



Kot Bhalwal, Jammu



Model Institute of Engineering
& Technology (Autonomous)
Dr. Arun K. Gupta Teaching-Learning Centre

Department of BBA & BCA

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Design For Sustainability
2.	Course Code	UGMDC-103(B)
3.	Academic Year	2024-25
4.	Semester	3rd
5.	Number of Lesson plans	36
6.	Faculty Assigned	Dr.Hemalatha Murugesan

Faculty Signature



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Version 1.1

Lesson Plan No. 1.1	Course Name: Design for Sustainability Topic: Fundamentals of ecology	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Identify and describe different types of ecosystems and their characteristics. b. Understand the interrelationships between organisms within various ecosystems. c. Analyze the impact of these interrelationships on ecological balance and sustainability.
Teaching Aids (if any)	a. ICT- Visual aid to illustrate types of ecosystems and interrelationships among organisms.
Teaching Development	<p>1. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you understand by an ecosystem? - Can you name different types of ecosystems? - Define key concepts: - Introduce the concept of ecology and ecosystems, explaining their importance in understanding environmental science. - Briefly discuss the significance of studying ecosystems and their interrelationships in the context of ecological balance. <p>2. Development (30 minutes)</p> <p>a) Types of Ecosystems</p> <ul style="list-style-type: none"> i. Terrestrial Ecosystems: <ul style="list-style-type: none"> - Forest Ecosystems: Characteristics, types (tropical, temperate, boreal). - Grassland Ecosystems: Types (savanna, temperate grasslands), flora, and fauna. - Desert Ecosystems: Adaptations of organisms to extreme conditions. ii. Aquatic Ecosystems: <ul style="list-style-type: none"> - Freshwater Ecosystems: Lakes, rivers, wetlands, and their characteristics. - Marine Ecosystems: Oceans, coral reefs, estuaries, and their biodiversity. <p>b) Interrelationships in Ecosystems</p> <ul style="list-style-type: none"> - Types of Interrelationships: Symbiosis, Mutualism, commensalism, Parasitism. - Food Chains and Food Webs: - Explain the concepts of producers, consumers, and decomposers. - Illustrate how energy flows through ecosystems via food chains and food webs.



	<p>c) Impact of Interrelationships:</p> <ul style="list-style-type: none">- Discuss how these interactions contribute to ecosystem stability and health.- Examples of specific interrelationships, such as predator-prey dynamics and competition for resources. <p>3. Exercise (5 minutes) Group Activity: Break students into small groups and assign each group a specific ecosystem type. Ask them to identify key organisms and their interrelationships within that ecosystem, presenting their findings to the class.</p>
Closure	<ol style="list-style-type: none">1. Summarize:<ul style="list-style-type: none">- Review the different types of ecosystems and the significance of interrelationships among organisms within these systems.- Reinforce the idea of ecological balance and sustainability.2. Suggested Reading: https://www.sciencedirect.com/topics/engineering/ecosystems3. Homework: Write a reflective essay (300-500 words) on how human activities impact a specific ecosystem and its interrelationships. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<ol style="list-style-type: none">1. Reflective Questions<ol style="list-style-type: none">a) What are the main characteristics of the different types of ecosystems?b) How do interrelationships among organisms contribute to ecological stability?2. Discussion: Encourage students to discuss potential challenges ecosystems face due to human impact, climate change, and resource depletion. <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 1.2	Course Name: Design for Sustainability Topic: Factors influencing sustainability of ecosystems	Course No.: UGMDC- 303 (B)
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Objectives	At the end of the lesson the student shall be able to: d. Articulate the key factors that influence the sustainability of ecosystems. e. Understand how these factors affect ecological balance and biodiversity. f. Analyze the role of human activity in ecosystem sustainability and propose measures for promoting long-term ecological health.
Teaching Aids (if any)	b. ICT- Visual aid to highlight key factors affecting ecosystems, with case studies of sustainable and unsustainable ecosystems.
Teaching Development	<p>4. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What is an ecosystem? - Can you think of factors that might affect the long-term sustainability of an ecosystem? - Briefly introduce ecosystems as the interaction between living organisms and their physical environment. - Explain that sustainability refers to an ecosystem's ability to maintain its structure, processes, and biodiversity over time. - <p>5. Development (30 minutes)</p> <p>d) Factors Influencing Sustainability of Ecosystems</p> <p>iii. Biodiversity:</p> <ul style="list-style-type: none"> - Higher biodiversity increases resilience to changes or disturbances. - Discuss examples where ecosystems with low biodiversity were vulnerable to collapse. <p>iv. Climate:</p> <ul style="list-style-type: none"> - Temperature, rainfall, and other climatic factors determine the types of organisms that can survive. - Explain how climate change threatens ecosystem stability. <p>v. Soil Quality:</p> <ul style="list-style-type: none"> - Nutrient availability and soil composition affect plant growth and, by extension, the entire food web. - Discuss practices like deforestation and over-farming that degrade soil health. <p>vi. Water Availability:</p> <ul style="list-style-type: none"> - The availability of clean water is crucial for



	<p>both aquatic and terrestrial ecosystems.</p> <ul style="list-style-type: none"> - Highlight how pollution and overuse of water sources lead to ecosystem degradation. <p>vii. Human Activity:</p> <ul style="list-style-type: none"> - Discuss industrialization, pollution, urbanization, deforestation, and overfishing as factors that negatively impact ecosystems. - Conversely, explain the role of conservation efforts and sustainable practices. <ul style="list-style-type: none"> - Desert Ecosystems: Adaptations of organisms to extreme conditions. <p>e) Ecosystem Services and Sustainability</p> <ul style="list-style-type: none"> - Define ecosystem services (e.g., provisioning, regulating, cultural, and supporting services). - Explain how the degradation of ecosystem services leads to unsustainability. <p>6. Exercise (5 minutes) One-minute paper: Students will write down two factors they believe are the most critical for maintaining the sustainability of ecosystems and why.</p>
Closure	<p>4. Summarize:</p> <ul style="list-style-type: none"> - Recap the key factors influencing ecosystem sustainability (biodiversity, climate, soil quality, water availability, human activity). - Ask students how they think these factors can be managed to promote sustainability. <p>5. Suggested Reading: https://sciencing.com/factors-affecting-the-ecosystem-13428099.html</p> <p>6. Homework: Write 300-500 words essay on how human activities in urban areas affect the sustainability of ecosystems, and suggest solutions for mitigating negative impacts.</p> <p>Spent 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>3. Reflective Questions</p> <ul style="list-style-type: none"> c) What role does biodiversity play in maintaining ecosystem sustainability? d) How can human intervention both harm and help ecosystems? What are the main characteristics of the different types of ecosystems? <p>4. Discussion: Encourage discussion on current events related to climate change and its impact on ecosystem sustainability.</p> <p>Spent 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 1.3	Course Name: Design for Sustainability Topic: Ecosystem restoration- developmental needs	Course No.: UGMDC- 303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> g. Articulate the key features and goals of ecosystem restoration. h. Understand the developmental needs and challenges in restoring degraded ecosystems. i. Analyze the role of ecosystem restoration in sustainable development and biodiversity conservation. Articulate the key factors that influence the sustainability of ecosystems.
Teaching Aids (if any)	<ul style="list-style-type: none"> c. ICT- Visual aid to highlight the key goals, processes, and needs of ecosystem restoration.
Teaching Development	<p>7. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you understand by ecosystem restoration? - Why is it necessary to restore ecosystems? - Concept Introduction: - Define ecosystem restoration as the process of assisting the recovery of degraded ecosystems to restore their structure, functions, and biodiversity. - Introduce the importance of ecosystem restoration in the context of addressing environmental challenges such as habitat loss, climate change, and biodiversity decline. <p>8. Development (30 minutes)</p> <p>f) Key Features and Goals of Ecosystem Restoration</p> <ul style="list-style-type: none"> viii. Restoring ecological processes: <ul style="list-style-type: none"> - Explain how restoration aims to recover essential processes such as nutrient cycling, water filtration, and carbon sequestration. ix. Biodiversity conservation: <ul style="list-style-type: none"> - Discuss the importance of restoring native species and habitats to prevent further species loss. x. Improving ecosystem services: <ul style="list-style-type: none"> - Highlight how restoration benefits communities by improving resources like clean water, air, and food security. xi. Climate change mitigation: <ul style="list-style-type: none"> - Explain how restoring forests and wetlands can enhance carbon storage and help mitigate climate change. <p>g) Developmental Needs of Ecosystem Restoration</p> <ul style="list-style-type: none"> i. Planning and Research:



	<ul style="list-style-type: none"> - The need for scientific studies and assessments to understand the ecological conditions and determine the appropriate restoration methods. ii. Resources and Funding: <ul style="list-style-type: none"> - Restoration projects require significant financial investment, manpower, and long-term commitment from stakeholders. iii. Community Involvement: <ul style="list-style-type: none"> - Engaging local communities is crucial for the success of restoration projects, as they can contribute to ongoing maintenance and sustainable use. iv. Policy and Legal Support: <ul style="list-style-type: none"> - Discuss the need for supportive environmental policies, regulations, and incentives for restoring ecosystems. v. Monitoring and Evaluation: <ul style="list-style-type: none"> - Explain how continuous monitoring is necessary to track the progress of restoration efforts and make adjustments where necessary. <p>9. Exercise (5 minutes) One-minute paper: Students will write down the most important factor they believe contributes to the success of ecosystem restoration and why.</p>
<p>Closure</p>	<p>7. Summarize:</p> <ul style="list-style-type: none"> - Recap the key points: the features and goals of ecosystem restoration, the developmental needs, and its role in promoting sustainable development. - Ask students what they think are the biggest challenges facing ecosystem restoration efforts. <p>8. Suggested Reading: Book 1, Ch. 4</p> <p>9. Homework: Write 300-500 words essay on how ecosystem restoration can help mitigate the impacts of climate change in a specific region (e.g., wetlands, forests, coral reefs).</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>5. Reflective Questions</p> <ul style="list-style-type: none"> e) What are the primary developmental needs for a successful ecosystem restoration project? f) How can community involvement enhance the success of ecosystem restoration efforts? role does biodiversity play in maintaining ecosystem sustainability? <p>6. Discussion:</p>



	<p>Encourage discussion on the potential obstacles to ecosystem restoration and how they can be overcome.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>
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Lesson Plan No. 1.4	Course Name: Design for Sustainability Topic: Concept and Dimensions of Sustainability and Sustainable Development	Course No.: UGMDCC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> j. Articulate the basic concept of sustainability and sustainable development. k. Understand the global importance of sustainability in development. l. Analyze the connection between sustainability and economic, environmental, and social dimensions.
Teaching Aids (if any)	d. ICT- Visual aid to introduce the concept of sustainability, examples, and the role of sustainable development.
Teaching Development	<p>10. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you think sustainability means? - How is it connected to development? - Concept Introduction: - Define sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs. - Introduce the concept of sustainable development as development that balances economic growth, social inclusion, and environmental protection. ecosystem restoration. <p>11. Development (30 minutes)</p> <p>h) Importance of Sustainability</p> <ul style="list-style-type: none"> i. Discuss key global movements and agreements that support sustainability (e.g., the Rio Earth Summit, the Paris Agreement on climate change). <p>i) Dimensions of Sustainability</p> <ul style="list-style-type: none"> vi. Environmental Sustainability: <ul style="list-style-type: none"> - Focus on preserving natural resources and ecosystems, controlling pollution, and promoting renewable energy. vii. Economic Sustainability: <ul style="list-style-type: none"> - Discuss economic growth that creates wealth and jobs but does not harm the environment. viii. Social Sustainability: <ul style="list-style-type: none"> - Discuss how development should focus on improving human well-being, reducing poverty, and promoting equality and justice. <p>j) Global Importance of Sustainable Development</p> <ul style="list-style-type: none"> - Discuss how sustainability is vital for long-term



	<p>prosperity and survival, given challenges like climate change, resource depletion, and inequality.</p> <p>12. Exercise (5 minutes) One-minute paper: Students write down the most important aspect of sustainability (environmental, economic, or social) and why they think it is crucial for sustainable development.</p>
Closure	<p>10. Summarize:</p> <ul style="list-style-type: none">- Recap the concept of sustainability and sustainable development and the three dimensions.- Ask students how they think sustainability can be applied in their own lives. <p>11. Suggested Reading: Book 2, Ch. 1</p> <p>12. Homework: Write 300-500 words reflective essay on how sustainability can be integrated into urban development planning.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>7. Reflective Questions</p> <ul style="list-style-type: none">g) What is sustainability, and why is it important for future generations?h) How do economic, environmental, and social dimensions interrelate in sustainable development? are the primary developmental needs for a successful ecosystem restoration project? <p>8. Discussion: Discuss the global challenges facing sustainability and how different countries are tackling them.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 1.5	Course Name: Design for Sustainability Topic: Concept and Dimensions of Sustainability and Sustainable Development	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: m. Understand the 17 Sustainable Development Goals (SDGs) and their relevance to sustainability. n. Analyze how each SDG relates to the three dimensions of sustainability.
Teaching Aids (if any)	e. ICT- Visual aid to introduce the 17 SDGs, their categories, and their link to sustainability.
Teaching Development	<p>13. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you think sustainability means? - How is it connected to development? - Concept Introduction: - Introduce the 17 SDGs as part of the UN's 2030 Agenda for Sustainable Development. - Explain that these goals provide a roadmap for achieving global sustainability in all dimensions. <p>14. Development (30 minutes)</p> <p>k) Overview of the 17 SDGs:</p> <ul style="list-style-type: none"> - Introduce each of the 17 SDGs briefly: <ol style="list-style-type: none"> i. SDG 1: No Poverty ii. SDG 2: Zero Hunger iii. SDG 3: Good Health and Well-being iv. SDG 4: Quality Education v. SDG 5: Gender Equality vi. SDG 6: Clean Water and Sanitation vii. SDG 7: Affordable and Clean Energy viii. SDG 8: Decent Work and Economic Growth ix. SDG 9: Industry, Innovation, and Infrastructure x. SDG 10: Reduced Inequality xi. SDG 11: Sustainable Cities and Communities xii. SDG 12: Responsible Consumption and Production xiii. SDG 13: Climate Action xiv. SDG 14: Life Below Water xv. SDG 15: Life on Land xvi. SDG 16: Peace, Justice, and Strong Institutions xvii. SDG 17: Partnerships for the Goals <p>l) Connection to the Three Dimensions of Sustainability</p> <ul style="list-style-type: none"> - Group the goals under the three dimensions:



	<ul style="list-style-type: none">- Environmental: SDGs 6, 7, 13, 14, 15 (focused on clean energy, water, climate action, life below water, and life on land).- Economic: SDGs 1, 2, 8, 9, 10 (related to poverty reduction, hunger, work, innovation, and inequality).- Social: SDGs 3, 4, 5, 11, 16 (focused on well-being, education, equality, sustainable cities, and justice) <p>15. Exercise (5 minutes) One-minute paper: Students choose one SDG and explain how achieving it can help promote sustainability.</p>
Closure	<p>13. Summarize:</p> <ul style="list-style-type: none">- Recap the 17 SDGs and their alignment with the three dimensions of sustainability.- Ask students which SDG they find most challenging and why. the concept of sustainability and sustainable development and the three dimensions. <p>14. Suggested Reading: Book 2, Ch. 1</p> <p>15. Homework: Write 300-500 words essay analyzing how a particular SDG can be achieved in your local community.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>9. Reflective Questions</p> <ul style="list-style-type: none">i) How do the SDGs address the economic, environmental, and social dimensions of sustainability?j) What are the main challenges in achieving the SDGs? is sustainability, and why is it important for future generations? <p>10. Discussion: Discuss the importance of global partnerships in achieving the SDGs.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 1.6	Course Name: Design for Sustainability Topic: Emergence of Sustainability	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> o. Articulate the key features that distinguish sustainability from traditional development approaches. p. Understand the foundational principles that have driven the emergence of sustainability as a global priority. q. Analyze the role of sustainability in modern environmental, economic, and social frameworks. Identify and describe different types of ecosystems and their characteristics.
Teaching Aids (if any)	f. ICT- Visual aid to highlight key events, principles, and milestones in the emergence of sustainability.
Teaching Development	<p>16. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you understand by sustainability? - How is sustainability different from conventional development models? - Concept Introduction: - Define sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (as defined in the Brundtland Report). - Explain the Brundtland Report (1987), which introduced the concept of sustainable development. <p>17. Development (30 minutes)</p> <p>m) Key Events in the Emergence of Sustainability</p> <ul style="list-style-type: none"> • Brundtland Report (1987): <ul style="list-style-type: none"> - Introduced the concept of sustainable development. • Rio Earth Summit (1992): <ul style="list-style-type: none"> - Discussed Agenda 21, a comprehensive plan for sustainable development worldwide. • Kyoto Protocol (1997): <ul style="list-style-type: none"> - Focus on reducing greenhouse gas emissions, highlighting the environmental dimension of sustainability. • Paris Agreement (2015): <ul style="list-style-type: none"> - Addressed climate change and emphasized global collaboration in sustainability efforts. <p>n) Principles of Sustainability</p> <p>xii. Intergenerational Equity:</p> <ul style="list-style-type: none"> - Discuss the importance of ensuring resources for future generations.



