Department of CIVIL ENGINEERING

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Green Building Infrastructure and Architecture
2.	Course Code	CE-604
3.	Academic Year	2024-25
4.	Semester	6th
5.	Number of Lesson plans	37
6.	Faculty Assigned	Dr. Bhagwan Das

Faculty Signature

Lesson Plan No. 1	Course Name: Green Building Infrastructure and Architecture Topic: Principles of planning in green buildings.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the importance of sustainable materials and resource management. c. Learn the environmental, economic, and social benefits of green buildings. d. Analyze case studies to identify best practices in green building design.
Teaching Aids (if any)	a. **Projector/Smart Board** for visual aids. b. Use of Nearpod tool for online quiz. c. **Case Study PDFs / Online Videos** (e.g., LEED-certified projects).
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. b. What do you know about green buildings? c. Why do you think green buildings are necessary today? Briefly discuss global challenges like climate change, resource depletion, and urban pollution. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Core Principles of Green Building Planning: b. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 2	**Course Name: Green Building Infrastructure and Architecture** **Topic: Site selection for green buildings.**	**Course No.: CE-604**

Objectives	At the end of the lesson the student shall be able to: a. Understand the site selection for buildings. b. Understand the types of orientation of buildings. c. Define common errors and planning in buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - What do you mean by site selection and orientation of buildings? - Define green buildings 2. **Development**(30minutes) - Introduce the concept selecting the buildings - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 3	**Course Name: Green Building Infrastructure and Architecture** **Topic: Energy efficient and environment friendly building.**	**Course No.: CE-604**

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the significance of sustainable materials and resource management c. Identify environmental, economic, and social benefits of green buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - Why are green buildings necessary today? - Define green buildings? - Define energy efficiency? 2. **Development**(30minutes) - Introduce the concept energy efficient and environment friendly building. - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 4	Course Name: Green Building Infrastructure and Architecture Topic: Orientation of buildings	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the site selection for buildings. b. Understand the types of orientation of buildings. c. Define common errors and planning in buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - What do you mean by site selection and orientation of buildings? - Define green buildings 2. **Development**(30minutes) - Introduce the concept selecting the buildings - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 2	Course Name: Green Building Infrastructure and Architecture Topic: Common errors in planning	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the site selection for buildings. b. Understand the types of orientation of buildings. c. Define common errors and planning in buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - What do you mean by site selection and orientation of buildings? - Define green buildings 2. **Development**(30minutes) - Introduce the concept selecting the buildings - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 6	Course Name: Green Building Infrastructure and Architecture Topic: Provision of rainwater harvesting	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept and purpose of rainwater harvesting. b. Explore various methods and technologies used for rainwater collection. c. Evaluate the environmental, social, and economic benefits. d. Analyze real-life applications and propose solutions for water management through rainwater harvesting.
Teaching Aids (if any)	a. **Projector/Smart Board** for visual aids. b. Use of Nearpod tool for online quiz. c. **Rainwater harvesting model** (optional demo or image slides).
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. b. How does rainwater go to waste in urban areas? c. What do you think happens to rainwater after it reaches the ground? Briefly discuss global challenges like climate change, resource depletion, and urban pollution. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Collecting and storing rainwater for later use. b. Explain basic components: rooftop, gutters, storage tanks, filtration units, recharge pits. c. Types and uses of rain water harvesting. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **d.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Each team designs a **rainwater harvesting plan** for a school, home, or community iii. hey present key features of their plan (roof area, tank capacity, use cases, etc.).
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html

