale with respect to engineering		
2. Apply the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required for creating sustainable solutions for society.		
3. Apply sustainable practices by utilizing the engineering knowledge and principles.		
4. Deliberate on potential strategic options and tools for assessing SD (efficiency, sufficiency).		
Course Content		
Module No	Contents	Time (Hrs)
1	Introduction: What is sustainability and sustainable development? – definitions, Concept & components of sustainability Limits to exponential growth on a finite planet, Environmental issues and crisis, such as resource degradation, greenhouse gases, global warming, desertification, industrialization Introduction to LiFE and sustainable lifestyle : Need for environmentally responsible behaviour, Principles of LiFE: Reduce, Reuse, Recycle and resource conservation, LiFE and Sustainable Development Goals (SDGs) ,Role of students and engineers in promoting sustainability	03
2	Sustainability perspective for Energy, Materials, Water, Food and Shelter: World energy usage, Problems with fossil fuels Alternatives - reduction, efficiency, introduction to maximum power theorem renewable energy, Impacts of material production, sources of waste, Problems with current waste management, Suggestions for reducing the impact of material use Water resource and use worldwide, Associated problems with current water systems, Sustainable water management, World food production, Usage of resources and environmental impacts, Alternatives - organic/local Current building styles and associated problems, Retrofit vs new build Sustainable Architecture	10

3	Social & Economic Sustainability Social sustainability - Components - equality, diversity, democracy, social cohesion, Issues - gender issue, poverty, environmental degradation, peace & justice, social sustainability performance - community engagement, community development, empowerment, health, volunteerism, etc. Economic sustainability - Relationship between macroeconomics policies, poverty and environment, Trade-offs between economic growth, social equity, and environmental sustainability, Role of international environmental agreements, green economy and climate change policies.	04
4	Governance for Sustainable Development Systems: Socio-economic policies for sustainable development, Strategies for implementing eco-development programmes, Policy responses to environmental degradation, Public participation - Demographic dynamics and sustainability, Integrated approach for resource protection and management.	03
5	Strategies and measurements of SD: Introduction to Sustainability assessment, Environment Sustainability metrics – simple and complex indicators, Sustainability methods and assessment - green buildings, Renewable energy, CSR, Biodiversity, Technologies, human development index (HDI), sustainability development index (SDI), LCA	04
6	The road to Sustainable Development - National and International Contribution: National Contribution: Societal transformations. Institutional theory, Rural and Urban development, Action plan for implementing sustainable development International Contribution - Brundtland, Rio summit, SDGs, Conventions, Protocols & Agreements, Action plan for implementing sustainable development, Moral obligations and Operational guidelines, Role of developed countries in the sustainable development.	04

Text Books:

1. Harris, J.M., Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at: http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF
2. Mackenthun, K.M., Basic Concepts in Environmental Management, 1 st edition, Lewis Publication, London, 1998.
3. Hjorth, P. and A. Bagheri, Navigating towards Sustainable Development: A System Dynamics Approach, In Futures, 38(1): 74-92, 2006.
4. Mog, J.M., Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs, World Development 32(12): 2139–2160, 2004.

Reference Books:

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-
2. Rating System, TERI Publications – GRIHA Rating System
3. Indian Green Building Council, IGBC Green Buildings rating system (New & Existing) - Abridged Reference Guide, Pilot Version, 2017.
4. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure (PDF – 68 kb)

Courses to refer

Sustainability and Engineering :

<https://rdmc.nottingham.ac.uk/bitstream/handle/internal/112/Engineering%20Sustailability>

Sustainable Design in Engineering MI-BT032

Course Code	Course Name	
MI-BT032	Sustainable Design in Engineering	
Course pre-requisites	MI-BT031	
Course Objectives		
The objective of the course is to enable student to design solutions in technology and engineering using the concepts of sustainability and circular economy in mind		
Course Outcomes		
At the end of the course students will be able to		
1) Explain the concepts of sustainability and sustainable development, and analyse the relationship between technology, energy use, and sustainability transitions using appropriate frameworks and indicators.		
2) Evaluate technology/design-integrated systems using SDG frameworks, and assess the feasibility and challenges of achieving sustainability goals through case-based analysis.		
3) Apply principles of environmental, economic, and social indicators in sustainable engineering design, infrastructure development, and renewable energy systems.		
4) Develop sustainable product design solutions using nature-based and biomimetic approaches, and present integrated sustainability strategies through project-based learning.		
Course Contents		
Module No	Contents	Time (Hrs)
1	Introduction: Introduction to technology, sustainability, and sustainable development. Concepts of sustainability and sustainable development. Technology; concepts and definitions. Components of sustainability (Social, Economic, Environmental). Linkages between resource use, technology, and sustainability. Interactions between energy and technology, and their implications for environment and sustainable development. Technology diffusion and commercialization; Business and sustainability. Measuring and Benchmarking Sustainability - Sustainability proofing; Frameworks for measuring sustainability; Indicators of sustainability. Sustainability Transitions, Drivers and Barriers; Policy and Institutional Innovations. Sustainability transition Case Studies.	08