	<p>xiii. Precautionary Principle:</p> <ul style="list-style-type: none"> - Emphasizes taking preventative action in the face of environmental damage, even if full scientific certainty is lacking. <p>xiv. Inclusive Growth:</p> <ul style="list-style-type: none"> - Focus on ensuring that economic development benefits all layers of society, not just a few. <p>xv. Polluter Pays Principle:</p> <ul style="list-style-type: none"> - Ensures that the cost of environmental degradation is borne by those responsible for. <p>o) Role of Sustainability in Modern Frameworks</p> <p>i. Environmental Sustainability:</p> <ul style="list-style-type: none"> - Emphasis on conservation of resources, renewable energy, and minimizing pollution. <p>ii. Economic Sustainability:</p> <ul style="list-style-type: none"> - Encouraging responsible consumption, production, and long-term economic stability without overexploitation of resources. <p>iii. Social Sustainability:</p> <ul style="list-style-type: none"> - Focus on poverty reduction, education, and ensuring equality, health, and well-being for all. <p>18. Exercise (5 minutes)</p> <p>One-minute paper: Students will write down the most important event or principle they believe contributed to the emergence of sustainability and why.</p>
<p>Closure</p>	<p>16. Summarize:</p> <ul style="list-style-type: none"> - Recap the key milestones in the emergence of sustainability and the principles guiding sustainable development. - Ask students which dimension of sustainability (environmental, economic, or social) they think is the most critical in today's world. <p>17. Suggested Reading: Book 1, Ch. 1</p> <p>18. Homework: Write a reflective essay (300-500 words) on how one major international agreement (e.g., Paris Agreement) has shaped global sustainability efforts.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>11. Reflective Questions</p> <p>k) How has the concept of sustainability evolved over time?</p>



1) What role does sustainability play in addressing climate change?

12. Discussion:

Discuss potential challenges countries face in implementing sustainability policies and initiatives.

Spend 5 minutes to evaluate student assimilation of the lesson contents.

Lesson Plan No. 1.7	Course Name: Design for Sustainability Topic: System Innovations for Sustainability	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> r. Articulate the key features that distinguish system innovations from traditional sustainability practices. s. Understand foundational principles that guide effective system innovations for achieving sustainability. t. Analyze the role of system innovations in driving sustainability across various sectors and industries.
Teaching Aids (if any)	<ul style="list-style-type: none"> g. ICT- Visual aid to highlight key roles, features, and examples of system innovations for sustainability.
Teaching Development	<p>19. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you understand by system innovations? - How might system innovations differ from traditional sustainability practices? - Concept Introduction: - Define system innovations as transformative changes in the way products, services, and infrastructure are designed, produced, and consumed to achieve sustainability. <p>20. Development (30 minutes)</p> <p>p) Key Features of System Innovations for Sustainability</p> <ul style="list-style-type: none"> • Holistic Approach <ul style="list-style-type: none"> - System innovations address sustainability challenges by considering the entire life cycle of products or processes, from production to disposal. • Interconnectedness <ul style="list-style-type: none"> - Emphasize how system innovations require collaboration across industries, sectors, and stakeholders to achieve large-scale impact. • Technological and Behavioral Integration: <ul style="list-style-type: none"> - System innovations blend technological advances (e.g., renewable energy, circular economy) with changes in human behavior and consumption patterns. <p>q) Principles of System Innovations for Sustainability</p> <ul style="list-style-type: none"> i. Efficiency and Optimization: <ul style="list-style-type: none"> - System innovations aim to maximize resource efficiency and minimize waste across the supply chain ii. Circularity:



	<ul style="list-style-type: none">- Introduce the concept of the circular economy, where products and materials are reused, recycled, or repurposed, reducing reliance on finite resources. <p>iii. Resilience and Adaptability:</p> <ul style="list-style-type: none">- Discuss how system innovations promote resilience to environmental and economic disruptions, enabling systems to adapt to changing conditions. <p>iv. Collaborative Governance:</p> <ul style="list-style-type: none">- Highlight the importance of collaboration between governments, businesses, and civil society to design and implement system-wide innovations. <p>r) Role of System Innovations in Achieving Sustainability</p> <ul style="list-style-type: none">• Industrial Examples:<ul style="list-style-type: none">- Energy: Transition to renewable energy systems, smart grids, and decentralized energy production.• Agriculture:<ul style="list-style-type: none">- Innovations in sustainable farming techniques, precision agriculture, and reducing food waste.• Social and Economic Impact:<ul style="list-style-type: none">- Explore how system innovations promote job creation in green industries, reduce environmental impact, and improve quality of life. <p>21. Exercise (5 minutes) One-minute paper: Students write down an example of a system innovation they think could significantly improve sustainability in a particular sector (e.g., transportation, agriculture, manufacturing) and explain why.</p>
<p>Closure</p>	<p>19. Summarize:</p> <ul style="list-style-type: none">- Recap the key features and principles of system innovations for sustainability, emphasizing the need for holistic approaches and cross-sector collaboration.- Ask students to reflect on how system innovations can address global challenges such as climate change and resource depletion. <p>20. Suggested Reading: Book 2, Ch. 1</p> <p>21. Homework: Write 300- 500 words reflective essay on how a particular system innovation (e.g., electric vehicles, smart cities) can transform the sustainability of an industry or region.</p>



	Spend 5 minutes to wrap up and consolidate the learnings.
Evaluation	<p>13. Reflective Questions</p> <p>m) How do system innovations differ from traditional sustainability approaches?</p> <p>n) What role does collaboration play in the success of system innovations for sustainability?</p> <p>14. Discussion:</p> <p>Discuss the challenges of implementing system innovations on a large scale and how different sectors can overcome these challenges.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 1.8	Course Name: Design for Sustainability Topic: Challenges to Sustainable Development	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> u. Articulate the key challenges that hinder the achievement of sustainable development goals (SDGs). v. Understand the barriers faced in implementing sustainable development across environmental, economic, and social dimensions. w. Analyze potential solutions and strategies to overcome these challenges and promote sustainability.
Teaching Aids (if any)	<ul style="list-style-type: none"> h. ICT- Visual aid to highlight the major challenges for sustainable development across various sectors.
Teaching Development	<p>22. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions - What do you think are some of the biggest challenges to achieving sustainable development? - Why do some nations or industries struggle with sustainability? - Concept Introduction: - Introduce the idea that while sustainable development is the desired goal, several key challenges hinder its implementation. - Briefly explain that these challenges are both local and global in nature, affecting all dimensions (environmental, economic, and social). <p>23. Development (30 minutes)</p> <p>s) Key Challenges for Sustainable Development</p> <ul style="list-style-type: none"> i. Environmental Challenges: <ul style="list-style-type: none"> - Climate Change: Rising temperatures, extreme weather events, and sea-level rise are making it difficult to achieve long-term environmental sustainability. - Resource Depletion: Overuse of natural resources like water, forests, and fossil fuels leads to unsustainable development. - Biodiversity Loss: Species extinction and habitat destruction due to deforestation, pollution, and urbanization. ii. Economic Challenges: <ul style="list-style-type: none"> - Inequality: Economic disparities between nations, regions, and social groups hinder inclusive growth. - Poverty: Many developing countries struggle to provide basic needs without compromising environmental sustainability. - Unemployment: Economic systems must create



	<p>jobs while transitioning to sustainable, green industries.</p> <ul style="list-style-type: none">- Overconsumption: High consumption patterns in developed nations strain natural resources and contribute to pollution and waste. <p>iii. Social Challenges:</p> <ul style="list-style-type: none">- Education and Awareness: A lack of public knowledge and education about sustainability can slow down progress.- Cultural Resistance: Some communities resist adopting sustainable practices due to entrenched habits or economic dependency on unsustainable industries.- Governance and Corruption: Poor governance, corruption, and lack of political will can prevent sustainable policies from being effectively implemented. <p>t) Potential Solutions to Overcome Challenges</p> <ul style="list-style-type: none">i. Climate Mitigation and Adaptation: Solutions like renewable energy, afforestation, and climate-resilient infrastructure can address environmental challenges.ii. Sustainable Economic Models: Promoting green jobs, the circular economy, and reducing inequality can address economic challenges.iii. Education and Policy Reform: Building awareness, strengthening governance, and implementing strong environmental policies can help overcome social and institutional barriers. <p>u) Global and Local Efforts to Overcome Challenges</p> <ul style="list-style-type: none">i. Discuss global efforts like the Paris Agreement and Sustainable Development Goals (SDGs), and local efforts such as community-led sustainability projects.ii. Use case studies to show how nations or regions have tackled some of these challenges (e.g., Costa Rica's reforestation programs or Germany's energy transition). <p>24. Exercise (5 minutes) One-minute paper: Students will write down one major challenge to sustainable development they think is most pressing and suggest a solution.</p>
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Closure	<p>22. Summarize:</p> <ul style="list-style-type: none">- Recap the main challenges to achieving sustainable development (climate change, inequality, lack of governance, etc.) and the potential solutions to overcome these barriers.- Recap the key milestones in the emergence of sustainability and the principles guiding sustainable development. <p>23. Suggested Reading: Book 2, Ch. 1</p> <p>24. Homework: Write a reflective essay (300-500 words) on how one country or region is addressing the challenges of sustainable development and what lessons can be learned from their efforts.</p> <p>Spent 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>15. Reflective Questions</p> <ul style="list-style-type: none">o) What are the key challenges hindering sustainable development?p) How can global collaboration help in overcoming these challenges? How has the concept of sustainability evolved over time? <p>16. Discussion: Encourage a discussion on the role of international organizations, governments, and individuals in overcoming these challenges and promoting sustainability.</p> <p>Spent 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 2.1	Course Name: Design for Sustainability Topic: Millennial Development Goals (MDGS)	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> x. Understand the significance of the Millennium Development Goals and their global impact. y. Identify the eight MDGs and articulate the targets associated with each goal. z. Analyze the role of businesses in achieving the MDGs and evaluate their strategies for sustainable development.
Teaching Aids (if any)	<ul style="list-style-type: none"> i. ICT- Visual aid highlighting each MDG, targets, and business implications.
Teaching Development	<p>25. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions <ul style="list-style-type: none"> - What is the Millennium Development Goals? - Why do you think they are important for global development? - Provide a brief overview of the MDGs' history and objectives. - Discuss the importance of the MDGs in addressing global challenges such as poverty, health, and education. <p>26. Development (30 minutes)</p> <p>a) Overview of the MDGs</p> <ul style="list-style-type: none"> - Discuss each of the eight MDGs: <ol style="list-style-type: none"> 1. Eradicate extreme poverty and hunger 2. Achieve universal primary education 3. Promote gender equality and empower women 4. Reduce child mortality 5. Improve maternal health 6. Combat HIV/AIDS, malaria, and other diseases 7. Ensure environmental sustainability 8. Develop a global partnership for development - Highlight the specific targets and indicators for each goal. <p>b) The Role of Businesses in Achieving the MDGs</p> <ul style="list-style-type: none"> - Analyze how businesses can contribute to the MDGs: <ul style="list-style-type: none"> - Corporate social responsibility (CSR) - Sustainable business practices - Partnerships with NGOs and governments - Discuss real-life examples of companies effectively <p>c) Strategies for Sustainable Development</p> <ul style="list-style-type: none"> - Evaluate business strategies that align with MDGs: <ul style="list-style-type: none"> - Ethical sourcing and supply chain management - Community engagement and development initiatives - Investment in education and health programs.



	<p>-</p> <p>27. Exercise (5 minutes) Group Activity: Students form small groups to brainstorm how a specific company can contribute to one of the MDGs. Each group presents their ideas in one minute.</p>
Closure	<p>25. Summarize:</p> <ul style="list-style-type: none">- Recap the MDGs and their significance in global development.- Discuss how businesses play a pivotal role in achieving these goals. <p>26. Suggested Reading: Ref. Book 1, Ch. 1</p> <p>27. Homework: Write a reflective essay (300-500 words) on how a chosen organization can strategically align its goals with the MDGs to enhance its impact on sustainable development.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>17. Reflective Questions</p> <ul style="list-style-type: none">q) What are the MDGs, and why are they significant?r) How can businesses effectively contribute to achieving these goals? <p>18. Discussion: Encourage an open dialogue about the role of businesses in achieving the MDGs and the ethical implications involved.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 2.2	Course Name: Design for Sustainability Topic: Sustainable Development Goals (SDGs)	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> aa. Understand the significance of the Sustainable Development Goals and their global impact. ab. Identify the 17 SDGs and articulate the targets associated with each goal. ac. Analyze the role of businesses in achieving the SDGs and evaluate their strategies for sustainable development.
Teaching Aids (if any)	j. ICT- Visual aid highlighting each SDG, targets, and business implications.
Teaching Development	<p>28. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions <ul style="list-style-type: none"> - What are the Sustainable Development Goals? - Why do you think they are important for global and local development? What are the Millennium Development Goals? - Why do you think they are important for global development? - Provide a brief overview of the SDGs' history and objectives, including their adoption in 2015 by the United Nations. - Discuss the importance of the SDGs in addressing global challenges such as poverty, inequality, and climate change. <p>29. Development (30 minutes)</p> <p>d) Overview of the SDGs</p> <ul style="list-style-type: none"> - Discuss each of the 17 SDGs: <ol style="list-style-type: none"> 9. No Poverty 10. Zero Hunger 11. Good Health and Well-Being 12. Quality Education 13. Gender Equality 14. Clean Water and Sanitation 15. Affordable and Clean Energy 16. Decent Work and Economic Growth 17. Industry, Innovation, and Infrastructure 18. Reduced Inequality 19. Sustainable Cities and Communities 20. Responsible Consumption and Production 21. Climate Action 22. Life Below Water 23. Life on Land 24. Peace, Justice, and Strong Institutions 25. Partnerships for the Goals - Highlight the specific targets and indicators for each goal.



