

Master of Architecture
(Energy Efficient and Sustainable Architecture)

CURRICULUM
(Effective from 2026-27 Onwards)



DEPARTMENT OF ARCHITECTURE
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015, INDIA



VISION OF THE INSTITUTE

- To be a university globally trusted for technical excellence where learning and research integrate to sustain society and industry.

MISSION OF THE INSTITUTE

- To offer undergraduate, postgraduate, doctoral and modular programmes in multi-disciplinary / inter-disciplinary and emerging areas.
- To create a converging learning environment to serve a dynamically evolving society.
- To promote innovation for sustainable solutions by forging global collaborations with academia and industry in cutting-edge research.
- To be an intellectual ecosystem where human capabilities can develop holistically.

VISION OF THE DEPARTMENT

- To create a world class learning environment to meet the challenges of built environment

MISSION OF THE DEPARTMENT

- Create professionally competent and socially responsible architects with human values
- Enhance knowledge and skill through academic, research and application
- Serve the society through meaningful interactions



PROGRAM EDUCATIONAL OBJECTIVES (PEO)	
PEO 1	To develop competent architectural professionals, researchers, and academicians in the energy-efficient and sustainable architecture domain, capable of addressing complex-built environment challenges.
PEO 2	To demonstrate technical proficiency in energy efficient and sustainable architecture domain.
PEO 3	To exhibit ethical professional conduct, effective interdisciplinary collaboration, and a commitment to lifelong learning, enabling adaptation to emerging technologies, policies, and societal needs in architecture.

PROGRAM OUTCOMES (POs)

1. PO1: An ability to independently formulate research questions, apply appropriate research methodologies, analyse architectural data, and develop validated design or technological solutions addressing complex built environment challenges.
2. PO2: An ability to prepare, document, and present comprehensive architectural design and research reports conforming to professional, technical, and academic norms
3. PO3: An ability to apply advanced knowledge in the chosen area of architectural specialisation to develop innovative, sustainable, and technically sound solutions compliant with regulatory and professional standards.



CURRICULAR COMPONENTS

Category	Credits Offered
Core Courses	24
Elective Courses	12
Studio	12
Internship	02
Open Elective (OE)	06
Project Work	24
Total	80



CURRICULLUM STRUCTURE
M.PLAN (Urban Planning)

Components	Number of Courses	Credits	Total Credits
Program Core (PC)	4 / Semester (8 in 1 st year)	24	36
Program Electives (PE)	2 / Semester (4 in 1 st year)	12	
Essential Studio Requirements (ESR)	1 / Semester (2 in 1 st year)	12	12
Internship/Industrial Training/Academic Attachment (I/A)	1	2	2
Open Elective (OE)/ Online Course (OC) #	2	6	6
Project Work Phase-I	1	12	12
Project Work Phase-II	1	12	12
Total	19	80	80

OPEN ELECTIVES (OE) / ONLINE COURSE (OC) (Compulsory): Students must complete 6 credits between I and IV semester either through online courses of their choice from NPTEL / Swayam (discipline electives / other electives) or through open electives offered by the PG programmes of the institute other than the programme specialization.

**SEMESTER 1**

S. No	Code	Course of Study	L	T	S	C	Category
1	AR701	Building Science & Sustainability	3	0	0	3	PC
2	AR703	Solar Passive Architecture	3	0	0	3	PC
3	AR705	Assessment of Built Environment	3	0	0	3	PC
4	AR707	Architectural Lighting Design	3	0	0	3	PC
5	AR709	Modelling Building Energy Performance	0	0	6	6	ESR
6		Program Elective I	3	0	0	3	PE
7		Program Elective II	3	0	0	3	PE
		Total	18	0	6	24	

SEMESTER 2

S. No	Code	Course of Study	L	T	S	C	Category
1	AR702	Building Energy Audit & Management	3	0	0	3	PC
2	AR704	Green Buildings and Ratings	3	0	0	3	PC
3	AR706	Ventilation, Air Conditioning, and IAQ	3	0	0	3	PC
4	AR708	Energy Efficient Landscape Design	3	0	0	3	PC
5	AR710	Energy Efficient and Sustainable Building Design Studio	0	0	6	6	ESR
6		Program Elective III	3	0	0	3	PE
7		Program Elective IV	3	0	0	3	PE
		Total	18	0	6	24	