	3. Homework Why rainwater harvesting is crucial for sustainable development Encourage students to reflect on how they can implement small-scale rainwater harvesting Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 7	Course Name: Green Building Infrastructure and Architecture Topic Green Building Materials and Equipment in India.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Identify green building materials and technologies used in India. b. Understand the environmental, social, and economic benefits of sustainable materials. c. Analyze how these materials and equipment reduce the carbon footprint in construction. d. Propose ideas for using eco-friendly materials in real-world projects.
Teaching Aids (if any)	a. □ Smartboard/Projector for slides and case study videos. b. □ Samples of eco-friendly materials (bamboo, AAC blocks, fly ash bricks – optional). c. □ PDFs on green-certified projects in India (IGBC, LEED-certified). d. □ Quiz tools (Nearpod/Kahoot). □ Worksheet for group activities.
Teaching Development	1. **Introduction** (5 minutes) a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Why do you think green buildings are necessary today? Explain that green materials aim to reduce the environmental impact at all stages of a building's life cycle. 2. Traditional vs. Green Materials (impact on energy, water use, and emissions). 3. Use a short video clip showcasing a green building in India.Core Principles of Green Building Planning: a. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **b.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **4. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 8	Course Name: Green Building Infrastructure and Architecture Topic: Important Sustainable features for Green Building.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the essential features of sustainable green buildings. b. Learn how these features reduce environmental impact and promote energy efficiency. c. Analyze real-world examples and case studies to see the benefits in action. d. Develop ideas for incorporating sustainable features in future building projects..
Teaching Aids (if any)	**a. Smartboard/Projector for videos/slides.** **b. Case studies of green-certified buildings (LEED or IGBC).** **c. Interactive quiz (Kahoot/Nearpod).** **d. Worksheet for group activity.** e. **Handouts on sustainable features (optional).**).
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Briefly discuss global challenges like climate change, resource depletion, and urban pollution. Show a visual comparison between conventional and green buildings. Use a **short video clip** showcasing a green building in India.. **2. Development (30 minutes)** a. Bamboo: Renewable, durable, and widely used in scaffolding and furniture. b. Fly Ash Bricks: Utilizes industrial waste, reducing the need for cement. c. AAC Blocks (Autoclaved Aerated Concrete): Lightweight, excellent insulation properties. d. CSEB (Compressed Stabilized Earth Blocks): Locally produced with minimal carbon footprint. e. Recycled Steel and Glass: Reduces mining and promotes reuse Emphasize minimizing environmental impact. Optimize building orientation to maximize natural light and ventilation. **f.** Energy Efficiency**.** Discuss renewable energy integration (e.g., solar panels). Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups.

	ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 9	Course Name: Green Building Infrastructure and Architecture Topic: Indian Green Building Council	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the purpose and role of the Indian Green Building Council (IGBC). b. Learn about IGBC's green building certification systems and rating tools. c. Explore how IGBC promotes sustainability in India. d. Analyze case studies of IGBC-certified projects.
Teaching Aids (if any)	a. Projector/Smartboard for presentations. b. Case studies PDFs of IGBC-certified projects. c. IGBC Handbook or handouts (optional). d. Quiz tools (Kahoot/Nearpod).
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What is a green building? b. Why do you think green building certification is important? Overview of the IGBC: Establishment: Introduced by the Confederation of Indian Industry (CII) in 2001. Mission: To enable a sustainable built environment and promote green practices in India. Global Context: IGBC aligns with the UN Sustainable Development Goals (SDGs) and complements international systems like LEED.. **2. Development (30 minutes)** a. Role of the Indian Green Building Council (IGBC): b. c. Developing Green Building Rating Systems: d. e. The IGBC offers customized rating systems for different building types: f. IGBC Green Homes g. IGBC Green Schools h. IGBC Green Factories i. IGBC Green Cities j. Each rating system provides specific guidelines to reduce energy consumption, water usage, and carbon emissions. k. IGBC Certification Process: l. m. Pre-certification: Assesses design and intent of the project. n. Final Certification: Evaluates performance after project completion. o. Certification levels: Certified, Silver, Gold, and Platinum based on sustainability performance. p. Key Benefits of IGBC Certification: q. r. Reduced operational costs due to efficient use of resources.

	s. Improved indoor air quality and occupant well-being. t. Contribution to carbon footprint reduction. u. Case Study Discussion: v. w. Example: Infosys Campus, Hyderabad (Platinum-certified). x. Example: CII-Godrej Green Business Centre, Hyderabad – the first IGBC Platinum building. y. Highlight how these projects achieved energy efficiency, waste management, and water savings.. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Each group selects a building type (home, school, office, etc.) and designs a green building plan that aligns with IGBC guidelines. **iii.** Groups present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. GBC's rating systems encourage sustainable practices in various sectors. 3. Green certification adds value by enhancing energy efficiency and reducing environmental impact. 4. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 5. Homework Research an IGBC-certified building in your region and write a short report on the project's key green features. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions How does IGBC contribute to sustainable development in India? 2. What are the challenges of adopting IGBC guidelines for all buildings? 3. Conduct a short online quiz using Nearpod. Field Visit: Plan a visit to an IGBC-certified building for practical exposure. Guest Lecture: Invite a green architect or IGBC professional to discuss trends and innovations. IGBC Handbook Review: Provide handouts or links to IGBC's website for further reading. Learning outcomes □ Gain insight into the role of IGBC in promoting sustainable construction in India. □ Understand the different rating systems and the certification process. □ Be inspired to incorporate sustainable practices in future building designs.