	<p>e) The Role of Businesses in Achieving the SDGs</p> <ul style="list-style-type: none">- Analyze how businesses can contribute to the SDGs:<ul style="list-style-type: none">- Corporate social responsibility (CSR)- Sustainable business practices- Innovation in products and services- Partnerships with NGOs and governments- Discuss real-life examples of companies effectively contributing to the SDGs, such as Unilever’s Sustainable Living Plan and Patagonia’s environmental initiatives. of companies effectively. <p>f) Strategies for Sustainable Development</p> <ul style="list-style-type: none">- Evaluate business strategies that align with SDGs:<ul style="list-style-type: none">- Ethical sourcing and supply chain management- Community engagement and development initiatives- Measuring and reporting on sustainability efforts <p>30. Exercise (5 minutes) Group Activity: Students form small groups to brainstorm how a specific company can contribute to a chosen SDG.</p>
<p>Closure</p>	<p>28. Summarize:</p> <ul style="list-style-type: none">- Recap the SDGs and their significance in promoting sustainable development.- Discuss the role of businesses in achieving these goals and the importance of corporate accountability. <p>29. Suggested Reading: Ref. Book 1, Ch. 1</p> <p>30. Homework: Write a reflective essay (300-500 words) on how a chosen organization can strategically align its goals with the SDGs to enhance its impact on sustainable development.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>19. Reflective Questions</p> <ul style="list-style-type: none">s) What are the SDGs, and why are they significant?t) How can businesses effectively contribute to achieving these goals? <p>20. Discussion: Encourage an open dialogue about the role of businesses in achieving the SDGs and the ethical implications involved.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 2.4	Course Name: Design for Sustainability Topic: UN Global Compact	Course No.: UGMDCC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ul style="list-style-type: none"> ad. Explain the purpose and principles of the UN Global Compact. ae. Identify the key areas of corporate responsibility associated with the Global Compact. af. Evaluate the impact of the Global Compact on organizational strategies and practices.
Teaching Aids (if any)	<ul style="list-style-type: none"> k. ICT- Visual aid highlighting the UN Global Compact's ten principles, key areas, and examples of organizations that have successfully implemented these principles.
Teaching Development	<p>31. Introduction (5 minutes)</p> <ul style="list-style-type: none"> - Ask Questions <ul style="list-style-type: none"> - What do you understand by corporate social responsibility (CSR)? - Why do you think global frameworks for sustainability and responsibility are important? - Briefly introduce the UN Global Compact as a voluntary initiative aimed at encouraging businesses to adopt sustainable and socially responsible policies. <p>32. Development (30 minutes)</p> <p>g) Overview of the UN Global Compact</p> <ul style="list-style-type: none"> - Discuss the history and significance of the UN Global Compact: <ul style="list-style-type: none"> • Launched in 2000 by the UN Secretary-General. • Aimed at aligning business operations with ten universally accepted principles in areas of human rights, labour, environment, and anti-corruption. <p>h) Ten Principles of the UN Global Compact</p> <ul style="list-style-type: none"> - Present and explain the ten principles divided into four categories: <ol style="list-style-type: none"> 1. Human Rights: <ul style="list-style-type: none"> • Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights. • Principle 2: Make sure that they are not complicit in human rights abuses. 2. Labour: <ul style="list-style-type: none"> • Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining. • Principle 4: Elimination of all forms of forced and compulsory labour. • Principle 5: Effective abolition of child labour. • Principle 6: Elimination of discrimination in respect



	<p>of employment and occupation.</p> <p>3. Environment:</p> <ul style="list-style-type: none"> • Principle 7: Businesses should support a precautionary approach to environmental challenges. • Principle 8: Undertake initiatives to promote greater environmental responsibility. • Principle 9: Encourage the development and diffusion of environmentally friendly technologies. <p>4. Anti-Corruption:</p> <ul style="list-style-type: none"> • Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery. <p>i) The Impact of the UN Global Compact</p> <ul style="list-style-type: none"> - Discuss how the Global Compact influences organizational practices: <ul style="list-style-type: none"> - Encourages companies to integrate sustainable and responsible practices into their operations. - Enhances reputation and stakeholder trust. - Facilitates networking and collaboration among businesses committed to sustainability. - Provides a platform for sharing best practices and solutions. <p>33. Exercise (5 minutes)</p> <p>Group Activity: In small groups, students will discuss a company known for its commitment to sustainability and corporate responsibility. Each group will present how the company aligns its practices with the UN Global Compact principles.</p>
<p>Closure</p>	<p>31. Summarize:</p> <ul style="list-style-type: none"> - Recap the importance of the UN Global Compact and its ten principles. <p>32. Suggested Reading:</p> <p>https://unglobalcompact.org/what-is-gc/ourwork/sustainable-development</p> <p>33. Homework:</p> <p>Write a reflective essay (300-500 words) on how a specific company has integrated the UN Global Compact principles into its operations and the impact it has had on its business strategy.</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>21. Reflective Questions</p> <ul style="list-style-type: none"> u) What are the benefits of joining the UN Global Compact for businesses? v) How can the principles of the UN Global Compact be implemented in small and medium-sized enterprises (SMEs)?



22. Discussion:

Encourage an open dialogue about how students can apply these principles in their future careers and the impact of corporate responsibility on society and the environment.

Spend 5 minutes to evaluate student assimilation of the lesson contents.



Lesson Plan No. 2.5	Course Name: Design for Sustainability Topic: European Sustainability Agenda	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: ag. Understand the key elements and objectives of the European Sustainability Agenda. ah. Analyze the strategies and frameworks established by the European Union (EU) to promote sustainability. ai. Evaluate the implications of the European Sustainability Agenda for businesses and society at large.
Teaching Aids (if any)	1. ICT- Visual aid highlighting key goals, strategies, and case studies related to the European Sustainability Agenda.
Teaching Development	34. Introduction (5 minutes) - Ask Questions - What do you understand by sustainability in the context of Europe? - Why is a coordinated sustainability agenda important for EU member states? - Introduce the European Sustainability Agenda as a strategic framework aimed at promoting sustainable development and environmental protection within the EU. at is the Millennium Development Goals? 35. Development (30 minutes) j) Overview of the European Sustainability Agenda - Discuss the origins and purpose of the agenda: • Developed as part of the EU's commitment to the United Nations Sustainable Development Goals (SDGs). • Aims to foster an inclusive, sustainable, and resilient European economy. - Highlight key components, such as: • The European Green Deal. • Circular economy initiatives. • Biodiversity strategies. k) Key Strategies and Frameworks - Present and explain major initiatives: 1. European Green Deal: • Overview of policies aimed at making Europe climate-neutral by 2050. • Strategies for reducing greenhouse gas emissions, promoting clean energy, and enhancing biodiversity. 2. Circular Economy Action Plan: • Strategies for reducing waste, promoting resource efficiency, and encouraging sustainable consumption.



	<p style="text-align: center;">3. Biodiversity Strategy for 2030:</p> <ul style="list-style-type: none">• Goals for restoring ecosystems, protecting natural habitats, and promoting sustainable agriculture. <p>- Discuss how these strategies are interconnected and support the overarching goal of sustainability community.</p> <p>1) Implications for Businesses and Society</p> <ul style="list-style-type: none">- Analyze how the European Sustainability Agenda affects:<ul style="list-style-type: none">• Businesses: Compliance requirements, opportunities for innovation, and shifts in consumer demand toward sustainable products.• Society: Enhanced quality of life, job creation in green sectors, and fostering social equity through sustainable practices. <p>36. Exercise (5 minutes) Group Activity: In small groups, students will discuss a specific company that has adopted sustainable practices in alignment with the European Sustainability Agenda. Each group will briefly present their findings.</p>
<p>Closure</p>	<p>34. Summarize:</p> <ul style="list-style-type: none">- Recap the importance of the European Sustainability Agenda and its implications for the economy, environment, and society. <p>35. Suggested Reading: Ref. Book 2, Ch. 1</p> <p>36. Homework: Write a reflective essay (300-500 words) on how a specific business can align its operations with the European Sustainability Agenda to enhance its sustainability goals.</p> <p>Spent 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>23. Reflective Questions</p> <ul style="list-style-type: none">w) What are the main objectives of the European Sustainability Agenda?x) How do the strategies outlined in the agenda contribute to achieving the SDGs? <p>24. Discussion: Encourage an open dialogue about the importance of sustainability and the role of the European Union in shaping sustainable practices in member states.</p> <p>Spent 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 3.1	Course Name: Design for Sustainability Topic: Concept of Product-Service System (PSS) and Sustainability	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the concept of Product-Service System (PSS) and its relation to sustainability. b. Identify the role of PSS in fostering more sustainable business models. c. Analyze the advantages of integrating PSS into modern businesses to achieve sustainability goals.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. ICT: Visual aids (e.g., PowerPoint slides) to explain PSS concepts and how they align with sustainability goals. b. Case Studies: Real-world examples of Product-Service Systems in sustainable business models.
Teaching Development	<p>1. Introduction (5 minutes) Ask Questions:</p> <ul style="list-style-type: none"> ○ What is a product? ○ What is a service? ○ Can you think of any business models that offer both a product and a service simultaneously? <ul style="list-style-type: none"> ● Define Key Concepts. ● Introduce the concept of Product-Service Systems (PSS) as a business model that combines products with services to meet customer needs in a more sustainable way. ● Explain the significance of sustainability in the context of business and how PSS can support sustainable development by minimizing waste and encouraging resource efficiency. <p>2. Development (30 minutes)</p> <p>a) Concept of Product-Service Systems (PSS) and Sustainability (15 minutes)</p> <ul style="list-style-type: none"> ● PSS Definition: <ul style="list-style-type: none"> ○ A PSS is a system where a company provides a combination of physical products and associated services that deliver value to customers in a more sustainable way. ● Relation to Sustainability: <ul style="list-style-type: none"> ○ Sustainability in PSS: Focuses on reducing the environmental impact by emphasizing resource efficiency, extending product lifecycles, and promoting the sharing economy. ○ Explain how PSS models align with sustainability by reducing waste, encouraging reuse, and optimizing resource use through services like maintenance, leasing, or sharing. <p>b) PSS and Business Models (10 minutes)</p> <ul style="list-style-type: none"> ● Impact on Business Models:



	<ul style="list-style-type: none">○ Highlight how businesses are shifting from traditional ownership-based models to usage-based models, where the emphasis is on providing access rather than ownership of products.○ Discuss how this transition contributes to reduced consumption and supports the circular economy, where products are reused, remanufactured, or recycled instead of being discarded.• Examples:<ul style="list-style-type: none">○ Car Leasing: Instead of selling cars, companies offer car leasing with maintenance services.○ Bicycle Sharing Systems: Providing access to bikes for short-term use instead of owning them. <p>3. Exercise (5 minutes) Group Activity:</p> <ul style="list-style-type: none">• Divide students into small groups and assign each group a specific PSS model (e.g., product-oriented, use-oriented, or result-oriented).• Ask each group to:<ul style="list-style-type: none">○ Identify a real-world example of the PSS type.○ Discuss the potential environmental benefits and sustainability features of the model.○ Present their findings to the class
Closure	<p>Summarize:</p> <ul style="list-style-type: none">○ Review the key points:<ul style="list-style-type: none">▪ The concept of PSS and its link to sustainability.▪ How PSS contributes to more sustainable business models by reducing waste and promoting resource efficiency. <p>Suggested Reading:</p> <ul style="list-style-type: none">○ Articles and case studies on Product-Service Systems and sustainability in business.○ Product-Service Systems: Business Models and Sustainability <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>• Reflective Questions:</p> <p>a) What is the concept of a Product-Service System (PSS)?</p> <p>b) How does PSS contribute to business sustainability?</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 3.2	Course Name: Design for Sustainability Topic: : Types of Product-Service Systems (PSS)	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the three main types of Product-Service Systems (PSS). b. Differentiate between product-oriented, use-oriented, and result-oriented PSS models. c. Analyze the sustainability benefits associated with each type of PSS.
Teaching Aids (if any)	a. ICT: Visual aids (e.g., PowerPoint slides) to illustrate the three types of PSS. b. Examples: Real-world applications of each type of PSS.
Teaching Development	<p>1. Introduction (5 minutes)</p> <ul style="list-style-type: none"> · Ask Questions: <ul style="list-style-type: none"> • Can you think of a business where you use a product but don't own it? • What services have you availed with a product (e.g., car rental, mobile repair)? · Define Key Concepts: <ul style="list-style-type: none"> • Briefly recap the concept of PSS as a combination of products and services aimed at enhancing sustainability. · Introduce the Lesson Focus: <ul style="list-style-type: none"> • Today, we will discuss the three main types of PSS and how they contribute to sustainable practices. <p>2. Development (30 minutes)</p> <p>a) Overview of the Three Types of PSS (15 minutes)</p> <p>Product-Oriented PSS:</p> <ul style="list-style-type: none"> ○ Focus on selling products with additional services such as maintenance, upgrades, or repairs. ○ Example: Selling machinery with ongoing maintenance services. ○ Sustainability Benefits: Extends product lifespan, reduces waste. <p>Use-Oriented PSS:</p> <ul style="list-style-type: none"> ○ Focus on providing access to products without ownership. ○ Example: Car sharing, furniture rentals. ○ Sustainability Benefits: Optimizes resource use, promotes shared consumption. <p>Result-Oriented PSS:</p> <ul style="list-style-type: none"> ○ Focus on delivering results rather than the product itself. ○ Example: Printing services where customers pay for prints, not printers. ○ Sustainability Benefits: Minimizes material use, aligns with circular economy principles. <p>b) Examples and Business Impacts (15 minutes)</p> <ul style="list-style-type: none"> • Use real-world case studies to show how companies implement each PSS type:



	<ul style="list-style-type: none">○ Product-Oriented: Dell providing PC maintenance contracts.○ Use-Oriented: Uber offering ride-hailing services.○ Result-Oriented: Xerox charging per copy printed.• Highlight how each model supports sustainability by reducing waste and promoting efficiency.
Closure	<p>Summarize Key Points:</p> <ul style="list-style-type: none">• The three types of PSS and their definitions.• Examples of businesses applying each PSS type.• Sustainability benefits of PSS in reducing waste and promoting efficiency. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">a) What are the three types of PSS?b) How does each type of PSS promote sustainability? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 3.3	Course Name: Design for Sustainability Topic: Benefits of Product-Service Systems (PSS) for Producers/Providers and Customers, Limitations of PSS	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Identify the benefits of PSS for producers/providers and customers. b. Analyze how PSS can enhance value creation and sustainability for businesses and customers. c. Recognize the limitations and challenges of implementing PSS.
Teaching Aids (if any)	a. ICT: Visual aids (e.g., charts, slides) illustrating benefits and limitations of PSS. b. Case Studies: Examples showcasing both advantages and challenges of PSS.
Teaching Development	1. Introduction (5 minutes) <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ What motivates businesses to adopt innovative models like PSS? ○ Can you think of any challenges businesses or customers may face with these models? • Define Key Concepts: <ul style="list-style-type: none"> ○ Recap the concept of PSS and its role in integrating products and services to create sustainable value. • Introduce Lesson Focus: <ul style="list-style-type: none"> ○ Today, we will explore how PSS benefits producers/providers and customers and discuss its potential limitations. . Development (30 minutes) <p>a) Benefits of PSS for Producers/Providers (10 minutes)</p> <ul style="list-style-type: none"> • Economic Benefits: <ul style="list-style-type: none"> ○ Recurring Revenue: Continuous income from services (e.g., subscriptions, leasing). ○ Customer Retention: Long-term relationships through service offerings. ○ Resource Efficiency: Cost savings through optimized resource use and reuse. • Strategic Benefits: <ul style="list-style-type: none"> ○ Competitive Advantage: Differentiation in the market through unique service offerings. ○ Circular Economy Alignment: Opportunities for remanufacturing, recycling, and reuse. • Example: Philips Lighting offering lighting as a service (e.g., pay-per-lux). <p>b) Benefits of PSS for Customers (10 minutes)</p> <ul style="list-style-type: none"> • Cost Benefits:



	<ul style="list-style-type: none"> ○ Reduced Upfront Costs: Pay for usage rather than ownership (e.g., car-sharing models). ○ Maintenance-Free: Providers often handle repairs and upkeep. • Convenience and Accessibility: <ul style="list-style-type: none"> ○ Easier Access to High-Quality Products: Through leasing, renting, or sharing. ○ Tailored Solutions: Services that better align with customer needs. • Example: Airbnb providing short-term housing solutions with added convenience. <p>c) Limitations of PSS (10 minutes)</p> <ul style="list-style-type: none"> • For Producers/Providers: <ul style="list-style-type: none"> ○ High Initial Investment: Infrastructure for offering services. ○ Operational Complexity: Managing product lifecycle, logistics, and customer support. ○ Market Resistance: Convincing traditional customers to shift from ownership to access. • For Customers: <ul style="list-style-type: none"> ○ Lack of Ownership: Emotional and psychological barriers to not owning products. ○ Limited Control: Dependence on provider reliability and quality. ○ Potential Higher Long-Term Costs: Service fees may exceed the cost of ownership over time. • Examples: <ul style="list-style-type: none"> ○ Challenges faced by ride-sharing companies like Uber (e.g., operational costs, trust issues).
<p>Closure</p>	<p>Summarize Key Points:</p> <ul style="list-style-type: none"> ○ Benefits for producers/providers: recurring revenue, competitive advantage, resource efficiency. ○ Benefits for customers: reduced costs, maintenance-free access, convenience. ○ Limitations for both parties: high initial investment, lack of ownership, operational complexity. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ol style="list-style-type: none"> a) What are the key benefits of PSS for producers/providers and customers? b) What are some limitations of adopting PSS? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 3.4	Course Name: Design for Sustainability Topic: Product-Service Systems (PSS) for Emerging and Low-Income Contexts	Course No.: UGMDCC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ol style="list-style-type: none"> Understand the relevance of Product-Service Systems (PSS) in emerging and low-income contexts. Identify how PSS models can address unique challenges like affordability, accessibility, and sustainability in such regions. Analyze real-world examples of PSS applications tailored to low-income and emerging markets.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: Visual presentations with diagrams, videos, and examples of PSS models in low-income regions. · Case Studies <ul style="list-style-type: none"> • M-KOPA Solar's pay-per-use model in Africa enables low-income households to access solar-powered electricity. · Articles: "Product-Service Systems for Resource Efficiency and Sustainability in Emerging Markets" by Tukker et al.
Teaching Development	<p>Introduction (5 minutes)</p> <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ What are some key challenges faced by low-income communities in accessing essential goods and services? ○ How might combining products and services help address these challenges? • Define Key Concepts: <ul style="list-style-type: none"> ○ Product-Service Systems (PSS): Combining physical products and associated services to deliver value. ○ Emerging and Low-Income Contexts: Regions where affordability, infrastructure, and access to resources are limited. • Introduce Focus: <ul style="list-style-type: none"> ○ How PSS can create solutions tailored to the needs of low-income communities while promoting sustainability. <p>2. Development (30 minutes)</p> <p>a) Relevance of PSS in Emerging and Low-Income Contexts (10 minutes)</p> <ul style="list-style-type: none"> • Affordability: <ul style="list-style-type: none"> ○ PSS models like pay-per-use or leasing reduce upfront costs. • Accessibility: <ul style="list-style-type: none"> ○ Service-based models can extend essential goods to underserved areas (e.g., mobile health clinics). • Sustainability: <ul style="list-style-type: none"> ○ Promotes sharing economies, reduces waste, and maximizes



	<p>resource efficiency.</p> <p>b) Examples of PSS in Low-Income Contexts (10 minutes)</p> <ul style="list-style-type: none"> • Healthcare: <ul style="list-style-type: none"> ○ Portable medical devices rented to clinics in rural areas. ○ Example: GE Healthcare's low-cost ultrasound services for rural communities. • Energy: <ul style="list-style-type: none"> ○ Solar energy systems provided on a pay-as-you-go basis. ○ Example: M-KOPA in Africa offering solar-powered home kits. • Agriculture: <ul style="list-style-type: none"> ○ Equipment-sharing platforms for small-scale farmers. ○ Example: Digital tractor leasing services like Hello Tractor in Nigeria. <p>c) Challenges of Implementing PSS in Low-Income Regions (10 minutes)</p> <ul style="list-style-type: none"> • Infrastructure: <ul style="list-style-type: none"> ○ Limited logistics and connectivity can hinder service delivery. • Cultural Acceptance: <ul style="list-style-type: none"> ○ Resistance to non-ownership models. • Economic Sustainability: <ul style="list-style-type: none"> ○ Balancing affordability with profitability for providers. • Examples: <ul style="list-style-type: none"> ○ Issues faced by renewable energy companies in ensuring consistent payments for services. <p>3. Exercise (5 minutes)</p> <ul style="list-style-type: none"> • Group Activity: <ul style="list-style-type: none"> ○ Divide students into small groups and assign them to focus on one sector (e.g., healthcare, energy, or agriculture). ○ Task: <ul style="list-style-type: none"> ▪ Propose a PSS model suitable for a low-income context in the assigned sector. ▪ Identify potential benefits and challenges of implementing the model. ▪ Present their proposal to the class.
<p>Closure</p>	<ul style="list-style-type: none"> • Summarize Key Points: <ul style="list-style-type: none"> • PSS models provide affordable, accessible, and sustainable solutions in low-income contexts. • Suggested Reading: <ul style="list-style-type: none"> • Articles and case studies on PSS applications in emerging markets (e.g., M-KOPA, Hello Tractor). <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>1. Reflective Questions</p> <ol style="list-style-type: none"> a) Why are PSS models relevant in low-income regions? b) What are the main challenges in implementing PSS in these contexts? Spend 5 minutes to evaluate student assimilation



Lesson Plan No. 3.5	Course Name: Design for Sustainability Topic: Product-Service System (PSS) Design for Sustainability	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the principles of designing Product-Service Systems (PSS) for sustainability. b. Identify the elements that make PSS sustainable across social, environmental, and economic dimensions. c. Analyze successful examples of sustainable PSS design in various industries. d. Propose innovative PSS models focused on sustainability goals.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: PowerPoint slides explaining PSS design principles and sustainability metrics. · Videos: Demonstrations of sustainable PSS models (e.g., circular economy solutions).
Teaching Development	<p>. Introduction (5 minutes)</p> <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ What do you think makes a product or service sustainable? ○ Can you give examples of businesses or industries where sustainability is a priority? • Define Key Concepts: <ul style="list-style-type: none"> ○ Product-Service System (PSS): A business model that integrates products and services to deliver value. ○ Sustainability: The balanced consideration of environmental, economic, and social impacts over a product or service lifecycle. • Highlight Focus: <ul style="list-style-type: none"> ○ Emphasize the need for sustainability in PSS design to address global challenges like climate change, resource depletion, and social inequity. <hr/> <p>2. Development (30 minutes)</p> <p>a) Principles of PSS Design for Sustainability (10 minutes)</p> <ul style="list-style-type: none"> • Triple Bottom Line Approach: <ul style="list-style-type: none"> ○ Environmental Sustainability: Focus on resource efficiency, reducing waste, and lifecycle management. ○ Economic Sustainability: Creating value through innovative business models like leasing, pay-per-use, and sharing economies. ○ Social Sustainability: Enhancing accessibility, inclusivity, and community well-being. • Lifecycle Thinking: <ul style="list-style-type: none"> ○ Design PSS to optimize the entire lifecycle, from production to disposal, ensuring circularity.



	<ul style="list-style-type: none"> • Stakeholder Engagement: <ul style="list-style-type: none"> ○ Involve customers, suppliers, and communities in the co-creation process. b) Examples of Sustainable PSS Design (10 minutes) <ul style="list-style-type: none"> • Energy Sector: <ul style="list-style-type: none"> ○ Solar-as-a-Service: Providing renewable energy solutions on a subscription basis (e.g., Sunrun). • Mobility: <ul style="list-style-type: none"> ○ Car-sharing platforms like Zipcar reduce environmental impact by promoting shared use. • Consumer Goods: <ul style="list-style-type: none"> ○ Subscription-based clothing rentals (e.g., Rent the Runway) reduce fast fashion waste. c) Challenges in Sustainable PSS Design (10 minutes) <ul style="list-style-type: none"> • Economic Feasibility: <ul style="list-style-type: none"> ○ Balancing affordability for consumers with profitability for providers. • Customer Acceptance: <ul style="list-style-type: none"> ○ Cultural resistance to non-ownership models. • Scalability and Infrastructure: <ul style="list-style-type: none"> ○ Addressing logistics and digital infrastructure needs. <hr/> <p>3. Exercise (5 minutes)</p> <ul style="list-style-type: none"> • Group Activity: <ul style="list-style-type: none"> ○ Divide students into groups and assign them an industry (e.g., healthcare, agriculture, or energy). ○ Task: Design a sustainable PSS model for their assigned industry. ○ Include sustainability goals, benefits, and challenges. ○ Groups will briefly present their ideas.
Closure	<ul style="list-style-type: none"> • Summarize Key Points: <ul style="list-style-type: none"> • PSS design for sustainability integrates environmental, social, and economic goals. • Successful models include solar energy services, mobility sharing, and subscription-based consumer goods. • Challenges include cultural shifts, cost management, and infrastructure needs. • Suggested Reading: <ul style="list-style-type: none"> • Articles on sustainable PSS design from <i>Journal of Cleaner Production</i>. • Case studies on circular economy solutions from <i>Ellen MacArthur Foundation</i>.
Evaluation	<p>Reflective Questions:</p> <ol style="list-style-type: none"> a. What are the key principles of sustainable PSS design? b. How can businesses overcome challenges in implementing sustainable PSS? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 3.6	Course Name: Design for Sustainability Topic: Main Approaches in PSS for Sustainability: Satisfaction System	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the concept of Satisfaction Systems in Product-Service Systems (PSS). b. Identify how the Satisfaction System approach contributes to sustainability by prioritizing user needs over product ownership. c. Analyze examples of Satisfaction Systems and their implications for environmental, social, and economic sustainability. d. Design a PSS model employing the Satisfaction System approach.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: PowerPoint slides with diagrams and examples of Satisfaction Systems in practice. · Case Studies: Real-world examples, such as mobility-as-a-service and energy-as-a-service models.
Teaching Development	<p>Introduction (5 minutes)</p> <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ What do customers seek when buying a product? Is it ownership or satisfaction of a need? ○ Can you think of examples where people prefer a service over owning a product? • Define Key Concepts: <ul style="list-style-type: none"> ○ Satisfaction System: A PSS approach focusing on fulfilling customer needs through service-oriented models rather than product ownership. ○ Example: Mobility solutions like car rentals or ride-sharing, where the focus is on transportation, not owning a car. • Introduce the Topic: <ul style="list-style-type: none"> ○ Emphasize how Satisfaction Systems align with sustainability goals by reducing resource consumption and waste. <hr/> <p>2. Development (30 minutes)</p> <p>a) Principles of Satisfaction Systems in PSS (10 minutes)</p> <ul style="list-style-type: none"> • Focus on Need Fulfillment: <ul style="list-style-type: none"> ○ Provides customers with the desired function or outcome rather than the product itself. ○ Example: Laundry services vs. owning washing machines. • Optimized Resource Use: <ul style="list-style-type: none"> ○ Minimizes resource use by emphasizing shared access or lifecycle management of products. • Customer-Centric Design: <ul style="list-style-type: none"> ○ Prioritizes user satisfaction through flexibility and customization. <p>b) Benefits of Satisfaction Systems for Sustainability (10 minutes)</p>



	<ul style="list-style-type: none"> • Environmental: <ul style="list-style-type: none"> ○ Reduced manufacturing demand leads to lower resource extraction and emissions. ○ Lifecycle extension of products via reuse, sharing, and refurbishment. • Economic: <ul style="list-style-type: none"> ○ Cost savings for users due to shared services. ○ Opportunities for businesses to innovate in service delivery. • Social: <ul style="list-style-type: none"> ○ Improved access to services for underserved communities. ○ Creation of jobs in service industries. <p>c) Examples of Satisfaction Systems (10 minutes)</p> <ul style="list-style-type: none"> • Mobility: <ul style="list-style-type: none"> ○ Car-sharing (e.g., Zipcar) and ride-sharing (e.g., Uber). • Energy Services: <ul style="list-style-type: none"> ○ Solar power-as-a-service models (e.g., M-KOPA). • Consumer Goods: <ul style="list-style-type: none"> ○ Clothing rental platforms (e.g., Rent the Runway). <hr/> <p>3. Exercise (5 minutes)</p> <ul style="list-style-type: none"> • Group Activity: <ul style="list-style-type: none"> ○ Assign each group a sector (e.g., healthcare, housing, or mobility). ○ Task: Design a Satisfaction System model for their assigned sector. <ul style="list-style-type: none"> ▪ Focus on sustainability goals, user benefits, and potential challenges. ○ Groups present their proposals to the class.
<p>Closure</p>	<ul style="list-style-type: none"> • Summarize Key Points: <ul style="list-style-type: none"> • Satisfaction Systems focus on fulfilling needs through service-based models, not ownership. • They contribute to sustainability by reducing resource use, increasing access, and supporting circular economies. • Examples include mobility services, energy subscriptions, and shared consumer goods. • Suggested Reading: <ul style="list-style-type: none"> • Tukker, A. "Product-Service Systems for a Resource-Efficient Circular Economy." • Case studies from the Ellen MacArthur Foundation.
<p>Evaluation</p>	<ul style="list-style-type: none"> • Reflective Questions: <ol style="list-style-type: none"> a. What is the key idea behind Satisfaction Systems in PSS? b. How do Satisfaction Systems align with sustainability goals? • Discuss answers and assess student comprehension in 5 minutes..