SUMMER TERM (Evaluation in the III semester)

S. No	Code	Course of Study	Credits
1	AR745	Internship / Industrial Training / Academic Attachment (I/A)	02

SEMESTER 3

S. No	Code	Course of Study	Credits
1	AR747	Project Work (Phase I)	12

SEMESTER 4

S. No	Code	Course of Study	Credits
1	AR748	Project Work (Phase II)	12

OPEN ELECTIVES

(Open Elective (OE) / Online Course (OC) can be completed between I – IV semester)

S. No	Code	Course of Study	Credits
1		Open elective I / Online Course	03
2		Open elective II / Online Course	03

Note: L – Lecture; T- Tutorial; S - Studio; C - Credit

**PROGRAM ELECTIVES**

S. No	Course Code	Course Name	C
1.	AR711	Advanced Architectural Acoustics	3
2.	AR712	Advanced Architectural Lighting	3
3.	AR713	Contemporary Theories of Architecture	3
4.	AR714	Economic Environmental Resources and Statistics	3
5.	AR715	Environmental Impact Assessment	3
6.	AR716	Environmental Lighting	3
7.	AR717	Environment and Sustainable Behaviour	3
8.	AR718	High Performance Facades	3
9.	AR719	Human Ecology and Building Biology	3
10.	AR720	Intelligent Buildings	3
11.	AR721	Life Cycle Analysis	3
12.	AR722	Net Zero and Carbon Neutral Buildings	3
13.	AR723	Post-Occupancy Evaluation of Buildings	3
14.	AR724	Research Methods	3
15.	AR725	Smart Cities	3
16.	AR726	South Indian Temple Architecture	3
17.	AR727	Sustainable Materials and Techniques	3
18.	AR728	Theory and Principles of Thermal Comfort	3
19.	AR729	Urban Environment	3
20.	AR730	Urban Microclimate	3
21.	AR731	Urban Sustainability and Place Making	3

OPEN ELECTIVES (OE) (Courses from Programme Electives, that will be Open Electives for other PG Specialization, if it is offered as Programme Elective for the respective specialization)

S. No	Course Code	Course Name	C
1.	AR714	Economic Environmental Resources and Statistics	3
2.	AR729	Urban Environment	3
3.	AR730	Urban Microclimate	3
4.	AR731	Urban Sustainability and Place Making	3



PROGRAM CORE

SEMESTER – 1

AR701	BUILDING SCIENCE AND SUSTAINABILITY	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Apply thermodynamics to interpret and quantify building energy behaviour
CLO2	Examine heat, air, and moisture interactions within building envelopes and assemblies
CLO3	Evaluate material performance in thermal, acoustic, and hygrothermal terms, including bio-based systems
CLO4	Translate building physics understanding into informed design decisions across scales

COURSE CONTENT

Introduction to Building science as a multidisciplinary domain - Scales of analysis: material, component, building, and urban systems- Climate, weather, and locational context - Systems thinking in buildings: energy, water, and environmental cycles - Comfort, human well-being, and biophilic considerations - Sustainability principles and environmental performance frameworks

Laws of thermodynamics and energy conservation - Heat transfer mechanisms: conduction, convection, radiation - Steady-state and dynamic heat flow in building envelopes - Psychrometrics - Thermal comfort and environmental conditioning - Energy demand, internal and external heat gains - Solar gains, shading strategies, and envelope transparency

Building as an integrated system - Heat, air, and moisture transport mechanisms - Thermal bridges, air leakage, - Moisture buffering, vapour diffusion, Envelope continuity and detailing (walls, roofs, windows) - Indoor air quality and moisture control - Natural ventilation -stack effect, cross ventilation, solar chimneys - Performance metrics: U-values, thermal resistance, airtightness

Thermal, acoustic, and hygrothermal properties of materials - Material parameters: conductivity, diffusivity, density, porosity - Bio-based materials: fibres, composites, and agricultural by-products - Moisture buffering capacity and indoor humidity stabilisation - Phase change materials (PCM) and thermal energy storage - Trade-offs between thermal, acoustic, and durability performance