Lesson Plan No. 10	Course Name: Green Building Infrastructure and Architecture Topic: Benefits Experienced in Green Buildings	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the environmental, economic, and social benefits of green buildings. b. Explore case studies that demonstrate these benefits in action. c. Analyze how green buildings contribute to sustainability goals. d. Develop ideas for incorporating green building strategies into future projects.
Teaching Aids (if any)	**a. Projector/Smartboard for videos/slides.** **b. Case study PDFs on successful green buildings.** **c. Interactive tools (Kahoot/Nearpod quiz).** d. **Worksheet for group activity (optional).**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What do you think are the benefits of green buildings? b. How might green buildings impact society beyond energy savings? Briefly discuss what makes a building "green." Emphasize that the benefits are more than just environmental—they also include economic and social improvements.. **2. Development (30 minutes)** a. Core Benefits of Green Buildings: b. Environmental Benefits: c. Reduction in Carbon Footprint: Lower greenhouse gas emissions through energy-efficient systems. d. Water Conservation: Use of rainwater harvesting and low-flow fixtures. e. Waste Reduction: Recycling construction waste and using sustainable materials. f. Improved Biodiversity: Green roofs and urban gardens. g. Economic Benefits: h. Lower Operational Costs: Energy and water savings through efficient equipment. i. Higher Property Value: Certified green buildings attract higher rental income and resale value. j. Incentives and Subsidies: Government support for sustainable projects (e.g., tax benefits for green-certified buildings). k. Social Benefits: l. Better Indoor Air Quality: Use of low-VOC materials improves health and well-being. m. Enhanced Comfort and Productivity: Natural ventilation and daylighting boost mental well-being. n. Community Impact: Promotes sustainable living and encourages others to adopt eco-friendly practices.

	o. Case Study Discussion: p. Infosys Campus, Hyderabad: Demonstrates cost savings through energy-efficient HVAC and lighting systems. **q.** CII-Godrej Green Business Centre: Highlights improved employee productivity and well-being. **Exercise (5 minutes)** i. Divide students into small groups. ii. Each group designs a small green building plan that emphasizes 2-3 key benefits (e.g., energy savings, biodiversity, or community well-being). **iii.** Groups present their ideas briefly
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 11	Course Name: Green Building Infrastructure and Architecture Topic: Principles of planning in green buildings.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the evolution and purpose of green building rating systems. b. Learn about the major global and Indian green rating systems (LEED, BREEAM, IGBC, GRIHA). c. Explore the benefits and challenges of adopting these systems. d. Analyze how these rating systems contribute to sustainable development..
Teaching Aids (if any)	**a. Projector/Smartboard for slides/videos.** **b. Case studies PDFs of certified projects.** **c. Interactive quiz tools (Nearpod/Kahoot).** d. **Timeline worksheet (optional) for student activity.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What do you think makes a building sustainable? b. Have you heard of green building certifications like LEED or IGBC? Briefly introduce the need for green buildings in the context of climate change, urbanization, and environmental degradation. Explain how green building rating systems emerged to standardize and promote sustainable practices.. **2. Development (30 minutes)** a. History of Green Building Rating Systems: b. Global Rating Systems: c. BREEAM (UK, 1990): First green building rating system in the world. d. LEED (USA, 1998): Focuses on energy, water, and indoor air quality. e. WELL Certification: Prioritizes human health and well-being. f. Indian Rating Systems: g. IGBC (Indian Green Building Council): Launched in 2001 by CII, inspired by LEED. h. GRIHA (Green Rating for Integrated Habitat Assessment): India's indigenous system, focused on energy efficiency and affordable housing. i. EDGE Certification: Aimed at promoting resource-efficient construction in emerging markets, including India. j. Certification Levels and Criteria. k. IGBC/LEED: Certified, Silver, Gold, and Platinum levels based on performance. l. Evaluation Categories: m. Energy efficiency n. Water conservation o. Indoor environmental quality p. Use of sustainable materials