Lesson Plan No. 3.7	Course Name: Design for Sustainability Topic: Stakeholder Configuration in PSS Design	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a) Understand the concept of stakeholder configuration in Product-Service Systems (PSS) design. b. Identify key stakeholders in the PSS value chain and their roles in the sustainability process. c. Analyze how stakeholder collaboration and interaction can enhance the sustainability and success of PSS models. d. Develop strategies for effective stakeholder engagement in designing sustainable PSS solutions.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: PowerPoint slides illustrating stakeholder mapping, PSS stakeholder roles, and interaction dynamics. · Case Studies: Examples from industries where multiple stakeholders collaborate in PSS (e.g., Fair Phone ,A sustainable smart phone).
Teaching Development	<p>Introduction (5 minutes)</p> <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ Who do you think the stakeholders are in a business model like Uber or a car-sharing service? ○ How do different stakeholders contribute to sustainability in a business? • Define Key Concepts: <ul style="list-style-type: none"> ○ Stakeholder Configuration: The arrangement and interaction of all parties involved in a PSS, such as customers, providers, suppliers, and other actors who influence or are influenced by the system. ○ Stakeholder Engagement: Involvement of stakeholders in the creation and management of PSS to align their interests with sustainability goals. <hr/> <p>2. Development (30 minutes)</p> <p>a) Importance of Stakeholder Configuration in PSS (10 minutes)</p> <ul style="list-style-type: none"> • Value Chain of PSS: <ul style="list-style-type: none"> ○ The product-service system involves multiple stakeholders, including: <ul style="list-style-type: none"> ▪ End Users/Consumers: The primary users of the product or service. ▪ Service Providers: Those who offer the service, including companies offering leasing, maintenance, or repair services. ▪ Suppliers: Suppliers of materials or components for products that are integrated into the service. ▪ Policy Makers & Regulators: Government bodies that set regulations for sustainable practices.



	<ul style="list-style-type: none"> ▪ Investors and Partners: Organizations or individuals providing financial support for PSS initiatives. • Stakeholder Mapping: <ul style="list-style-type: none"> ○ Mapping out stakeholder relationships helps identify how each one contributes to and benefits from the system. <p>b) Stakeholder Roles and Interactions in PSS Design (10 minutes)</p> <ul style="list-style-type: none"> • Collaboration for Sustainability: <ul style="list-style-type: none"> ○ Collaboration among stakeholders is critical to align business goals with sustainability objectives. ○ Example: In energy-as-a-service, energy companies, technology providers, and consumers work together to ensure resource efficiency and cost reduction. • Balancing Interests: <ul style="list-style-type: none"> ○ Addressing conflicts of interest (e.g., profit vs. sustainability) through effective stakeholder negotiation and communication. • Stakeholder Influence: <ul style="list-style-type: none"> ○ The influence of external factors (e.g., regulation, public perception) on stakeholder behavior and decisions. <p>c) Stakeholder Challenges in PSS Design (10 minutes)</p> <ul style="list-style-type: none"> • Engagement and Coordination: <ul style="list-style-type: none"> ○ Engaging diverse stakeholders in the design phase of PSS models can be challenging, particularly when interests conflict. ○ Example: Suppliers may prioritize cost efficiency, while end-users may prioritize environmental impact. • Trust Building: <ul style="list-style-type: none"> ○ Trust among stakeholders is essential for smooth collaboration and to ensure long-term success. • Sustaining Engagement: <ul style="list-style-type: none"> ○ Ensuring that stakeholders remain committed to sustainability goals throughout the lifecycle of the PSS. <hr/> <p>3. Exercise (5 minutes)</p> <ul style="list-style-type: none"> • Group Activity: <ul style="list-style-type: none"> ○ Divide students into small groups and assign a case study from a PSS implementation in Fair Phone product ○ Task: Map out the stakeholders in the case study and identify their roles, interests, and how they collaborate for sustainability. ○ Groups will present their stakeholder analysis and suggest improvements for engagement and collaboration.
<p>Closure</p>	<p>Summarize Key Points:(5 minutes) Stakeholder configuration plays a vital role in designing successful and sustainable PSS models.</p> <ul style="list-style-type: none"> • Effective collaboration among stakeholders ensures that



	<p>sustainability goals are met and that the PSS operates efficiently.</p> <ul style="list-style-type: none">• Key challenges include balancing diverse stakeholder interests, managing relationships, and maintaining engagement. <p>· Suggested Reading:</p> <ul style="list-style-type: none">• "Stakeholder Theory and PSS Design: A Case Study Approach" – <i>Journal of Business Research</i>.• "Collaboration and Stakeholder Involvement in Product-Service Systems" – <i>Sustainability Science</i>. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ol style="list-style-type: none">a. How do stakeholders influence the design and success of a PSS?b. What strategies can be used to align stakeholder interests with sustainability goals? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 3.8	Course Name: Design for Sustainability Topic: System Sustainability	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the concept of system sustainability in Product-Service System (PSS) design. b. Analyze the relationship between system thinking and sustainability in PSS. c. Identify the key principles that contribute to the sustainability of entire PSS systems. d. Design a sustainable system within a PSS framework.
Teaching Aids (if any)	ICT: PowerPoint slides explaining system sustainability principles in PSS. Case Studies: Examples of sustainable systems across different industries like transportation, energy, and agriculture.
Teaching Development	<p>Introduction (5 minutes)</p> <ul style="list-style-type: none"> • Ask Questions: <ul style="list-style-type: none"> ○ What do you understand by "system" in the context of sustainability? ○ Can you think of a system in your daily life that is designed to be sustainable? • Define Key Concepts: <ul style="list-style-type: none"> ○ System Sustainability: Refers to the ability of a system (e.g., a PSS) to maintain its function, efficiency, and sustainability over time without degrading the environment, society, or economy. ○ System Thinking: An approach that focuses on understanding how various components of a system interact with each other and how these interactions affect the system as a whole. <p>2. Development (30 minutes)</p> <p>a) System Sustainability in PSS Design (10 minutes)</p> <ul style="list-style-type: none"> • Sustainability as a Systemic Goal: <ul style="list-style-type: none"> ○ Sustainable PSS must consider the entire lifecycle, from resource extraction to product/service disposal. ○ A sustainable system should minimize waste, optimize resource use, and enhance efficiency. • Key Principles of System Sustainability in PSS: <ul style="list-style-type: none"> ○ Integration of Products and Services: Products and services in PSS should work together seamlessly to minimize environmental impact and ensure optimal resource use. ○ Circular Economy Principles: Promoting recycling, reusing, and refurbishing to extend the life of resources. ○ Multi-dimensional Impact: Consider the social, environmental, and economic impacts of a system's operations, ensuring that no aspect of sustainability is overlooked.



	<p>b) System Thinking Approach in PSS (15 minutes)</p> <ul style="list-style-type: none">• Interconnected Components:<ul style="list-style-type: none">○ Each element in the PSS (product, service, user) should be viewed as part of a larger, interdependent system.○ Example: In the case of energy-as-a-service, the system includes the energy provider, the customer, infrastructure, and the environment.• Feedback Loops:<ul style="list-style-type: none">○ Systems thinking emphasizes feedback loops where changes in one part of the system lead to changes in other parts (e.g., reduced energy consumption leads to lower costs and environmental impact).• Optimization and Resilience:<ul style="list-style-type: none">○ A sustainable PSS system should be resilient, capable of adapting to changing conditions, and able to optimize resource use over time. <p>c) Key Elements of System Sustainability (10 minutes)</p> <ul style="list-style-type: none">• Resource Efficiency:<ul style="list-style-type: none">○ Design systems to use resources efficiently, focusing on renewable and biodegradable materials where possible.• Scalability and Adaptability:<ul style="list-style-type: none">○ Sustainable systems should be scalable (able to grow or adapt) and flexible to future needs and technological advancements.• Long-Term Impact Assessment:<ul style="list-style-type: none">○ Assess the long-term effects of a PSS, such as environmental degradation, resource depletion, and social impacts.
<p>Closure</p>	<ul style="list-style-type: none">• Summarize Key Points:<ul style="list-style-type: none">○ System sustainability in PSS focuses on designing systems that are resource-efficient, adaptable, and resilient over the long term.○ System thinking emphasizes interconnectedness and feedback loops, ensuring that all components of a PSS contribute to sustainability goals.○ Key principles include lifecycle thinking, circular economy, and multi-dimensional impact assessment.• Suggested Reading:<ul style="list-style-type: none">○ "Systemic Design for Sustainability" by Peter Jones – explores integrating systems thinking into sustainability design. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ol style="list-style-type: none">a. What role does systems thinking play in ensuring the sustainability of PSS?b. How can resource optimization and feedback loops enhance the sustainability of PSS? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 4.1	Course Name: Design for Sustainability Topic: Introduction to System Design	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Define the concept of system design and its relevance to sustainability. b. Identify key components of a system design process. c. Understand the importance of designing sustainable systems in various industries. d. Evaluate the role of system design in promoting long-term sustainability goals.
Teaching Aids (if any)	· ICT: Visual aids (e.g., PowerPoint slides, flowcharts) explaining the key steps and principles in system design. · Case Studies: Examples of system design applications in industries such as renewable energy, urban planning, and product lifecycle management.
Teaching Development	Introduction (5 minutes): <ul style="list-style-type: none">• Ask Questions:<ul style="list-style-type: none">○ What do you understand by the term "system"?○ Can you think of any examples of systems in daily life?○ Why do you think system design is important for sustainability?• Briefly define system design as the process of defining the architecture, components, and interfaces of a system to meet specific needs and objectives, including sustainability goals.• Introduce the concept of sustainable system design, which seeks to reduce environmental impacts while ensuring the system meets its intended function. Development (30 minutes): <p>a) Concept of System Design (15 minutes): Define system design and its role in the creation of sustainable solutions.</p> <ul style="list-style-type: none">○ System: A group of interacting or interrelated entities that form a complex whole.○ Design: The process of planning and creating something, considering its structure and function.○ In the context of sustainability, system design involves creating systems that balance social, economic, and environmental factors. <p>Key Components of System Design:</p> <ul style="list-style-type: none">○ Inputs: Resources such as energy, materials, and labor.○ Processes: The transformations or actions that turn inputs into outputs.○ Outputs: Final products or services that meet user needs.○ Feedback Loops: Mechanisms that help refine and optimize the system's performance. <p>b) Sustainable System Design (10 minutes): Discuss how system design plays a critical role in promoting</p>



	<p>sustainability by:</p> <ul style="list-style-type: none">○ Minimizing waste and maximizing resource efficiency.○ Designing for longevity, reducing the need for frequent replacements.○ Promoting circular economy models, where products and materials are reused or recycled.○ Considering social equity, ensuring systems benefit communities and improve quality of life. <p>Provide examples of sustainable systems in real-world scenarios:</p> <ul style="list-style-type: none">○ Energy-efficient buildings: Designing buildings with passive solar heating, energy-efficient appliances, and sustainable materials.○ Waste management systems: Developing systems that focus on reducing waste and increasing recycling through efficient collection, sorting, and disposal methods. <p>Exercise (5 minutes): Group Activity:</p> <ul style="list-style-type: none">• Divide students into small groups and ask them to design a sustainable system for a specific context (e.g., urban waste management, transportation, or a renewable energy solution). Each group should:<ul style="list-style-type: none">○ Identify the system components (inputs, processes, outputs).○ Explain how sustainability goals (environmental, social, economic) are incorporated into the system design.○ Present their designs to the class.
<p>Closure</p>	<p>Summary (5 minutes):</p> <ul style="list-style-type: none">• Recap the key points:<ul style="list-style-type: none">○ System design is a process that defines the structure and components of a system to meet specific needs.○ The role of sustainable system design in addressing environmental, economic, and social challenges.○ The importance of system design in achieving long-term sustainability. <p>Suggested Reading: "Sustainable System Design: Challenges and Opportunities" by David W. Fuller "The Role of Systems Design in Achieving Sustainable Development" published in the <i>Journal of Systems Engineering and Management</i>. Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ul style="list-style-type: none">• How can system design contribute to the achievement of sustainable development goals?• What are the challenges involved in designing sustainable systems? <p>Discussion: Encourage students to reflect on how they can apply system design principles in their future careers, particularly in fields such as urban planning, product design, and energy management. Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 4.2	Course Name: Design for Sustainability Topic: Criteria for Evaluating Sustainability in System Design	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the key criteria for evaluating the sustainability of system designs. b. Identify the environmental, social, and economic aspects of sustainable system design. c. Analyze how to apply these criteria in real-world systems. d. Evaluate how sustainability can be integrated into the system design process for long-term viability.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: PowerPoint slides illustrating sustainability criteria, real-world examples, and evaluation frameworks. · Case Studies: Examples of successful sustainable system designs in industries like energy, manufacturing, and waste management.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ul style="list-style-type: none"> ○ What makes a system sustainable? ○ Can you think of examples of systems that are either sustainable or unsustainable? ○ Why do we need criteria for evaluating sustainability in system design? <p>Briefly define sustainability in system design as the ability of a system to maintain or improve its function without causing environmental degradation or compromising future generations' ability to meet their own needs.</p> <p>Development (30 minutes):</p> <p>a) Key Criteria for Evaluating Sustainability (15 minutes):</p> <p>Introduce the triple bottom line approach to sustainability, which evaluates systems based on three core criteria:</p> <ul style="list-style-type: none"> ○ Environmental Impact: <ul style="list-style-type: none"> ▪ How the system affects the environment, considering factors like resource use, pollution, energy efficiency, and waste management. ▪ Key considerations: Reducing carbon emissions, conserving water, and minimizing resource extraction. ○ Social Impact: <ul style="list-style-type: none"> ▪ How the system contributes to social equity, community well-being, and public health. ▪ Key considerations: Fair labor practices, community involvement, and accessibility. ○ Economic Impact: <ul style="list-style-type: none"> ▪ How the system performs economically, ensuring



	<p>financial viability and economic value.</p> <ul style="list-style-type: none"> ▪ Key considerations: Cost-effectiveness, long-term financial sustainability, and economic growth through sustainable practices. <p>Sustainable System Design Evaluation Framework:</p> <ul style="list-style-type: none"> ○ Life Cycle Assessment (LCA): Analyzing environmental impacts of a product or system from cradle to grave (production to disposal). ○ Resource Efficiency: Evaluating how efficiently the system uses resources (materials, energy, water). ○ Adaptability and Resilience: Assessing how well the system can adapt to changes in environmental conditions, market needs, or technology over time. ○ Circular Economy Principles: Evaluating whether the system supports reusability, recycling, and reducing waste. <p>b) Application of Sustainability Criteria in System Design (10 minutes)</p> <p>Case Study Example 1: Renewable Energy System</p> <ul style="list-style-type: none"> ○ Evaluate a wind turbine system based on its environmental impact (e.g., low emissions), social benefits (e.g., job creation), and economic viability (e.g., cost-effectiveness over time). <p>Case Study Example 2: Eco-friendly Manufacturing Process</p> <ul style="list-style-type: none"> ○ Assess a zero-waste manufacturing system considering its resource efficiency, its effect on local communities (social impact), and its profitability (economic sustainability). <p>Discuss how different industries apply these sustainability criteria to their system designs, emphasizing the importance of a holistic approach that includes environmental, social, and economic considerations.</p> <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none"> • Divide the students into small groups and assign each group a system (e.g., public transportation, waste management, or a sustainable building). Ask them to: <ul style="list-style-type: none"> ○ Apply the three sustainability criteria (environmental, social, and economic) to evaluate the system's sustainability. ○ Present their findings to the class, highlighting areas for improvement and proposing solutions to make the system more sustainable.
<p>Closure</p>	<p>Summary (5 minutes):</p> <ul style="list-style-type: none"> • Recap the key points: <ul style="list-style-type: none"> ○ The three pillars of sustainability—environmental, social, and economic—are essential in evaluating system designs. ○ Sustainability evaluation criteria such as life cycle assessment, resource efficiency, adaptability, and circular economy principles are essential tools for assessing the sustainability of systems.