Building Envelope performance - energy, airflow, and daylight - Performance metrics - energy use, carbon, and comfort indices - Lifecycle assessment and embodied energy considerations - Sustainability rating systems and policy frameworks - Case studies: high-performance and climate-responsive buildings



LEARNING RESOURCES & REFERENCES

1. Hens, H. (2017). Building physics – Heat, air and moisture: Fundamentals and engineering methods. Wiley.
2. Handbook of energy efficiency in buildings: A life cycle approach. (2018). Elsevier, Netherlands.
3. Kwok, A. G., & Grondzik, W. T. (2018). The green studio handbook. Routledge.
4. Straube, J. F., & Burnett, E. F. P. (2005). Building science for building enclosures. Building Science Press, United States.
5. Szokolay, S. V. (2014). Introduction to architectural science: The basis of sustainable design. Routledge.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply thermodynamics to understand building energy behaviour.
CO2	Analyse heat, air, and moisture flow in building envelopes.
CO3	Evaluate material performance in thermal, acoustic, and moisture aspects.
CO4	Use building physics knowledge to support design decisions.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	3	2
CO2	2	3	1
CO3	1	2	3
CO4	3	2	1



AR 703	SOLAR PASSIVE ARCHITECTURE	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the principles of solar geometry and its application in architectural design.
CLO2	Analyse climate data and site conditions to formulate passive solar design strategies.
CLO3	Apply thermal mass, insulation, and shading techniques to optimize building performance.
CLO4	Design and evaluate passive solar heating and cooling systems in buildings.
CLO5	Integrate Building Energy Simulation (BES) tools for performance-based design.
CLO6	Develop awareness of green building standards and sustainable construction practices.

COURSE CONTENT

Earth-Sun relationship, Components of solar radiation, fundamentals for passive design, Topography and microclimate influences on solar access, Urban heat island effect and its mitigation, Wind rose analysis and prevailing wind patterns, Obstruction analysis and solar access rights, Site selection criteria for passive solar design.

Modes of heat transfer, Definition and role of thermal mass in passive design, Materials: concrete, brick, rammed earth, adobe, stone — comparative analysis, Trombe wall: principles, proportions, and performance, Phase Change Materials (PCMs), Types of insulation.

Principles of Passive Cooling, Heat avoidance vs. heat dissipation strategies, Shading Design and Solar Control, Horizontal overhangs: design methodology using sun-path geometry, Vertical fins: effective azimuth range and dimensions, Vegetation as shading: tree strategy and canopy modelling, Evaporative Cooling Systems, Earth-Coupled Cooling, Roof-Level Passive Cooling, Green roof thermal performance in tropical climates.

Direct Gain Systems, Principles of direct gain: south-facing glazing and thermal storage, Thermal curtains and movable insulation — night-time heat retention, Indirect Gain Systems Performance evaluation: Solar Savings Fraction (SSF), Sunspaces and Solar Greenhouses, Thermal Comfort in Passive Heating Design, ASHRAE Standard 55 and ISO 7730 — adaptive comfort model, Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD), Operative temperature and mean radiant temperature in heated spaces, Case studies: hill station residences, cold climate vernacular architecture. Building Energy Simulation (BES), Overview of BES tools: Energy Plus, Design Builder, IDA ICE, e QUEST, Climate file formats: EPW, TMY3, IWEC — sourcing and usage, Solar Analysis and Daylight Simulation, Daylight factor (DF), Useful Daylight Illuminance (UDI), and sDA / ASE metrics, Green Building Rating Systems, Net Zero Energy Buildings (NZEB): definition, targets, and road map, Energy Codes and Standards, Embodied



energy vs. operational energy: lifecycle perspective, Carbon footprint assessment of building materials and systems, Integrated Passive Solar Design Process, Climate-based design strategies matrix.