	q. Benefits and Challenges of Green Rating Systems: r. Benefits: s. Reduces carbon emissions and resource consumption. t. Increases property value and lowers operational costs. u. Attracts government subsidies and incentives. v. Challenges: w. High initial cost of green technologies. x. Limited awareness and expertise in some regions. y. Case Study Discussion. z. Example: CII-Godrej Green Business Centre (Hyderabad) – the first Platinum-rated green building in India. Example: Infosys Hyderabad – achieved energy savings through efficient HVAC and renewable energy systems. **Exercise (5 minutes)** i. Divide students into small groups. ii. Each group creates a timeline showing the development and adoption of green building rating systems (from BREEAM to IGBC and GRIHA). iii. Groups present their timelines briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. Green building rating systems have evolved to guide and reward sustainable practices in construction. These systems contribute to achieving sustainable development goals (SDGs) through resource conservation and improved living environments. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research and write a report on the impact of an IGBC or LEED-certified building in your area or city. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 12	Course Name: Green Building Infrastructure and Architecture Topic: Principles of planning in green buildings.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the principles of green building design in the residential sector. b. Explore the environmental, economic, and social benefits of green residential buildings. c. Identify key sustainable materials and technologies used in residential construction. d. Analyze case studies of successful green residential projects..
Teaching Aids (if any)	**a. Projector/Smartboard for slides/videos.** **b. Case studies PDFs of green residential projects.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**).
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What do you think makes a home sustainable? b. How might green buildings impact our daily lives?? Define green buildings and their relevance to the residential sector. Discuss the increasing importance of sustainability in housing due to urbanization, climate change, and resource depletion. **2. Development (30 minutes)** a. Principles of Green Building Design in the Residential Sector: b. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 13	Course Name: Green Building Infrastructure and Architecture Topic: Market Transformation Principles of green building	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of market transformation in the context of green building. b. Identify key principles and strategies that facilitate the adoption of green building practices. c. Analyze the role of various stakeholders in promoting green buildings. d. Discuss the economic and environmental impacts of market transformation in construction.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What do you think influences people to choose green buildings over traditional ones? b. How can market forces impact sustainable construction practices? c. Define market transformation: a systematic shift in the building industry towards sustainable practices, driven by policy, demand, and innovation. d. Explain how the green building movement aims to change market dynamics to favor eco-friendly practices. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Principles of Market Transformation in Green Building: Importance of raising awareness among consumers, builders, and policymakers about the benefits of green buildings. Role of training programs and certifications in improving skills related to green construction. b. Policy and Regulation Impact of government incentives, such as tax breaks and subsidies for green buildings. Example: Building codes and standards that encourage sustainable practices (e.g., IGBC, LEED certifications). c. Market Demand: Growing consumer preference for energy-efficient, healthy living spaces. Importance of showcasing successful green projects to create demand.

	□ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **d.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 14	Course Name: Green Building Infrastructure and Architecture Topic: Selection of site and Orientation of the building.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the site selection for buildings. b. Understand the types of orientation of buildings. c. Define common errors and planning in buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - What do you mean by site selection and orientation of buildings? - Define green buildings 2. **Development**(30minutes) - Introduce the concept selecting the buildings - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 15	Course Name: Green Building Infrastructure and Architecture Topic Usage of low energy materials.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Identify green building materials and technologies used in India. b. Understand the environmental, social, and economic benefits of sustainable materials. c. Analyze how these materials and equipment reduce the carbon footprint in construction. d. Propose ideas for using eco-friendly materials in real-world projects.
Teaching Aids (if any)	a. □ Smartboard/Projector for slides and case study videos. b. □ Samples of eco-friendly materials (bamboo, AAC blocks, fly ash bricks – optional). c. □ PDFs on green-certified projects in India (IGBC, LEED-certified). d. □ Quiz tools (Nearpod/Kahoot). □ Worksheet for group activities.
Teaching Development	1. **Introduction** (5 minutes) a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Why do you think green buildings are necessary today? Explain that green materials aim to reduce the environmental impact at all stages of a building's life cycle. 2. Traditional vs. Green Materials (impact on energy, water use, and emissions). 3. Use a short video clip showcasing a green building in India.Core Principles of Green Building Planning: a. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **b.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **4. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 16	Course Name: Green Building Infrastructure and Architecture Topic: Effective cooling and heating systems.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 17	Course Name: Green Building Infrastructure and Architecture Topic: Natural building design consideration	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand key natural design considerations for green buildings. b. Explore how natural elements like light, ventilation, and landscaping contribute to sustainability. c. Learn about passive design strategies that reduce reliance on artificial systems. d. Analyze case studies of green buildings that effectively integrate natural design principles.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. How do natural elements like sunlight and wind impact building design? b. Why might green buildings rely more on natural systems than conventional ones? c. Explain the concept of natural design: using environmental factors (light, ventilation, landscaping) to enhance building performance. d. Emphasize that these strategies reduce energy consumption and improve occupant comfort.? e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Building Orientation and Site Planning: Position buildings to maximize natural light and solar heat gain in colder months. Orient windows and openings to capture prevailing winds for ventilation. Use landscaping to provide shade and reduce heat gain in warmer months. **Passive Solar Design:** ncorporate thermal mass materials (brick, concrete) to absorb and release heat. Design south-facing windows to capture winter sun while avoiding overheating in summer. b. Use shading devices (awnings, pergolas) to block excessive sunlight during summer.Passive Design Strategies: **Natural Ventilation**:

	Utilize cross-ventilation by placing openings on opposite sides of rooms. Integrate stack ventilation (airflow driven by temperature differences). Design ventilation shafts and wind catchers to funnel cool air into the building.. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 18	Course Name: Green Building Infrastructure and Architecture Topic: Energy in building design	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the significance of sustainable materials and resource management c. Identify environmental, economic, and social benefits of green buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - Why are green buildings necessary today? - Define green buildings? - Define energy efficiency? 2. **Development**(30minutes) - Introduce the concept energy efficient and environment friendly building. - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 19	Course Name: Green Building Infrastructure and Architecture Topic: perfect competition and pricing	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of perfect competition and how it applies to the green building sector. b. Explore how market forces determine the pricing of green buildings. c. Analyze challenges in achieving perfect competition within the green building industry. d. Discuss how competition affects the adoption of green building materials and technologies..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) **a.** Start with engaging questions to prompt students' curiosity. a. What factors affect the price of green buildings? b. How might competition help lower the cost of sustainable construction? c. Briefly explain different market structures (perfect competition, monopolistic competition, oligopoly). d. Introduce perfect competition: a market where many sellers offer identical products, leading to price optimization. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** **a. Application of Perfect Competition to Green Building:** Many Participants: Multiple contractors and manufacturers of green materials. Standardized Products: Similar building materials and certifications (e.g., IGBC, LEED). Free Entry and Exit: Any new contractor can enter the market if they meet green building standards. **b. How Pricing Works in Perfect Competition:** Supply and Demand: The price of green materials or technologies falls when supply increases or demand decreases. No Pricing Power: Individual firms (builders) cannot influence the market price since materials and technologies are standardized.sustainable practices (e.g., IGBC, LEED certifications). **c. Challenges in Achieving Perfect Competition in Green Building:**

	High Entry Barriers: Initial costs of green certifications and technologies can prevent new entrants. Limited Consumer Awareness: Many buyers are not fully aware of the long-term savings from green buildings. Innovation and Differentiation: Builders may develop unique technologies, creating a more monopolistic competition. Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 20	Course Name: Green Building Infrastructure and Architecture Topic: Thermal phenomena & thermal comfort	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 21	Course Name: Green Building Infrastructure and Architecture Topic: Air quality, passive heating and cooling systems.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
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Lesson Plan No. 22	Course Name: Green Building Infrastructure and Architecture Topic: Energy Analysis- Active HVAC systems.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
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Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 23	Course Name: Green Building Infrastructure and Architecture Topic: Types of audit, energy flow diagram and consumption	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the different types of energy audits and their role in green building management. b. Learn how energy flow diagrams represent energy usage in buildings. c. Explore strategies for reducing energy consumption in green buildings. d. Analyze case studies on energy-efficient buildings and audit practices.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why is energy management important in green buildings? b. Have you heard of energy audits? What do you think they involve? c. Explain that energy audits are systematic evaluations of a building's energy use. d. Highlight that green buildings aim to reduce energy consumption by using efficient systems and monitoring energy flows. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** **a. Types of Energy Audits:** **Preliminary or Walk-Through Audit:** A quick assessment to identify obvious areas of energy savings. Involves minimal data collection (e.g., lighting, HVAC settings). **General Energy Audit:** A more detailed analysis with energy consumption trends and utility bills. Identifies cost-effective improvements and areas for optimization. **Investment-Grade Audit**: he most comprehensive audit, including detailed financial analysis of savings. Used for large-scale energy investments like solar panels or HVAC upgrades. **Energy Flow Diagram**

