

## **IV-Year-I Semester**

## **GREEN BUILDINGS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**Pre-requisite:** Basic knowledge of Building Components, Engineering Physics

### **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.

### **Syllabus**

**UNIT-I:** Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design. **(10 Hours)**

**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. **(14 Hours)**

**UNIT III:** Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material. **(12 Hours)**

**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. **(15 Hours)**

**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 **(13 Hours)**

### **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
8. Peter Noever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

### Online references:

- Sustainable Materials and Green Buildings: <https://archive.nptel.ac.in/courses/105/102/105102195/>
- Renewable Energy and Green Building Entrepreneurship: <https://www.coursera.org/learn/renewable-energy-entrepreneurship>
- Indian Green Building Council (Certification course): <https://igbc.in/igbc/redirectHtml.htm?redVal=showGreenEducationRatingsystemNosignin>

### Course Outcomes:

*The students will be able to*

- CO1: Understand why buildings should be made energy efficient.
- CO2: Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, Photovoltaics, and Ground source heat pumps, and their adaption to green building concepts.
- CO3: Understand the concepts of Site and Climate, Building Form, Building Fabric
- CO4: Understand the concepts of Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
- CO5: Have the necessary skills to undertake an Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies too.

### BL – Bloom's Taxonomy Levels

1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating

### Micro-Syllabus of Strength of Materials-I

<b>Unit-I: Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design. (10 Hours)</b>		
<b>Unit</b>	<b>Module</b>	<b>Micro content</b>
<b>I</b>	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. **(14 Hours)**

Unit	Module	Micro content
<b>II</b>	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 Micro Climate	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, grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material. **(12 Hours)**

Unit	Module	Micro content
<b>III</b>	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.

**(15 Hours)**

Unit	Module	Micro content
IV	Infiltration and ventilation	Infiltration
		Passive Cooling Techniques
	Lighting	Lighting
		Day lighting
		Day lighting and Controls
		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 **(13 Hours)**

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

### Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>C01</b>	2					1	3		2	1		
<b>C02</b>	2					1	3		2	1		1
<b>C03</b>	2		3				3		2	1		2
<b>C04</b>	2		3			2	3		2	1		2
<b>C05</b>	2					1	3		2	1		1

\*\*\*\*\*