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| Course Code: | **Subject Title: Green Buildings** |

# Course Objectives:

1. This course aims to highlight importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. To familiarize students with the concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. To give a fuller understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. To highlight the importance of Environmental Management as well as Environmental Impact Assessment methods in Energy efficient buildings.

**UNIT I :**

Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design**.**

**UNIT II:**

Renewable Energy sources that can be used in Green Buildings – Conventional and Non Conventional Energy, Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Rainwater Harvesting Climate and Energy, Macro and Microclimate. Indian Examples.

**UNIT III:**

Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, rouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material.

**UNIT IV:**

Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modelling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water.

**UNIT V:**

Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED, GRIHA & IGBC Certification for buildings. Ecohomes, Sustainable architecture and urban design – principles of environmental architecture, Benefits of green buildings – Energy Conservation Building code - NBC -Case Studies – Green Buildings in Auroville and Dakshina Chitra, Tamil Nadu, India

TEXT BOOKS:

1. William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc Indian Green Building Council

REFERENCE BOOKS:

1. Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.
2. Sim Van Der Ryn, Stuart Cowan, “Ecological Design”, Island Press (1996).
3. Dianna Lopez Barnett, William D. Browning,”A Primer on Sustainable Building”, Rocky Mountain Green Development Services.
4. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, John Wiley.
5. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc
6. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons
7. Ben Farmer & Hentie Louw., Companion to Contemporary Architectural Thought, London & New York: Routledge
8. Peter Noever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

**Micro Syllabus of Green Buildings**

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| **Unit-I:** Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design. | | | |
| **Unit** | **Module** | **Micro content** | |
| Introduction to green buildings | Introduction to green buildings | Green Buildings within the Indian Context | |
| Green building and its relevance | |
| Green Building Rating Systems in India | |
| Types of Energy | |
| Energy Efficiency and Pollution | |
| Better Buildings | |
| Reducing energy consumption | |
| Low energy design | |
| **Unit– II:**  Renewable Energy sources that can be used in Green Buildings – Conventional and Non Conventional Energy, Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Rainwater Harvesting, Climate and Energy, Macro and Microclimate. Indian Examples. | | | |
| **Unit** | **Module** | | **Micro content** |
| **II** | Renewable Energy sources that can be used in Green Buildings | | Conventional Energy |
| Non Conventional Energy |
| Solar Energy | | Passive Solar Heating |
| Passive Solar collection |
| A passive solar energy strategy |
| Wind and other renewable | | Photovoltaics |
| Solar Photovoltaic Systems |
| Types of Solar PV Generating System |
| Rainwater Harvesting | | Artificial ground water recharge |
| Roof top rainwater harvesting |
| Harvesting in limited rainfall areas |
| Rainwater harvesting for plotted/group housing developments |
| Climate and Energy | | Climate and Energy |
| Macro and Microclimate | | Site and Micro Climate |
| MACRO CLIMATE |
| MICRO CLIMATE |
| Micro Climate – Effect of local terrain and Buildings |
| IMPROVING MICRO CLIMATE THROUGH DESIGN |
| Factor affecting micro climate |
| **Unit-III:**  Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, rouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material. | | | |
| **Unit** | **Module** | | **Micro content** |
| **III** | Building Forms | | Building Form Development Plan |
| Building Form, Orientation and Shading |
| Envelope Optimization |
| Thermal Performance | | Enhancement of thermal performance of walls |
| Types of thermal insulation materials: |
| **Unit-IV:**  Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modelling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water. | | | |
| **Unit** | **Module** | | **Micro content** |
| **IV** | Infiltration and ventilation | | Infiltration |
| Passive Cooling Techniques |
| Lighting | | Lighting |
| Day lighting |
| Day lighting and Controls |
| Artificial Lighting |
| Lighting and Ventilation of Rooms |
| Rainwater Harvesting |
| Window design for natural ventilation |
| SKYLIGHT |
| **Unit-V:** Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED, GRIHA & IGBC Certification for buildings. Ecohomes, Sustainable architecture and urban design – principles of environmental architecture, Benefits of green buildings – Energy Conservation Building code - NBC -Case Studies – Green Buildings in Auroville and Dakshina Chitra, Tamil Nadu, India | | | |
| **Unit** | **Module** | | **Micro content** |
| **V** | Environmental assessment methods for buildings (LEED, BREEAM, HQE) | | LEED (Leadership in Energy and Environmental Design |
| BREEAM (Building Research Establishment Environmental Assessment) |
| Three primary rating systems for Green buildings in India | | Green Rating for Integrated Habitat Assessment (GRIHA) |
| Indian Green Building Council (IGBC) |
| Bureau of Energy Efficiency (BEE) |
| energy efficiency of a building | | energy efficiency of a building |
| energy efficiency in buildings importance |
| Determining a building’s energy performance Energy use indicators |
| Five Principles of an environmental architecture |
| The Energy Conservation Building Code |

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