	<ul style="list-style-type: none">○ The importance of integrating sustainability into the design process to ensure systems' long-term effectiveness and minimize their negative impacts. <p>Suggested Reading:</p> <ul style="list-style-type: none">○ "Designing for Sustainability: A Guide to Building Greener Digital Products and Services" by Tim Frick○ "Sustainable Design: A Critical Guide" by David Bergman <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• What are the key criteria for evaluating sustainability in system design?• How can a system design be made more sustainable by considering its environmental, social, and economic impacts? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 4.3	Course Name: Design for Sustainability Topic: A Modular Method for System Design for Sustainability	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ol style="list-style-type: none"> Understand the concept of the Modular System Design for Sustainability (MSDS) framework. Identify the key principles and steps involved in the MSDS method. Apply the MSDS method to analyze and improve the sustainability of system designs. Explore case studies that demonstrate the practical implementation of MSDS in real-world systems.
Teaching Aids (if any)	<ul style="list-style-type: none"> ICT: PowerPoint slides illustrating the MSDS framework, steps, and examples. Visuals: Flow diagrams and charts to explain the modular approach. Case Studies: Examples of systems that have implemented MSDS for enhanced sustainability.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> What do you think "modular design" means in the context of system sustainability? How can modularity contribute to creating sustainable systems? <p>Introduce MSDS:</p> <ol style="list-style-type: none"> MSDS is a structured framework to design systems for sustainability by breaking them into functional modules. Explain how it facilitates adaptability, efficiency, and sustainability by focusing on modular innovation and system integration. <p>Development (30 minutes):</p> <p>a) Overview of MSDS Framework (15 minutes):</p> <p>Definition of MSDS:</p> <ul style="list-style-type: none"> A systematic approach to designing and organizing systems using modular components to meet sustainability goals. Focuses on environmental, social, and economic sustainability through modularity and system optimization. <p>Principles of MSDS:</p> <ul style="list-style-type: none"> Modularity: Systems are divided into interchangeable and upgradable components to enhance flexibility and lifecycle management. Scalability: Allows systems to grow or shrink as needed without significant redesign. Circularity: Encourages reuse, repair, and recycling of modules to minimize waste and environmental impact. Interoperability: Ensures modules can integrate



	<p>seamlessly into different systems or contexts.</p> <p>b) Steps in MSDS Application (10 minutes):</p> <p>System Analysis:</p> <ul style="list-style-type: none"> ○ Identify the system’s purpose and key sustainability challenges. ○ Analyze stakeholder needs and environmental impacts. <p>Modular Design Strategy:</p> <ul style="list-style-type: none"> ○ Break down the system into distinct functional modules. ○ Develop sustainable design goals for each module (e.g., energy efficiency, material reduction). <p>Integration and Testing:</p> <ul style="list-style-type: none"> ○ Ensure seamless interaction between modules to maintain overall system functionality. ○ Test for scalability, adaptability, and sustainability metrics. <p>Lifecycle Management:</p> <ul style="list-style-type: none"> ○ Plan for module upgrades, repairs, and recycling to extend the system's lifespan. <p>c) Case Studies on MSDS Implementation (5 minutes):</p> <p>Case Study 1: Modular Renewable Energy Systems</p> <ul style="list-style-type: none"> ○ Example: Wind turbines with modular blades for easy maintenance and upgrades. ○ Key Benefit: Extends operational lifespan and reduces resource use. <p>Case Study 2: Modular Smartphones</p> <ul style="list-style-type: none"> ○ Example: Phones with replaceable cameras, batteries, and screens. ○ Key Benefit: Reduces electronic waste by allowing partial upgrades instead of replacing the entire device. <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none"> • Divide the class into small groups and assign a system (e.g., home appliances, transportation, or packaging). • Each group will: <ul style="list-style-type: none"> ○ Identify possible modules within the system. ○ Propose ways to improve sustainability using MSDS principles. ○ Present their ideas to the class.
<p>Closure</p>	<p>Summary (5 minutes):</p> <ol style="list-style-type: none"> 1. Recap the key points: <ol style="list-style-type: none"> 1. The importance of modular design for sustainability. 2. How MSDS can help achieve environmental, social, and economic goals in system design. 3. Practical steps and applications of the MSDS framework. <p>Suggested Reading:</p> <p>Articles:</p> <ul style="list-style-type: none"> ○ "MSDS: A Modular Approach to Sustainability in System Design" ○ "The Role of Modular Design in Achieving Sustainable



	<p style="text-align: center;">Development Goals"</p> <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• What are the advantages of modular design in creating sustainable systems?• How does MSDS facilitate circular economy practices?• Can MSDS be applied to existing systems, or is it more effective for designing new systems? <p>Discussion:</p> <p>Encourage students to explore the challenges of implementing modularity in large-scale systems and brainstorm innovative solutions.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>

Lesson Plan No. 4.4	Course Name: Design for Sustainability Topic: MSDS: A Modular Method for System Design for Sustainability	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ol style="list-style-type: none"> Understand the concept of the Modular System Design for Sustainability (MSDS) framework. Identify the key principles and steps involved in the MSDS method. Apply the MSDS method to analyze and improve the sustainability of system designs. Explore case studies that demonstrate the practical implementation of MSDS in real-world systems.
Teaching Aids (if any)	ICT: PowerPoint slides illustrating the MSDS framework, steps, and examples.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> What do you think "modular design" means in the context of system sustainability? How can modularity contribute to creating sustainable systems? <p>Introduce MSDS:</p> <ol style="list-style-type: none"> MSDS is a structured framework to design systems for sustainability by breaking them into functional modules. Explain how it facilitates adaptability, efficiency, and sustainability by focusing on modular innovation and system integration. <p>Development (30 minutes):</p> <p>a) Overview of MSDS Framework (15 minutes):</p> <p>Definition of MSDS:</p> <ul style="list-style-type: none"> A systematic approach to designing and organizing systems using modular components to meet sustainability goals. Focuses on environmental, social, and economic sustainability through modularity and system optimization. <p>Principles of MSDS:</p> <ul style="list-style-type: none"> Modularity: Systems are divided into interchangeable and upgradable components to enhance flexibility and lifecycle management. Scalability: Allows systems to grow or shrink as needed without significant redesign. Circularity: Encourages reuse, repair, and recycling of modules to minimize waste and environmental impact. Interoperability: Ensures modules can integrate seamlessly into different systems or contexts. <p>b) Steps in MSDS Application (10 minutes):</p> <p>System Analysis:</p> <ul style="list-style-type: none"> Identify the system's purpose and key sustainability challenges.



	<ul style="list-style-type: none"> ○ Analyze stakeholder needs and environmental impacts. <p>Modular Design Strategy:</p> <ul style="list-style-type: none"> ○ Break down the system into distinct functional modules. ○ Develop sustainable design goals for each module (e.g., energy efficiency, material reduction). <p>Integration and Testing:</p> <ul style="list-style-type: none"> ○ Ensure seamless interaction between modules to maintain overall system functionality. ○ Test for scalability, adaptability, and sustainability metrics <p>Lifecycle Management:</p> <ul style="list-style-type: none"> ○ Plan for module upgrades, repairs, and recycling to extend the system's lifespan. <p>c) Case Studies on MSDS Implementation (5 minutes):</p> <p>Case Study 1: Modular Renewable Energy Systems</p> <ul style="list-style-type: none"> ○ Example: Wind turbines with modular blades for easy maintenance and upgrades. ○ Key Benefit: Extends operational lifespan and reduces resource use. <p>Case Study 2: Modular Smartphones</p> <ul style="list-style-type: none"> ○ Example: Phones with replaceable cameras, batteries, and screens. ○ Key Benefit: Reduces electronic waste by allowing partial upgrades instead of replacing the entire device. <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none"> • Divide the class into small groups and assign a system (e.g., home appliances, transportation, or packaging). • Each group will: <ul style="list-style-type: none"> ○ Identify possible modules within the system. ○ Propose ways to improve sustainability using MSDS principles. ○ Present their ideas to the class.
<p>Closure</p>	<p>Summary (5 minutes):</p> <ol style="list-style-type: none"> 1. Recap the key points: <ol style="list-style-type: none"> 1. The importance of modular design for sustainability. 2. How MSDS can help achieve environmental, social, and economic goals in system design. 3. Practical steps and applications of the MSDS framework. <p>Articles:</p> <ul style="list-style-type: none"> • "MSDS: A Modular Approach to Sustainability in System Design" • "The Role of Modular Design in Achieving Sustainable Development Goals" <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ul style="list-style-type: none"> • What are the advantages of modular design in creating sustainable systems?



- How does MSDS facilitate circular economy practices?
- Can MSDS be applied to existing systems, or is it more effective for designing new systems?

Discussion:

Encourage students to explore the challenges of implementing modularity in large-scale systems and brainstorm innovative solutions.

Spend 5 minutes to evaluate student assimilation of the lesson contents.

Lesson Plan No. 4.5	Course Name: Design for Sustainability Topic: Sustainable System Design Steering Tools and Stimulus	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of steering tools for sustainable system design. b. Identify various tools and stimuli used to guide sustainability in system design. c. Explore the applications of these tools in real-world design processes. d. Evaluate the effectiveness of steering tools in achieving sustainable outcomes.
Teaching Aids (if any)	ICT: Visual aids, including charts and images of steering tools such as Life Cycle Analysis (LCA), Circular Economy frameworks, and Ecodesign principles.
Teaching Development	<p>Introduction (5 minutes):</p> <ol style="list-style-type: none"> 1. <p>Ask Questions:</p> <ol style="list-style-type: none"> 2. 1. What are the main challenges in designing systems sustainably? 2. How can tools help guide sustainable practices in system design? 3. <p>Introduce the Topic:</p> <ol style="list-style-type: none"> 4. 1. Define sustainable system design as an approach that integrates ecological, social, and economic considerations. 2. Explain how steering tools and stimuli act as frameworks or triggers to ensure designs align with sustainability goals. <p>Development (30 minutes):</p> <p>a) Overview of Steering Tools (15 minutes):</p> <p>Definition and Role of Steering Tools:</p> <ol style="list-style-type: none"> 1. Steering tools provide systematic guidance for incorporating sustainability into the design process. 2. They align design decisions with long-term sustainability objectives. <p>Key Steering Tools for Sustainable Design:</p> <ol style="list-style-type: none"> 1. Life Cycle Analysis (LCA): Evaluates the environmental impact of a product or system throughout its lifecycle. 2. Material Flow Analysis (MFA): Tracks the flow of materials to ensure efficient and sustainable use of resources. 3. Circular Economy Frameworks: Promote reuse, recycling, and resource recovery. 4. Ecodesign Principles: Integrate environmental considerations into product design from the outset. 5. Sustainable Development Goals (SDGs): Use global goals



	<p>to align system design with broader sustainability objectives.</p> <p>b) Stimuli for Sustainable Design (10 minutes): Definition and Importance of Stimuli:</p> <ol style="list-style-type: none"> 1. Stimuli act as triggers or motivators to incorporate sustainability into the design process. <p>Types of Stimuli:</p> <ol style="list-style-type: none"> 1. Regulatory Stimuli: Environmental laws and regulations (e.g., emissions standards, waste management policies). 2. Market Stimuli: Consumer demand for eco-friendly products and services. 3. Technological Stimuli: Advancements in sustainable materials and green technologies. 4. Cultural Stimuli: Growing awareness and societal shifts toward sustainability. <p>c) Applications and Examples (5 minutes):</p> <ul style="list-style-type: none"> • Case Study 1: Use of LCA in the design of a sustainable packaging system to reduce waste and emissions. • Case Study 2: Implementation of Ecodesign principles in electronics to promote repairability and recyclability. <p>Exercise (5 minutes): Group Activity:</p> <ul style="list-style-type: none"> • Divide students into small groups and assign a specific tool (e.g., LCA or Circular Economy frameworks). • Ask each group to: <ul style="list-style-type: none"> ○ Explain how the tool works. ○ Apply it to a hypothetical design scenario (e.g., designing a sustainable transportation system). ○ Present their findings to the class.
Closure	<p>Summary (5 minutes):</p> <ul style="list-style-type: none"> • Recap the importance of steering tools and stimuli in guiding sustainable system design. • Highlight how these tools ensure resource efficiency, reduce environmental impacts, and promote sustainable innovation. <p>Articles:</p> <ul style="list-style-type: none"> • "Integrating Sustainability into System Design: Tools and Approaches." • "Circular Economy and Design: A Systematic Framework for Resource Efficiency." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none"> · How does LCA help designers make sustainable decisions? · What role do regulatory and market stimuli play in motivating sustainability efforts? · How can cultural shifts influence the adoption of sustainable design practices? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 4.6	Course Name: Design for Sustainability Topic: Tools for Idea Generation in Sustainable System Design	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the importance of idea generation in sustainable system design. Identify and explain tools used to generate innovative ideas for sustainability. Apply these tools to develop creative and sustainable design solutions.
Teaching Aids (if any)	<ul style="list-style-type: none"> ICT: Visual aids showcasing tools like brainstorming frameworks, TRIZ methodology, and biomimicry-inspired design examples. Examples: Case studies of innovative designs driven by idea generation tools.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> Why is idea generation critical in system design? What challenges arise in developing sustainable design solutions? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> Define idea generation as a creative process for developing innovative solutions. Emphasize the role of systematic tools in fostering sustainability-focused innovation. <p>Development (30 minutes):</p> <p>a) Tools for Idea Generation (15 minutes):</p> <p>Brainstorming:</p> <ol style="list-style-type: none"> Collaborative sessions to generate diverse ideas. Techniques like mind mapping and reverse brainstorming for sustainability. <p>TRIZ (Theory of Inventive Problem Solving):</p> <ol style="list-style-type: none"> A systematic approach to solve design contradictions. Focus on achieving sustainability by balancing competing goals. <p>Biomimicry:</p> <ol style="list-style-type: none"> Drawing inspiration from nature to develop sustainable solutions. Examples: Self-cleaning surfaces modeled after lotus leaves, energy-efficient systems inspired by termite mounds. <p>Design Thinking Frameworks:</p> <ol style="list-style-type: none"> Empathy-driven ideation to address user and environmental needs. Steps: Empathize, define, ideate, prototype, and test.