LEARNING RESOURCES & REFERENCES

1. Balcomb, J. D. (Ed.). (1992). Passive solar buildings. MIT Press, Cambridge, Massachusetts.
2. Brown, G. Z., & DeKay, M. (2001). Sun, wind & light: Architectural design strategies (2nd ed.). John Wiley & Sons, New York.
3. Kachkouch, W., Outzourhit, A., & Obbadi, A. (2018). Passive cooling techniques for buildings in hot arid climates. Energy and Buildings, 158, 1–18.
4. Lechner, N. (2014). Heating, cooling, lighting: Sustainable design methods for architects (4th ed.). John Wiley & Sons, New Jersey.
5. Santamouris, M., & Assimakopoulos, D. (Eds.). (1996). Passive cooling of buildings. James & James, London.
6. Szokolay, S. V. (2008). Introduction to architectural science: The basis of sustainable design (2nd ed.). Architectural Press / Elsevier, Oxford.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Demonstrate understanding of solar geometry, climate data analysis, and site-specific passive design potential.
CO2	Design building envelopes with appropriate thermal mass, insulation, and solar control measures.
CO3	Evaluate and apply passive solar heating and cooling strategies suitable to different climate zones.
CO4	Utilize energy simulation software to predict and optimize building energy performance.
CO5	Integrate green building frameworks and lifecycle principles into sustainable architectural design.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	2	3
CO2	2	3	3
CO3	3	2	3
CO4	3	3	2
CO5	2	3	3



AR705	ASSESSMENT OF BUILT ENVIRONMENT	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the evolution of Building Performance Evaluation (BPE), including post-occupancy evaluation approaches and the various methods used in performance assessment.
CLO2	Develop an understanding of performance evaluation across different phases of the building life cycle, from planning and design to occupancy and adaptive reuse.
CLO3	Investigate the methods, techniques, and tools used for assessing building performance, environmental response, and the impact of built form.
CLO4	Evaluate sustainability, energy efficiency, and user satisfaction in buildings through case studies and performance assessment frameworks.

COURSE CONTENT

Evolution and conceptual framework of building performance evaluation. Methods and phases of assessing building performance – strategic planning effectiveness review, program review, design review, construction commissioning, post occupancy evaluation, adaptive reuse/recycling market/needs assessment.

Bench marking the sustainability of a building project. Case studies of assessing the performance of buildings. Human elements in building performance evaluation. Tools for performance evaluation.

LEARNING RESOURCES & REFERENCES

1. Buff, K. (Ed.). (2003). Energy & high-performance facility source book. Fairmont Press, Lilburn.
2. Lacasse, M. A., & Parker, D. (Eds.). (2018). Building performance evaluation: From delivery process to life cycle phases. ASTM International.
3. Preiser, W. F. E. (1989). Building evaluation. Springer.
4. Preiser, W. F. E., & Vischer, J. C. (2004). Assessing building performance. Elsevier Limited, London.
5. Santamouris, M. (2005). Energy performance of residential buildings. James & James, London.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyse and synthesize the fundamentals of Building Performance Evaluation (BPE) and building science to understand the relationship between buildings and the environment in the local context.
CO2	Critically evaluate the role and application of Building Performance Evaluation in real-world environmental and energy-efficient design practices.
CO3	Apply appropriate building energy performance evaluation methods, techniques, and tools for assessing building efficiency and environmental response.
CO4	Evaluate and interpret building performance data to determine the energy and functional performance of buildings.
CO5	Recommend suitable methods and tools to assess building performance, identify potential building-related issues, and propose appropriate improvement strategies.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	3	2
CO5	3	2	3



AR707	ARCHITECTURAL LIGHTING DESIGN	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To understand different daylighting concepts, daylighting analysis and design.
CLO2	To know the Artificial lighting design methods.
CLO3	To be knowledgeable about the lighting requirements of building typologies and the lighting design process
CLO4	To carry out the lighting design of buildings through simulation.

COURSE CONTENT

Fundamentals of light: Electromagnetic spectrum. Visual response, visual acuity, Glare & visual comfort. Colour perception, Visual Task Requirements. Principles of good lighting. Lighting requirements of different building typologies.

Day Lighting: Need for daylight, Daylight factor, Dynamic daylighting metrics. Daylighting principles. Side lighting concepts, Top lighting concepts. Designing Atria / Light Courts. Daylighting and Building design elements: Impact of Building form and orientation, fenestration – location and geometry, external obstructions, etc. Daylight Controls. Daylighting Analysis, Daylighting Design.

Electrical light sources. Luminaires – Design aspects and light distribution. Task requirements. Lighting Design: Lumen method and point-by-point method. Qualitative aspects calculations. Night-time exterior and building façade lighting. Supplementary Artificial Lighting.