	A diagram that visualizes the flow of energy from input to output within a building. **Components of an Energy Flow Diagram:** Energy Sources: Electricity, natural gas, solar power, etc. Energy Systems: HVAC, lighting, water heating, appliances. Energy Losses: Heat losses, inefficient equipment, transmission losses. **Importance of Energy Flow Diagrams**: Helps in identifying inefficiencies and optimizing energy flows. Assists in creating energy-saving strategies through visualization.. **Exercise (5 minutes)** i. Divide students into small groups. ii. Provide each group with a sample energy flow diagram. iii. Groups analyze the diagram and identify areas for energy savings. **iv.** Groups present their findings to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 24	Course Name: Green Building Infrastructure and Architecture Topic: Identification of wastage -Priority of conservative measures.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the types of wastage (energy, water, material) in buildings. b. Learn methods to identify and measure wastage. c. Prioritize conservation measures based on impact, cost, and feasibility. d. Develop strategies to reduce wastage through efficient building practices.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. What kinds of resources are wasted in buildings? b. Why is it important to identify and reduce wastage? **2. Development (30 minutes)** **Energy Wastage:** Use of inefficient lighting (incandescent bulbs). Poorly insulated spaces leading to heat loss or excessive cooling. Appliances running on standby mode consuming "phantom energy.". **Water Wastage:** Leaks in pipes and faucets. Overuse of potable water for non-essential purposes (e.g., landscaping). Absence of rainwater harvesting systems. **Material Wastage**: Improper inventory management leading to excess materials. Lack of recycling or reusing construction waste. Impact: Measures that yield the greatest savings (e.g., LED lights, smart thermostats). Cost-Effectiveness: Low-cost solutions with high impact (e.g., fixing leaks, sealing windows). Ease of Implementation: Measures that require minimal disruption (e.g., adding insulation, using energy-efficient appliances). a. Long-Term Sustainability: Strategies that improve performance over time (e.g., rainwater harvesting, solar panels). **b.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies.

	3. Exercise (5 minutes) i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 25	Course Name: Green Building Infrastructure and Architecture Topic: Maintenance of Management Programme	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of maintenance management for sustainable operations. b. Learn strategies for effective management of energy, water, and waste systems. c. Explore digital tools and technologies used in green building maintenance (e.g., IoT, Building Management Systems - BMS). d. Analyze the role of preventive and predictive maintenance in ensuring resource efficiency..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Why is regular maintenance crucial in green buildings? b. What challenges do you think arise in managing green systems (like solar panels or HVAC)? **c.** Briefly introduce the importance of maintenance to prolong the benefits of green infrastructure (energy efficiency, water conservation, etc.). **2. Development (30 minutes)** **Core Components of Maintenance in Green Buildings:** Monitoring and maintaining solar panels, energy-efficient HVAC systems. Managing battery storage and demand-response systems. **Water Management:** Maintenance of rainwater harvesting units, greywater systems, and efficient plumbing fixtures. Ensuring no water leaks or malfunctions in irrigation systems.. **Material Wastage**: Improper inventory management leading to excess materials. Lack of recycling or reusing construction waste. Impact: Measures that yield the greatest savings (e.g., LED lights, smart thermostats). Cost-Effectiveness: Low-cost solutions with high impact (e.g., fixing leaks, sealing windows). Ease of Implementation: Measures that require minimal disruption (e.g., adding insulation, using energy-efficient appliances). a. Long-Term Sustainability: Strategies that improve performance over time (e.g., rainwater harvesting, solar panels).

	b. Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 26	Course Name: Green Building Infrastructure and Architecture Topic: Standards of energy efficiency in buildings	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the significance of sustainable materials and resource management c. Identify environmental, economic, and social benefits of green buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - Why are green buildings necessary today? - Define green buildings? - Define energy efficiency? 2. **Development**(30minutes) - Introduce the concept energy efficient and environment friendly building. - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 27	Course Name: Green Building Infrastructure and Architecture Topic: Trends in energy consumption	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the significance of sustainable materials and resource management c. Identify environmental, economic, and social benefits of green buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - Why are green buildings necessary today? - Define green buildings? - Define energy efficiency? 2. **Development**(30minutes) - Introduce the concept energy efficient and environment friendly building. - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 28	Course Name: Green Building Infrastructure and Architecture Topic: Efficiency measures in buildings.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the key principles of green building design and planning. b. Explore the significance of sustainable materials and resource management c. Identify environmental, economic, and social benefits of green buildings.
Teaching Aids (ifany)	b. Video https://sustainabilityworkshop.venturewell.org/buildings/building-orientation-bim.html.
Teaching Development	1. **Introduction**(5minutes) - Ask questions - Why are green buildings necessary today? - Define green buildings? - Define energy efficiency? 2. **Development**(30minutes) - Introduce the concept energy efficient and environment friendly building. - Graphically representation of orientation of buildings - Discuss the errors in planning the building. - Represent its type in action - Explain its importance 3. **Exercise**(5minutes)– • Divide students into small groups. • Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). • Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 29	Course Name: Green Building Infrastructure and Architecture Topic: Operating strategies.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand key operational strategies that enhance the sustainability of green buildings. b. Explore methods to optimize energy, water, and waste management systems during operations. c. Learn the role of digital technologies such as BMS (Building Management Systems) and IoT. d. Identify best practices for engaging building occupants to ensure operational efficiency.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. How do operational strategies impact a building's sustainability performance? b. Can efficient building operations help in achieving net-zero energy goals? **c.** Briefly introduce the significance of operations phase in a building's lifecycle, where systems are maintained and optimized for energy efficiency, comfort, and resource conservation. **d. Development (30 minutes)** **Energy Management:** Monitoring and optimizing solar, HVAC, and lighting systems. Use of demand response strategies to manage peak energy loads. **Water Wastage:** Leaks in pipes and faucets. Overuse of potable water for non-essential purposes (e.g., landscaping). Absence of rainwater harvesting systems. **Material Wastage**: Improper inventory management leading to excess materials. Lack of recycling or reusing construction waste. Impact: Measures that yield the greatest savings (e.g., LED lights, smart thermostats). Cost-Effectiveness: Low-cost solutions with high impact (e.g., fixing leaks, sealing windows). Ease of Implementation: Measures that require minimal disruption (e.g., adding insulation, using energy-efficient appliances).