	<p>b) Applications and Benefits (10 minutes):</p> <ol style="list-style-type: none">1. Highlight success stories:<ol style="list-style-type: none">1. Example: Wind turbine designs inspired by whale flippers.2. Example: Lightweight structures inspired by honeycomb patterns.2. Benefits:<ol style="list-style-type: none">1. Encourages creative solutions.2. Reduces environmental impact by prioritizing sustainability from the start. <p>c) Exercise (5 minutes):</p> <ul style="list-style-type: none">• Group Activity: Students brainstorm innovative solutions for reducing food waste in urban areas using biomimicry principles.
Closure	<ul style="list-style-type: none">• Summary (5 minutes):<ul style="list-style-type: none">• Recap the tools discussed and their role in generating sustainable ideas.• Emphasize the importance of creativity in tackling sustainability challenges.• Suggested Reading:<ul style="list-style-type: none">• "Biomimicry: Innovation Inspired by Nature" by Janine Benyus.• Articles on TRIZ applications in sustainable design. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• How does biomimicry contribute to sustainable design?• Why is brainstorming essential in the idea generation process? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 4.7	Course Name: Design for Sustainability Topic: Strategic Tools for Sustainable System Design	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: At the end of the lesson, students will be able to: a. Understand the role of strategic tools in sustainable system design. b. Identify key strategic tools and frameworks used for sustainability. c. Analyze how these tools influence decision-making and long-term planning.
Teaching Aids (if any)	<ul style="list-style-type: none"> · ICT: Visual presentations on tools like SWOT analysis, Life Cycle Thinking (LCT), and the Circular Economy Model. · Examples: Real-world scenarios illustrating the use of strategic tools.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> 1. Why is strategy important in system design? 2. Can you name any frameworks or tools used for strategic decision-making in sustainability? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> 1. Define strategic tools as frameworks that guide long-term decision-making. 2. Explain their importance in achieving systemic sustainability goals. <p>Development (30 minutes):</p> <p>a) Strategic Tools Overview (15 minutes):</p> <p>SWOT Analysis:</p> <ol style="list-style-type: none"> 1. Identifies strengths, weaknesses, opportunities, and threats in the context of sustainability. 2. Example: Analyzing a product's potential for adopting renewable materials. <p>Life Cycle Thinking (LCT):</p> <ol style="list-style-type: none"> 1. Considers environmental impacts at every stage of a product's life. 2. Focus on reducing resource use and emissions throughout the lifecycle. <p>Circular Economy Model:</p> <ol style="list-style-type: none"> 1. Promotes a closed-loop system of reuse, recycling, and resource recovery. 2. Encourages shifting from linear consumption models. <p>Scenario Planning:</p> <ol style="list-style-type: none"> 1. Evaluates multiple potential future scenarios to guide sustainability strategies. <p>b) Applications and Examples (10 minutes):</p> <ul style="list-style-type: none"> • Case studies: <ul style="list-style-type: none"> ○ Use of LCT in designing eco-friendly packaging. ○ Application of the Circular Economy model in the fashion



	<p>industry to minimize textile waste.</p> <p>c) Exercise (5 minutes):</p> <ul style="list-style-type: none">• Small Group Activity: Students conduct a SWOT analysis for implementing solar panels in a rural community, identifying sustainability benefits and challenges.
Closure	<ul style="list-style-type: none">• Summary (5 minutes):<ul style="list-style-type: none">• Recap the strategic tools and their applications in sustainable design.• Emphasize the need for systemic thinking in long-term planning.• Suggested Reading:<ul style="list-style-type: none">• "Cradle to Cradle: Remaking the Way We Make Things" by William McDonough and Michael Braungart.• Research articles on Circular Economy practices. <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• How does SWOT analysis help in sustainable design decision-making?• What are the key benefits of adopting the Circular Economy model?

Lesson Plan No. 4.8	Course Name: Design for Sustainability Topic: Support tools for the generation of ideas and strategic to system design.	Course No.: UGMDC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of steering tools for sustainable system design. b. Identify various tools and stimuli used to guide sustainability in system design. c. Explore the applications of these tools in real-world design processes. d. Evaluate the effectiveness of steering tools in achieving sustainable outcomes.
Teaching Aids (if any)	ICT: Visual aids, including charts and images of steering tools such as Life Cycle Analysis (LCA), Circular Economy frameworks, and Eco-design principles.
Teaching Development	<p>Introduction (5 minutes): Ask Questions: 1. What are the main challenges in designing systems sustainably? 2. How can tools help guide sustainable practices in system design?</p> <p>Introduce the Topic: 1. Define sustainable system design as an approach that integrates ecological, social, and economic considerations. 2. Explain how steering tools and stimuli act as frameworks or triggers to ensure designs align with sustainability goals.</p> <hr/> <p>Development (30 minutes): a) Overview of Steering Tools (15 minutes): Definition and Role of Steering Tools: 1. Steering tools provide systematic guidance for incorporating sustainability into the design process. 2. They align design decisions with long-term sustainability objectives. Key Steering Tools for Sustainable Design: 1. Life Cycle Analysis (LCA): Evaluates the environmental impact of a product or system throughout its lifecycle. 2. Material Flow Analysis (MFA): Tracks the flow of materials to ensure efficient and sustainable use of resources. 3. Circular Economy Frameworks: Promote reuse, recycling, and resource recovery. 4. Ecodesign Principles: Integrate environmental considerations into product design from the outset. 5. Sustainable Development Goals (SDGs): Use global goals to align system design with broader sustainability objectives.</p> b) Stimuli for Sustainable Design (10 minutes): Definition and Importance of Stimuli: 1. Stimuli act as triggers or motivators to incorporate sustainability into the design process. Types of Stimuli: 1. Regulatory Stimuli: Environmental laws and regulations (e.g.,



	<p>emissions standards, waste management policies).</p> <ol style="list-style-type: none">2. Market Stimuli: Consumer demand for eco-friendly products and services.3. Technological Stimuli: Advancements in sustainable materials and green technologies.4. Cultural Stimuli: Growing awareness and societal shifts toward sustainability. <p>c) Applications and Examples (5 minutes):</p> <ul style="list-style-type: none">• Case Study 1: Use of LCA in the design of a sustainable packaging system to reduce waste and emissions.• Case Study 2: Implementation of Ecodesign principles in electronics to promote repairability and recyclability. <hr/> <p>Exercise (5 minutes): Group Activity:</p> <ul style="list-style-type: none">• Divide students into small groups and assign a specific tool (e.g., LCA or Circular Economy frameworks).• Ask each group to:<ul style="list-style-type: none">○ Explain how the tool works.○ Apply it to a hypothetical design scenario (e.g., designing a sustainable transportation system).○ Present their findings to the class.
<p>Closure</p>	<p>Summary (5 minutes):</p> <ul style="list-style-type: none">• Recap the importance of steering tools and stimuli in guiding sustainable system design.• Highlight how these tools ensure resource efficiency, reduce environmental impacts, and promote sustainable innovation. <p>Articles:</p> <ul style="list-style-type: none">• "Integrating Sustainability into System Design: Tools and Approaches."• "Circular Economy and Design: A Systematic Framework for Resource Efficiency." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ul style="list-style-type: none">· How does LCA help designers make sustainable decisions?· What role do regulatory and market stimuli play in motivating sustainability efforts?· How can cultural shifts influence the adoption of sustainable design practices? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 5.1	Course Name: Design for Sustainability Topic: Introduction to Life Cycle Design	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Life Cycle Design (LCD). b. Identify the key stages and principles involved in LCD. c. Explore the environmental, economic, and social impacts addressed through LCD. d. Apply the LCD approach to real-world product or system development.
Teaching Aids (if any)	ICT: Visual aids, including diagrams of the product life cycle, charts demonstrating life cycle impacts, and examples of tools such as Life Cycle Analysis (LCA).
Teaching Development	<p>Lesson Plan No. 5.1 Course Name: Design for Sustainability Topic: Introduction to Life Cycle Design Course No.: UGMDCC-303 (B)</p> <hr/> <p>Objectives At the end of the lesson, the student shall be able to: a. Understand the concept of Life Cycle Design (LCD). b. Identify the key stages and principles involved in LCD. c. Explore the environmental, economic, and social impacts addressed through LCD. d. Apply the LCD approach to real-world product or system development.</p> <hr/> <p>Teaching Aids (if any) ICT: Visual aids, including diagrams of the product life cycle, charts demonstrating life cycle impacts, and examples of tools such as Life Cycle Analysis (LCA).</p> <hr/> <p>Teaching Development Introduction (5 minutes): Ask Questions:</p> <ol style="list-style-type: none"> 1. What is a product's life cycle, and why is it important in sustainability? 2. How can understanding a life cycle influence design decisions? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> 1. Define Life Cycle Design as an approach that considers the entire lifespan of a product or system, from raw material extraction to end-of-life disposal. 2. Explain how LCD minimizes environmental impacts and maximizes resource efficiency by integrating sustainability into every stage of a product's life.



Lesson Plan No. 5.1

Course Name: Design for Sustainability

Topic: Introduction to Life Cycle Design

Course No.: UGMDCC-303 (B)

Objectives

At the end of the lesson, the student shall be able to:

- a. Understand the concept of Life Cycle Design (LCD).
 - b. Identify the key stages and principles involved in LCD.
 - c. Explore the environmental, economic, and social impacts addressed through LCD.
 - d. Apply the LCD approach to real-world product or system development.
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Teaching Aids (if any)

ICT: Visual aids, including diagrams of the product life cycle, charts demonstrating life cycle impacts, and examples of tools such as Life Cycle Analysis (LCA).

Teaching Development

Introduction (5 minutes):

Ask Questions:

1. What is a product's life cycle, and why is it important in sustainability?
2. How can understanding a life cycle influence design decisions?

Introduce the Topic:

1. Define Life Cycle Design as an approach that considers the entire lifespan of a product or system, from raw material extraction to end-of-life disposal.
 2. Explain how LCD minimizes environmental impacts and maximizes resource efficiency by integrating sustainability into every stage of a product's life.
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Development (30 minutes):

a) Overview of Life Cycle Design (15 minutes):

Definition and Role of LCD:

1. Life Cycle Design ensures products are created with minimal environmental impact over their entire lifespan.
2. It addresses design choices that impact resource efficiency, durability, and end-of-life management.

Key Principles of LCD:

1. **Holistic Approach:** Considers the entire life cycle: raw material extraction, manufacturing, use, and disposal.
2. **Resource Optimization:** Reduces waste and energy consumption during all life cycle stages.
3. **Eco-Design Integration:** Promotes the use of renewable and



	<p>recyclable materials.</p> <p>4. End-of-Life Management: Encourages recycling, reuse, and responsible disposal.</p> <p>Stages of Life Cycle:</p> <ol style="list-style-type: none"> 1. Raw Material Extraction 2. Manufacturing and Production 3. Distribution 4. Use and Maintenance 5. End-of-Life (Reuse, Recycle, or Disposal) <p>b) Applications of Life Cycle Design (10 minutes):</p> <ul style="list-style-type: none"> • Examples: <ol style="list-style-type: none"> 1. Designing a sustainable smartphone with modular components for easy repair and recycling. 2. Creating energy-efficient appliances that reduce electricity consumption during use. • Case Study: Use of life cycle analysis in reducing emissions from the production of electric vehicles. <p>c) Benefits and Challenges (5 minutes):</p> <ul style="list-style-type: none"> • Benefits: <ol style="list-style-type: none"> 1. Reduced environmental footprint. 2. Enhanced product value through sustainable innovation. • Challenges: <ol style="list-style-type: none"> 1. Complexity of evaluating all life cycle stages. 2. Balancing sustainability with cost and performance. <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none"> • Divide students into small groups and assign them a product (e.g., a water bottle or a laptop). • Ask each group to: <ol style="list-style-type: none"> 1. Identify key stages in the product's life cycle. 2. Suggest improvements to make the product more sustainable. 3. Share their findings with the class.
Closure	<p>Closure (5 minutes):</p> <p>Summary:</p> <ul style="list-style-type: none"> • Recap the importance of Life Cycle Design in achieving sustainability goals. • Emphasize how LCD promotes responsible resource use and minimizes environmental impacts. • Highlight the application of LCD in real-world industries like electronics, transportation, and packaging. <p>Articles for Reference:</p> <ul style="list-style-type: none"> • "Life Cycle Thinking in Sustainable Product Design." • "Innovative Approaches to Life Cycle Assessment." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none"> • How does Life Cycle Design help in reducing a product's environmental impact? • What challenges might designers face when applying LCD principles? • How can recycling and reuse be incorporated into the life cycle of a product?



Lesson Plan No. 5.2	Course Name: Design for Sustainability Topic: Relevance of Life Cycle Design for Sustainability	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of Life Cycle Design (LCD) in achieving sustainability. b. Recognize how LCD addresses environmental, social, and economic impacts across a product's life cycle. c. Analyze real-world examples of LCD contributing to sustainable development. d. Evaluate how the integration of LCD principles promotes resource efficiency and waste reduction.
Teaching Aids (if any)	ICT: Visual presentations of product life cycles, environmental impact charts, case studies, and sustainable design frameworks.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> Why is it important to consider a product's entire life cycle in sustainability? What challenges might arise if life cycle impacts are ignored during the design process? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> Define the relevance of Life Cycle Design (LCD) as a strategic approach for sustainability. Explain how LCD aligns with the principles of sustainable development by minimizing negative environmental and social impacts while enhancing economic value. <hr/> <p>Development (30 minutes):</p> <p>a) Relevance of Life Cycle Design (15 minutes):</p> <p>Sustainability and LCD Connection:</p> <ol style="list-style-type: none"> LCD ensures every stage of a product's life cycle—from raw material extraction to disposal—is assessed for environmental, social, and economic impacts. It shifts the focus from isolated improvements to a comprehensive approach for sustainability. <p>Core Aspects of LCD for Sustainability:</p> <ol style="list-style-type: none"> Environmental Benefits: <ul style="list-style-type: none"> Minimizes waste and pollution through recycling and reuse. Encourages the use of eco-friendly materials. Social Benefits: <ul style="list-style-type: none"> Promotes fair labor practices and health safety in production stages. Reduces societal burdens like e-waste and pollution.