LEARNING RESOURCES & REFERENCES

1. Evans, B. (1981). Daylight in architecture. McGraw-Hill Book Co., New York.
2. Karlen, M., & Benya, J. (2017). Lighting design basics (3rd ed.). John Wiley & Sons.
3. Mills, S. (2018). Fundamentals of architectural lighting (1st ed.). Routledge.
4. Pritchard, D. C. (1995). Lighting. Longman Scientific & Technical, Harlow.
5. Schiler, M. (1992). Simplified design of building lighting. John Wiley & Sons, Inc., New York.
6. Tregenza, P., & Loe, D. (1998). The design of lighting. E & FN Spon, London.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Assessment of daylighting availability in existing buildings (Analysis)
CO2	Design of fenestration for daylighting of interior spaces
CO3	Artificial lighting design for the interior spaces of different types of buildings
CO4	Integration of daylighting and artificial lighting – Permanent Supplementary Artificial Lighting Design

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	2	2
CO2	1	3	3
CO3	1	3	3
CO4	2	3	3



AR709	MODELLING BUILDING ENERGY PERFORMANCE	L	T	S	C
		0	0	6	6

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Interpret energy consumption patterns in buildings with reference to climate, envelope, and systems
CLO2	Analyse various building systems like HVAC and their interaction with building energy design
CLO3	Estimate peak and annual energy demand through analytical and simulation methods
CLO4	Evaluate building performance using benchmarks, codes, and statistical models

COURSE CONTENT

Exploring Climate and Building Energy Systems: Energy Flow and Heat Transfer Analysis, Climatic Data for Building Performance Analysis, Weather Data Analysis - Typical Meteorological Year (TMY) and Actual Meteorological Year (AMY), Solar Geometry and Shading Analysis, Wind Patterns and Microclimate analysis, Psychrometric Analysis for Thermal Comfort.

Appraising Building Systems and Energy Use: Internal Loads and Heat Gain Assessment, Peak Heating and Cooling Load Calculation, Annual Energy Estimation, Envelope, Internal Loads, and HVAC Interaction, Lighting Loads and Thermal Implications, System Selection and Integration, Energy Use Intensity (EUI) Concepts and Calculation.

Modelling Building Energy and Environment: Energy Consumption in Buildings, Familiarisation with simulation platforms (Energy Plus / Open Studio interface), Modelling Parameters and Input Data, Material properties (thermal conductivity, U-value), Schedules (occupancy, lighting, equipment use), Internal gains (people, lighting, plug loads - Understanding modelling workflow: input, simulation, output, - Navigation of software environment and basic tools.

Simulating Building Energy and Environment Performance: Building Performance Modelling (BPM), Creation of building geometry, Export and integration with simulation software, simulation types: energy, daylight, thermal comfort, understanding modelling as an iterative design process, Simplified (shoebox) models for early-stage analysis, Detailed model with input parameters, Calculation of EUI from simulated data.

Compliance with Energy Standards and performance benchmarks: Development of multiple scenarios (baseline vs improved design), Parametric variation of inputs (envelope, loads, systems) and evaluation of its impact on EUI and Thermal Comfort. Energy codes and standards: ASHRAE 90.1, ECBC, LEED frameworks- compliance and performance benchmarks, Compare EUI with benchmark values and identify performance gaps, linking simulation outputs with real-world validation, Statistical analysis and model calibration.



LEARNING RESOURCES & REFERENCES

1. ANSI/ASHRAE/IES. (2022). Standard 90.1: Energy standard for buildings except low-rise residential buildings. ASHRAE.
2. Garg, V., Mathur, J., & Bhatia, A. (2020). Building energy simulation: A workbook using DesignBuilder (2nd ed.). CRC Press.
3. Lechner, N. (2021). Heating, cooling, lighting: Sustainable design methods for architects (5th ed.). Wiley.
4. Szokolay, S. V. (2021). Introduction to architectural science: The basis of sustainable design (4th ed.). Routledge.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply building energy concepts to analyse energy consumption patterns.
CO2	Examine the interaction between building systems and energy design
CO3	Estimate building energy demand using analytical and simulation methods.
CO4	Evaluate building performance using standards, benchmarks, and statistical tools.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	3	1
CO2	1	3	2
CO3	1	2	3
CO4	3	2	1



SEMESTER – 2

AR702	BUILDING ENERGY AUDIT AND MANAGEMENT	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the principles of energy consumption, energy management, and the significance of energy conservation in buildings within the Indian context.
CLO2	Develop knowledge of historical and diagnostic energy audit methodologies, including the use of instrumentation and data collection techniques.
CLO3	Examine energy management strategies, organizational frameworks, monitoring systems, and tools used for evaluating building energy performance.
CLO4	Investigate opportunities for reducing building energy consumption through improvements in building fabric, services, systems, and operational practices.