2	Design Integration: Understand, evaluate, define, and forecast sustainability. Morphology-based understanding of technology/design and detailed morphological analysis of each chosen design/technology Development of technology/design-integrated systems model. Consideration of 17 Sustainable Development Goals (SDGs) Coverage of the fundamental mandate of SDG-4 . Addressing feasibility, opportunities, challenges, and limitations in achieving sustainability. Case Studies	08
3	Design For Sustainability Environmental design for sustainability: economic, environmental indicators, social performance indicators, sustainable engineering design principles and application Case Studies	08
4	Sustainability in Infrastructure Climate and building design, Green Building concepts, Building energy efficiency and renewable energy assessment in buildings, Indoor air quality and wellness, Sustainable construction and maintainability, Low-carbon material and process Introduction to Sustainable Transportation, Water and wastewater engineering and reuse, solid waste management, Restoration and Retrofit, Passive Design, Case Studies	08
5	Sustainability by Renewable Energy Introduction to Renewable Energy; Solar Energy, Wind Energy, Biomass and Bioenergy, Hydroelectric and Ocean Energy, Geothermal Energy, Energy Storage and Grid Integration, Renewable Energy Policies and Economic Environmental and Social Impacts, Future Trends and Innovations, Case studies	09
6	Sustainable Product Design Sustainable Design methods, Nature-Based Design Solutions Biophilic Design & Biomimicry, Case Studies	09
7	Project Presentations	06
Text Books:		
1. David T. Allen David R. Shonnard Sustainable Engineering Concepts, Design and case Studies , Pearson, Edition1, 2015. 2. Harris, J.M., Basic Principles for Sustainable Development, Global Development and Environment Institute, working paper 00-04. Available at: http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF 3. Mackenthun, K.M., Basic Concepts in Environmental Management, 1 st edition, Lewis Publication, London, 1998. 4. Mog, J.M., Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs, World Development 32(12): 2139–2160, 2004.		
Reference Books:		
1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-		

2. Rating System, TERI Publications – GRIHA Rating System
3. Indian Green Building Council, IGBC Green Buildings rating system (New & Existing) - Abridged Reference Guide, Pilot Version, 2017.

Courses to refer

Sustainability and Engineering : <https://iisc.talentsprint.com/sustainable-engineering>

Sustainability Assessment MI-BT033

Course Code		Course Name
MI-BT033		Sustainability Assessment
Course pre-requisites		MI-BT031, MI-BT032
Course Objectives		
The objective of the course is to enable student to assess technology and engineering using the concepts of sustainability and circular economy in mind and make the correct choice of alternative		
Course Outcomes		
At the end of the course students will be able to		
1. Apply Material Flow Analysis (MFA) and Life Cycle Assessment (LCA) techniques to assess environmental impacts, resource use, and system changes in anthropogenic systems. 2. Analyse the ISO framework, methodology, and tools for conducting LCA, including data collection, inventory analysis, impact assessment, and result interpretation. 3. Evaluate economic and social dimensions of sustainability using Life Cycle Cost Analysis (LCCA) and Social Life Cycle Assessment (S-LCA), incorporating real-world criteria and indicators. 4. Interpret sustainability standards, corporate sustainability assessments, and practical case studies across civil, architectural, and environmental domains to support informed decision-making.		
Course Content		
Module No	Contents	Time (Hrs)
1	Introduction to Assessment and Sustainability Assessment Methods for sustainability assessment: Life Cycle Assessment (LCA), Environmental Impact Assessment (EIA), Social Life Cycle Assessment (S-LCA), TBL Analysis, Material Flow Analysis (MFA), Ecological Footprint Analysis, Carbon Footprint Assessment, Sustainability Reporting Frameworks, Cost-Benefit Analysis (CBA) with Externalities, Multi-Criteria Decision Analysis (MCDA)	5
2	Materials Flow Analysis (MFA)	8