	<p>3. Economic Benefits:</p> <ul style="list-style-type: none">▪ Lowers costs by improving resource efficiency.▪ Enhances market value through sustainable product innovation. <p>b) Real-World Applications (10 minutes):</p> <ul style="list-style-type: none">• Case Study 1: Using Life Cycle Analysis (LCA) in the automotive industry to optimize energy consumption and reduce emissions during production and use.• Case Study 2: Designing biodegradable packaging to minimize environmental impact during disposal.• Case Study 3: Incorporating modularity in electronics to facilitate easy repair and upgrade, extending product lifespan. <p>c) Benefits of Integrating LCD (5 minutes):</p> <ul style="list-style-type: none">• Reduces a product's overall carbon footprint.• Encourages innovation in sustainable product development.• Promotes circular economy practices like recycling and reuse.• Enhances corporate social responsibility (CSR) and brand value. <hr/> <p>Exercise (5 minutes): Group Activity:</p> <ul style="list-style-type: none">• Divide students into small groups and assign each group a product category (e.g., clothing, electronics, or packaging).• Ask them to:<ol style="list-style-type: none">1. Identify how LCD principles can improve sustainability in that category.2. Suggest at least two changes to the product life cycle for greater environmental, social, or economic benefits.3. Present their suggestions to the class.
Closure	<p>Summary:</p> <ul style="list-style-type: none">• Recap the significance of Life Cycle Design in sustainability efforts.• Highlight how LCD ensures environmental conservation, social well-being, and economic efficiency.• Emphasize its application in real-world industries to address global challenges like climate change and resource scarcity. <p>Articles for Reference:</p> <ul style="list-style-type: none">• "The Role of Life Cycle Thinking in Sustainable Development."• "From Cradle to Grave: A Comprehensive Look at Product Life Cycles."
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• Why is considering a product's life cycle critical for sustainability?• How does LCD address the three pillars of sustainability (environmental, social, and economic)?• What are some examples of products that effectively incorporate LCD principles? <p>Spend 5 minutes to evaluate student assimilation of the lesson contents.</p>



Lesson Plan No. 5.3	Course Name: Design for Sustainability Topic: : Methods and Strategies for Life Cycle Design	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand various methods and strategies used in Life Cycle Design (LCD). b. Identify tools and techniques that guide sustainable design decisions across the product life cycle. c. Explore the application of these methods in real-world product design and development. d. Evaluate the effectiveness of strategies in promoting resource efficiency and minimizing environmental impact.
Teaching Aids (if any)	ICT: Visual presentations, flowcharts of life cycle design methods, examples of tools like Life Cycle Assessment (LCA), and case studies.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> 1. What are the key challenges in designing sustainable products or systems? 2. How can specific methods help improve sustainability across a product's life cycle? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> 1. Define methods and strategies for Life Cycle Design as systematic approaches to reduce environmental impacts, improve efficiency, and enhance product value. 2. Explain their role in aligning design processes with sustainability goals. <p>Development (30 minutes):</p> <p>a) Methods for Life Cycle Design (15 minutes):</p> <p>Life Cycle Assessment (LCA):</p> <ol style="list-style-type: none"> 1. Evaluates environmental impacts at each stage of a product's life. 2. Provides data-driven insights for reducing emissions, waste, and resource use. <p>Eco-Design:</p> <ol style="list-style-type: none"> 1. Integrates environmental considerations into product design from the outset. 2. Encourages material selection, energy efficiency, and modularity for repair and upgrade. <p>Material Flow Analysis (MFA):</p> <ol style="list-style-type: none"> 1. Tracks material use throughout the life cycle to minimize waste and optimize resources. <p>Cradle-to-Cradle Design:</p> <ol style="list-style-type: none"> 1. Ensures products are designed for reuse, recycling, or safe disposal. 2. Promotes a circular economy. <p>Sustainable Development Goals (SDGs):</p>



	<p>1. Aligns design strategies with global sustainability objectives like clean energy, responsible consumption, and reduced waste.</p> <p>b) Strategies for Life Cycle Design (10 minutes):</p> <p>Circular Economy Strategies:</p> <ol style="list-style-type: none">1. Design for durability, repairability, and recyclability.2. Shift from linear "take-make-dispose" models to circular "reuse-repair-recycle" systems. <p>Energy Optimization Strategies:</p> <ol style="list-style-type: none">1. Prioritize energy-efficient processes and renewable energy sources in manufacturing.2. Optimize product use-phase energy consumption (e.g., energy-saving appliances). <p>End-of-Life Management Strategies:</p> <ol style="list-style-type: none">1. Incorporate take-back programs for product recycling.2. Use biodegradable or recyclable materials for easy disposal. <p>c) Applications and Examples (5 minutes):</p> <ul style="list-style-type: none">• Example 1: Using LCA to design a low-emission electric vehicle.• Example 2: Implementing eco-design in furniture production for modularity and recyclability.• Example 3: Circular economy strategies in packaging design, focusing on reusability and minimal waste. <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none">• Divide students into groups and assign a product category (e.g., electronics, clothing, or packaging).• Ask each group to:<ol style="list-style-type: none">1. Identify one method (e.g., LCA or Eco-Design) and explain its application to the product.2. Develop one strategy to improve the product's sustainability.3. Present their findings to the class.
<p>Closure</p>	<p>Summary:</p> <ul style="list-style-type: none">• Recap the methods and strategies of Life Cycle Design as essential tools for sustainability.• Highlight how these approaches reduce environmental impacts, improve resource efficiency, and align with global sustainability goals.• Emphasize the importance of integrating these methods into real-world design processes. <p>Articles for Reference:</p> <ul style="list-style-type: none">• "Life Cycle Strategies for Sustainable Product Design."• "Eco-Design and Circular Economy Practices in Industry." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
<p>Evaluation</p>	<p>Reflective Questions:</p> <ul style="list-style-type: none">• How does Life Cycle Assessment guide sustainable design?• What is the role of eco-design in reducing environmental impacts?• How can circular economy strategies transform traditional product design approaches?

Lesson Plan No. 5.4	Course Name: Design for Sustainability Topic: Approaches to Life Cycle Design	Course No.: UGMDCC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ol style="list-style-type: none"> Understand different approaches to Life Cycle Design (LCD). Explore how these approaches contribute to sustainability across a product's life cycle. Analyze the application of various LCD approaches in real-world scenarios. Evaluate the advantages and challenges of these approaches in sustainable design.
Teaching Aids (if any)	ICT: Visual aids (flowcharts, diagrams), real-life examples, videos of sustainable product development using LCD approaches.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> Why is it important to have structured approaches in Life Cycle Design? Can you think of examples where considering the entire life cycle has improved sustainability? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> Define approaches to Life Cycle Design as systematic frameworks to address sustainability challenges at every stage of a product's life. Highlight their relevance in promoting environmental, social, and economic benefits. <hr/> <p>Development (30 minutes):</p> <p>a) Overview of Life Cycle Design Approaches (15 minutes):</p> <p>Linear Approach:</p> <ol style="list-style-type: none"> Traditional "cradle-to-grave" design considers production, use, and disposal. Limitations: Focuses on disposal rather than reuse or recycling, leading to resource wastage. <p>Circular Approach:</p> <ol style="list-style-type: none"> "Cradle-to-cradle" model emphasizes reuse, repair, remanufacturing, and recycling. Encourages a closed-loop system, reducing waste and conserving resources. <p>Eco-Design Approach:</p> <ol style="list-style-type: none"> Integrates environmental considerations during the design phase. Focuses on resource-efficient material selection, energy-efficient production, and waste minimization. <p>System-Based Approach:</p> <ol style="list-style-type: none"> Considers the product as part of a larger system (e.g., supply chain, logistics, and disposal systems). Optimizes sustainability across interrelated systems. <p>Life-cycle Thinking Approach:</p>



	<ol style="list-style-type: none">1. Emphasizes decision-making based on lifecycle impacts, from raw material extraction to disposal or recycling.2. Uses tools like Life Cycle Assessment (LCA) to guide sustainable practices. <p>b) Applications of LCD Approaches (10 minutes):</p> <ul style="list-style-type: none">• Case Study 1: Circular approach in the design of modular smartphones for easy repair and recycling.• Case Study 2: Eco-design of energy-efficient home appliances, reducing operational energy consumption.• Case Study 3: System-based approach in sustainable urban transportation planning, considering emissions, energy, and infrastructure. <p>c) Advantages and Challenges (5 minutes):</p> <p>Advantages:</p> <ol style="list-style-type: none">1. Reduces environmental impact and resource depletion.2. Enhances economic efficiency and product value.3. Encourages innovation in sustainable product design. <p>Challenges:</p> <ol style="list-style-type: none">1. High initial costs for adopting sustainable materials and technologies.2. Limited consumer awareness and demand for sustainable products.3. Complexity in implementing system-based and circular approaches in industries. <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none">• Divide students into groups and assign each an approach (e.g., Eco-Design, Circular, System-Based).• Ask each group to:<ol style="list-style-type: none">1. Provide an example of how the assigned approach can be applied in product design.2. Highlight its benefits and challenges.3. Share their findings with the class.
Closure	<p>Summary:</p> <ul style="list-style-type: none">• Recap the key approaches to Life Cycle Design and their significance in sustainability.• Emphasize how these approaches integrate environmental, economic, and social considerations.• Encourage students to explore the practical implementation of these approaches in their projects. <p>Articles for Reference:</p> <ul style="list-style-type: none">• "Circular Economy and Sustainable Design: Bridging the Gap."• "Eco-Design Principles for Life Cycle Thinking." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• How does the circular approach differ from the linear approach in Life Cycle Design?• What role does the system-based approach play in sustainable design?• Can you think of a product or service that effectively uses lifecycle thinking?



Lesson Plan No. 5.5	Course Name: Design for Sustainability Topic: Life Cycle Assessment (LCA).	Course No.: UGMDCC-303 (B)
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept and purpose of Life Cycle Assessment (LCA). b. Identify the steps involved in conducting an LCA. c. Explore real-world applications of LCA in sustainable design and decision-making. d. Analyze the benefits and challenges of using LCA for sustainability.
Teaching Aids (if any)	ICT: Visual aids, including diagrams of LCA stages, examples of LCA software (e.g., SimaPro, GaBi), and case studies.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> 1. What factors do you think impact the sustainability of a product throughout its life cycle? 2. How can we measure and evaluate these impacts? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> 1. Define Life Cycle Assessment (LCA) as a tool for evaluating the environmental impacts associated with all stages of a product's life. 2. Highlight its role in identifying areas for improvement and guiding sustainable decisions. <hr/> <p>Development (30 minutes):</p> <p>a) Overview of Life Cycle Assessment (10 minutes):</p> <p>Definition:</p> <p>LCA is a systematic analysis of environmental impacts from raw material extraction to disposal (cradle-to-grave).</p> <ol style="list-style-type: none"> 1. Helps in identifying hotspots and opportunities for reducing impacts. <p>Importance of LCA:</p> <ol style="list-style-type: none"> 1. Provides a data-driven basis for sustainability decisions. 2. Aligns product development with environmental goals like carbon neutrality and waste reduction. <p>b) Steps in Conducting LCA (15 minutes):</p> <p>1. Goal and Scope Definition:</p> <ol style="list-style-type: none"> 1. Define the purpose of the LCA and the boundaries (e.g., cradle-to-grave, cradle-to-gate). 2. Identify the functional unit (e.g., one unit of a product). <p>2. Inventory Analysis:</p> <ol style="list-style-type: none"> 1. Collect data on material and energy inputs and outputs across all stages of the life cycle. 2. Example: Resource extraction, manufacturing, transportation, use, and disposal. <p>3. Impact Assessment:</p> <ol style="list-style-type: none"> 1. Analyze the environmental impacts of inputs and outputs. 2. Categories include global warming potential, water use, air



	<p>pollution, and waste generation.</p> <p>4. Interpretation:</p> <ol style="list-style-type: none">1. Identify improvement areas based on results.2. Make recommendations for design modifications or process changes. <p>c) Applications of LCA (5 minutes):</p> <ul style="list-style-type: none">• Example 1: Comparing the environmental impacts of single-use and reusable packaging.• Example 2: Evaluating the carbon footprint of electric vs. conventional vehicles.• Example 3: Designing sustainable building materials with lower embodied energy. <hr/> <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none">• Assign students a product (e.g., a water bottle, smartphone, or clothing item).• Ask each group to:<ol style="list-style-type: none">1. Outline the life cycle stages of the product.2. Identify potential environmental impacts at each stage.3. Suggest one improvement based on LCA principles.
Closure	<p>Summary (5 minutes)</p> <ul style="list-style-type: none">• Recap the concept, steps, and significance of LCA in promoting sustainability.• Highlight how LCA aids in making informed decisions to minimize environmental impacts.• Encourage students to consider the entire life cycle in their design projects. <p>Articles for Reference:</p> <ul style="list-style-type: none">• "Life Cycle Assessment for Sustainable Product Development."• "Case Studies in LCA: Tools for Decision-Making." <p>Spend 5 minutes to wrap up and consolidate the learnings.</p>
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• What is the main purpose of conducting an LCA?• How does inventory analysis contribute to understanding a product's environmental impact?• Can you think of a product where LCA has led to significant sustainability improvements? <p>Spend 5 minutes evaluating the students' understanding through discussion and the group activity outcomes.</p>

Lesson Plan No. 5.6	Course Name: Design for Sustainability Topic: Framework for Life Cycle Assessment (LCA)	Course No.: UGMDC-303 (B)
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Objectives	<p>At the end of the lesson the student shall be able to:</p> <ol style="list-style-type: none"> Understand the structured framework for conducting Life Cycle Assessment (LCA). Learn the components and methodology involved in the LCA framework. Explore how the LCA framework guides sustainable decision-making. Apply the LCA framework to real-world scenarios for evaluating environmental impacts.
Teaching Aids (if any)	ICT: Flowcharts, diagrams of the LCA framework stages, examples of LCA tools (e.g., SimaPro, GaBi), and practical case studies.
Teaching Development	<p>Introduction (5 minutes):</p> <p>Ask Questions:</p> <ol style="list-style-type: none"> Why do we need a structured approach for assessing a product's life cycle impacts? How might a framework help in making sustainable design choices? <p>Introduce the Topic:</p> <ol style="list-style-type: none"> Define the LCA framework as a systematic process for assessing environmental impacts of products or systems throughout their life cycle. Highlight its importance in identifying improvement opportunities and promoting sustainability. <hr/> <p>Development (30 minutes):</p> <p>a) Components of the LCA Framework (15 minutes):</p> <ol style="list-style-type: none"> Goal and Scope Definition: <ol style="list-style-type: none"> Clarify the purpose of the LCA and its intended application. Define system boundaries (e.g., cradle-to-grave, cradle-to-gate). Establish the functional unit (e.g., one product, one service). Life Cycle Inventory (LCI) Analysis: <ol style="list-style-type: none"> Compile data on all inputs (materials, energy) and outputs (emissions, waste) in the product's life cycle. Example: Tracking resource usage during production, transportation, and disposal. Life Cycle Impact Assessment (LCIA): <ol style="list-style-type: none"> Categorize and quantify the environmental impacts identified in the inventory. Examples of impact categories: <ul style="list-style-type: none"> ▪ Global Warming Potential (GWP). ▪ Resource Depletion. ▪ Water Use. Use weighting methods to prioritize impacts based on severity. 4. Interpretation:



	<ol style="list-style-type: none">1. Analyze results to identify key environmental hotspots.2. Make recommendations for reducing impacts or improving processes.3. Ensure consistency with the goal and scope. <p>b) Key Methodologies in the LCA Framework (10 minutes):</p> <ul style="list-style-type: none">• Process-Based Approach: Focuses on individual processes in the life cycle.• Input-Output Analysis: Evaluates economic and environmental interactions at a broader level.• Hybrid Approach: Combines process-based and input-output methods for a comprehensive assessment. <p>Case Studies:</p> <ul style="list-style-type: none">• Assessing the carbon footprint of a product using cradle-to-grave LCA.• Identifying waste reduction strategies in packaging using cradle-to-gate analysis. <p>c) Applications of the LCA Framework (5 minutes):</p> <ul style="list-style-type: none">• Policy Making: Informing regulations on emissions or resource usage.• Corporate Sustainability: Developing greener products and services.• Consumer Awareness: Providing transparency through eco-labels and certifications. <hr/> <p>Exercise (5 minutes):</p> <p>Group Activity:</p> <ul style="list-style-type: none">• Divide students into groups and assign each group one stage of the LCA framework.• Ask them to:<ol style="list-style-type: none">1. Explain their assigned stage in detail.2. Illustrate its importance using a real-world example (e.g., smartphones, packaging).3. Present their insights to the class.
Closure	<p>Summary:</p> <ul style="list-style-type: none">• Recap the four key stages of the LCA framework.• Emphasize how the framework provides a structured method for assessing and reducing environmental impacts.• Encourage students to consider the LCA framework when designing sustainable solutions. <p>Articles for Reference:</p> <ul style="list-style-type: none">• "ISO 14040: Principles and Framework of LCA."• "Applying the Life Cycle Framework to Product Innovation."
Evaluation	<p>Reflective Questions:</p> <ul style="list-style-type: none">• Why is defining the goal and scope crucial in the LCA framework?• How does the inventory analysis stage contribute to sustainability?• Which methodology—process-based, input-output, or hybrid—do you think is most effective for real-world applications? <p>Spend 5 minutes evaluating the students' understanding through group presentations and discussions.</p>