	e. Long-Term Sustainability: Strategies that improve performance over time (e.g., rainwater harvesting, solar panels). **f.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **2. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 30	Course Name: Green Building Infrastructure and Architecture Topic Evaluation methods of energy savings	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Identify green building materials and technologies used in India. b. Understand the environmental, social, and economic benefits of sustainable materials. c. Analyze how these materials and equipment reduce the carbon footprint in construction. d. Propose ideas for using eco-friendly materials in real-world projects.
Teaching Aids (if any)	a. □ Smartboard/Projector for slides and case study videos. b. □ Samples of eco-friendly materials (bamboo, AAC blocks, fly ash bricks – optional). c. □ PDFs on green-certified projects in India (IGBC, LEED-certified). d. □ Quiz tools (Nearpod/Kahoot). □ Worksheet for group activities.
Teaching Development	1. **Introduction** (5 minutes) a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Why do you think green buildings are necessary today? Explain that green materials aim to reduce the environmental impact at all stages of a building's life cycle. 2. Traditional vs. Green Materials (impact on energy, water use, and emissions). 3. Use a short video clip showcasing a green building in India.Core Principles of Green Building Planning: a. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **b.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **4. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 31	Course Name: Green Building Infrastructure and Architecture Topic Optimum selection of energy sources.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Identify green building materials and technologies used in India. b. Understand the environmental, social, and economic benefits of sustainable materials. c. Analyze how these materials and equipment reduce the carbon footprint in construction. d. Propose ideas for using eco-friendly materials in real-world projects.
Teaching Aids (if any)	a. □ Smartboard/Projector for slides and case study videos. b. □ Samples of eco-friendly materials (bamboo, AAC blocks, fly ash bricks – optional). c. □ PDFs on green-certified projects in India (IGBC, LEED-certified). d. □ Quiz tools (Nearpod/Kahoot). □ Worksheet for group activities.
Teaching Development	1. **Introduction** (5 minutes) a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Why do you think green buildings are necessary today? Explain that green materials aim to reduce the environmental impact at all stages of a building's life cycle. 2. Traditional vs. Green Materials (impact on energy, water use, and emissions). 3. Use a short video clip showcasing a green building in India.Core Principles of Green Building Planning: a. Site Selection and Orientation □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **b.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **4. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 32	Course Name: Green Building Infrastructure and Architecture Topic: Air-to-air energy recovery.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 33	Course Name: Green Building Infrastructure and Architecture Topic: Introduction to automatic control systems	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept and purpose of automatic control systems in green buildings. b. Explore different types of automated systems (e.g., BMS, HVAC automation). c. Learn how automation contributes to energy efficiency and resource optimization. d. Analyze real-life examples of automated control systems in green buildings.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Have you seen automated systems in use, such as motion-sensor lighting? b. Why do you think automation is crucial for sustainable building operations? c. Briefly introduce the idea that automatic control systems monitor, manage, and optimize the operation of building resources, ensuring energy and water savings while maintaining occupant comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **HVAC Automation**: Use of sensors to regulate temperature, humidity, and air quality. Adaptive scheduling to optimize heating and cooling based on occupancy. **Lighting Control Systems**: Motion sensors and daylight harvesting systems to reduce unnecessary lighting. b. Dimming controls to maintain desired light levels. c. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat.

	Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **d.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 34	Course Name: Green Building Infrastructure and Architecture Topic: Control issues related to energy conservation	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Identify green building materials and technologies used in India. b. Understand the environmental, social, and economic benefits of sustainable materials. c. Analyze how these materials and equipment reduce the carbon footprint in construction. d. Propose ideas for using eco-friendly materials in real-world projects.
Teaching Aids (if any)	a. □ Smartboard/Projector for slides and case study videos. b. Samples of eco-friendly materials (bamboo, AAC blocks, fly ash bricks – optional). c. _ PDFs on green-certified projects in India (IGBC, LEED-certified). d. _ Quiz tools (Nearpod/Kahoot). _ Worksheet for group activities.
Teaching Development	1. **Introduction** (5 minutes) a. What conventional building materials are common in India? b. How do these materials impact the environment? c. Why do you think green buildings are necessary today? Explain that green materials aim to reduce the environmental impact at all stages of a building's life cycle. 2. Traditional vs. Green Materials (impact on energy, water use, and emissions). 3. Use a short video clip showcasing a green building in India.Core Principles of Green Building Planning: a. Site Selection and Orientation □ Emphasize minimizing environmental impact. _ Optimize building orientation to maximize natural light and ventilation. **b.** Energy Efficiency**.** _ Discuss renewable energy integration (e.g., solar panels). _ Introduce energy management systems and efficient HVAC technologies. **4. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 35	Course Name: Green Building Infrastructure and Architecture Topic: Interior air quality and thermal comfort in buildings	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 36	Course Name: Green Building Infrastructure and Architecture Topic: Classification of HVAC control system.	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling..
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

	Solar Water Heaters: Uses solar energy to heat water for space heating.). b. Passive Design Strategies: Passive Cooling: Use of shading devices, cross-ventilation, and cool roofs. Passive Heating: Use of thermal mass (concrete/brick) to store and release heat. Building Orientation: Position buildings to maximize natural light and heat gain in winter. □ Emphasize minimizing environmental impact. □ Optimize building orientation to maximize natural light and ventilation. **c.** Energy Efficiency**.** □ Discuss renewable energy integration (e.g., solar panels). □ Introduce energy management systems and efficient HVAC technologies. **3. Exercise (5 minutes)** i. Divide students into small groups. ii. Task: Propose a green building plan for a given site, focusing on one or more principles (site selection, energy efficiency, etc.). iii. Students present their ideas briefly to the class.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading http://www.digimat.in/nptel/courses/video/105105168/L20.html 3. Homework Research a local building project with green certification. Write a brief report highlighting the key sustainable strategies used Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions Why is green building planning important for future cities How can resource efficiency reduce the operational cost of buildings 2. Conduct a short online quiz using Nearpod. Spend 5 minutes to evaluate student assimilation of the lesson contents This lesson plan provides an engaging and interactive approach to teaching the principles of green building planning. You can adjust the timing or activities as per your class duration or requirements. Let me know if you need further customization!

Lesson Plan No. 37	Course Name: Green Building Infrastructure and Architecture Topic: Practical HVAC control system Designing and turning controllers	Course No.: CE-604

Objectives	At the end of the lesson the student shall be able to: a. Understand the importance of energy-efficient cooling and heating systems. b. Explore different types of sustainable cooling and heating technologies. c. Analyze the environmental, economic, and health benefits of effective systems. d. Learn about design strategies that reduce the need for mechanical heating and cooling.
Teaching Aids (if any)	**a. Projector/Smartboard for presentations and videos.** **b. Case studies or articles on successful market transformation in green building.** **c. Interactive quiz tools (Kahoot/Nearpod).** d. **Worksheets for group activities.**
Teaching Development	1. **Introduction** (5 minutes) a. Start with engaging questions to prompt students' curiosity. a. Why do buildings need efficient cooling and heating systems? b. What impact do conventional HVAC systems have on the environment?? c. Explain the role of heating, ventilation, and air conditioning (HVAC) systems in maintaining indoor comfort. d. Highlight the environmental challenges caused by traditional HVAC systems, including high energy consumption and carbon emissions.. e. Show a visual comparison between conventional and green buildings. **2. Development (30 minutes)** a. Key Types of Cooling and Heating Systems: **Energy-Efficient Cooling Systems**: Evaporative Cooling: Uses water to cool air, ideal for dry climates. Geothermal Cooling: Uses the earth's stable underground temperature to cool air. VRF (Variable Refrigerant Flow) Systems: Adjust refrigerant flow according to zone-specific cooling needs. Solar-Powered Air Conditioning: Uses photovoltaic (PV) panels to power cooling units. **Energy-Efficient Heating Systems**: Geothermal Heat Pumps: Use underground heat to warm buildings. Radiant Floor Heating: Transfers heat directly through floors. Heat Recovery Ventilation (HRV): Recaptures heat from exhaust air to preheat fresh air.

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