	1.History of MFA 2.Basic concepts related to Material flow analysis 2. Objectives and Key Principles 3. Methodology 4. Urban Metabolism 5. Applications and Case Studies													
3	Life Cycle Assessment: Introduction to product life cycle , life cycle thinking, risk assessment, impact criteria, LCA history, Detailed methodology and ISO framework - detailed example on LCA comparisons, LCA benefits and drawbacks, historical Development and LCA steps from ISO framework, goal and scope definition, life cycle inventory analysis and Life cycle impact assessment and interpretation Benefits and drawbacks of LCA and LCA software tools Case studies	10												
4	Environment Impact Assessment Need, Definition, Objectives, Introduction to Phase I and Phase II, Methods of Impact Assessment	04												
5	Life Cycle Cost Analysis (LCCA) Cost categories, income categories, current value calculations, discounts and their importance Differences in setting repayment periods pertaining to projects based on current value, introducing environment costs to integrate environmental and economic aspects in decision-making Case Studies	05												
6	Social Life Cycle Assessment (S-LCA)Basic concepts including minimum wage and living wage, Introduction to S-LCA methodology, Criteria and indicators Case studies	05												
7	Sustainability Reporting frameworks Corporate sustainability Assessment and Assessment Tools, Sustainability Indices, Assessment Tools, Introduction to B Corp Case Studies	05												
<table border="1"> <tr> <th colspan="3">Text Books:</th></tr> <tr> <td colspan="3"> 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. An overview of sustainability assessment methodologies, March 2009, Ecological Indicators 15(2):189-212, 15(2):189-212, DOI:10.1016/j.ecolind.2008.05.011 </td></tr> <tr> <th colspan="3">Reference Books:</th></tr> <tr> <td colspan="3"> 1. Sustainability Standards: A New Deal to Build Forward Better, 2021, International Trade Centre 2. Mohammad Ali, Sustainability Assessment, Elsevier, 2023. </td></tr> </table>			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. An overview of sustainability assessment methodologies, March 2009, Ecological Indicators 15(2):189-212, 15(2):189-212, DOI: 10.1016/j.ecolind.2008.05.011			Reference Books:			1. Sustainability Standards: A New Deal to Build Forward Better, 2021, International Trade Centre 2. Mohammad Ali, Sustainability Assessment, Elsevier, 2023.		
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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. An overview of sustainability assessment methodologies, March 2009, Ecological Indicators 15(2):189-212, 15(2):189-212, DOI: 10.1016/j.ecolind.2008.05.011														
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1. Sustainability Standards: A New Deal to Build Forward Better, 2021, International Trade Centre 2. Mohammad Ali, Sustainability Assessment, Elsevier, 2023.														

Assessment Tool	
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https://www.learningfornature.org/wp-content/uploads/2019/08/Sustainability-assessment-tool.xlsm	
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Circular Economy, Finance and Governance MI-BT034

Course Code	Course Name	
MI-BT034	Circular Economy, Finance and Governance	
Course pre-requisites	M031,M032,M033	
Course Objectives		
1. This course designed to empower participants with the knowledge and strategies essential to thrive in the era of advanced circular economy and finance		
Course Outcomes		
At the end of course students will be able to : 1. Explain the foundational principles and evolution of the Circular Economy and its role in promoting regenerative and sustainable systems. 2. Analyse the main components of the Circular Economy such as cradle-to-cradle design, product life extension, and sustainable material sourcing. 3. Evaluate the integration of Circular Economy principles into innovative business strategies and identify organisational benefits. 4. Compare European Circular Economy policies and practices and assess their relevance and applicability in the Indian context using case studies. 5. Design a basic circular business model considering product design, supply chain, and stakeholder engagement, with reference to real-world examples.		
Course Content		
Module No	Contents	Time (Hrs)
1	Introduction and Overview of Circular Economy: foundational principles and evolution of Circular Economy. Explore how this advanced paradigm goes beyond sustainability, focusing on regenerative systems, waste reduction, and the creation of a closed-loop economy. Understand the role of Circular Economy in addressing global challenges and creating long-term environmental and economic value. Case Studies	10
2	Main Concepts and Components of Circular Economy: Delve into the core concepts and components that form the backbone of Circular Economy. Learn about cradle-to-cradle design, product life extension, recycling innovations, and sustainable material sourcing. Understand how these elements contribute to creating a circular and resilient economic ecosystem Case Studies	08
3	Circular Economy and Business Ideas and Benefits: Explore the integration of circular economy principles into business strategies. Identify innovative business ideas that align with Circular Economy 3.0 and uncover the tangible benefits for organizations, including cost savings, enhanced brand reputation, and increased resilience in the face of environmental challenges. Case Studies	08
4	Europe and Circular Economy and Applicability to India : Investigate the role of Europe as a leader in promoting and implementing Circular Economy practices. Analyze policies, initiatives, and success stories from European countries, gaining insights into the regional approaches to fostering sustainability and circularity. Explore the Applicability to Indian Context. Case Studies	08

5	Circular Business Model and How to Start, How to Build? Delve into the practical aspects of implementing a circular business model. Learn how to initiate and build a circular economy strategy within an organization, considering key factors such as product design, supply chain management, and stakeholder engagement. Explore case studies of successful circular businesses and gain actionable insights for implementation. Case Studies	08
Text Books:		
1. Santosh Ganesh, Kapila Mehta, The Circular Economy: A Blueprint for the Future of Business, Notion Press, ISBN 9798892337397,2022 2. Reimagining ESG Hardcover – 20 December 2024 by Shailesh Haribhakti, Srinath Sridharan , Suyash Agrawal 3. Net Positive: How Courageous Companies Thrive by Giving More Than They Take Hardcover – 5 October 2021 by Paul Polman (Author), Andrew Winston (Author) 4. Ed Weenk, Rozanne Henzen, Mastering the circular Economy, KoganPage, ISBN 978 1 39860 274 8,2021		
Courses to refer https://www.coursera.org/learn/sustainability-and-the-circular-economy		