COURSE CONTENT

An overview of energy consumption and its effects. Current energy consumption scenario in India. Need to reduce emissions. Aims and main aspects of energy management of buildings. Benefits and methodology for conducting the historical Energy audit. Objectives & benefits of conducting a Diagnostic Energy Audit. Instrumentation.

Energy management matrix as a tool to diagnose the current state of energy management in any given organization. Management issues in the matrix – energy policy, organization, motivation, information systems, Marketing & investment. Determining the organizational profile. Monitoring & targeting of energy use.

Identification of Opportunities for reducing energy Consumption – Improvements to the building fabric & building services.

Details of building energy survey – building information, building physical data, building envelope construction details, mechanical systems, electrical systems & equipment, hot water systems, indoor environmental conditions for each space, control systems and operating schedules.

Energy use profile, maintenance schedule, and special energy conservation features observed. Energy conservation program. Comment & suggestions to improve energy savings. Tables of energy costs - comparative analysis, energy usage in MJ - comparative analysis and summary sheet – total energy cost & consumption.



LEARNING RESOURCES & REFERENCES

1. O'Callaghan, P. W. (1980). Buildings for energy conservation. Pergamon Press, London.
2. Moss, J. K. (1996). Energy management and operating costs in buildings. E & FN Spon, London.
3. Levermore, G. (2000). Building energy management systems. E & FN Spon, London.
4. Krarti, M. (2000). Energy audit of building systems: An engineering approach. CRC Press LLC, Florida.
5. Thulmann, A., & Younger, W. J. (2003). Handbook of energy audits. The Fairmont Press.
6. Turner, W. C., & Doty, S. (2020). Energy management handbook (9th ed.). The Fairmont Press, Inc.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyse building energy consumption patterns and apply various energy auditing methods for evaluating building energy performance.
CO2	Evaluate the tools, techniques, and management systems used for energy management in the building sector.
CO3	Assess energy management strategies and identify opportunities for reducing energy consumption through efficient building design and operational practices.
CO4	Conduct and evaluate building energy surveys by analysing building systems, energy use patterns, and environmental performance.
CO5	Recommend appropriate methods, tools, and energy conservation measures to improve energy efficiency and reduce energy consumption in buildings.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	3	2
CO5	3	2	3



AR704	GREEN BUILDINGS AND RATINGS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To introduce green building principles and sustainability concepts.
CLO2	To understand sustainable planning and resource-efficient design strategies.
CLO3	To study energy, water, waste, materials, and life-cycle performance in buildings.
CLO4	To familiarize students with green building standards and rating systems.

COURSE CONTENT

Definition of Green Building. Impact of design, construction & maintenance of buildings on the environment and natural resources. Benefits of building green.

Green Building Concepts - Sustainable site planning, Building design optimization, Energy performance optimization, Renewable energy utilization, Water and waste management, Solid waste management, Sustainable building materials and construction technology, Health, well-being and environmental quality. Life-cycle costing of the building and its components, including economic & environmental impacts and performance.

Building standards and codes. Introduction to international rating systems. Green building rating systems in India: GRIHA (Green Rating for Integrated Habitat Assessment, IGBC (Indian Green Building Council), LEED India (Leadership in Energy and Environmental Design), GEM Green Building Certification, etc.

LEARNING RESOURCES & REFERENCES

1. Ching, F. D. K., & Shapiro, I. M. (2020). Green building illustrated (2nd ed.). John Wiley & Sons.
2. Farmer, J., and Richardson, K. (1999). Green shift: Changing attitudes in architecture to the natural world. Architectural Press.
3. Kibert, C. J. (2016). Sustainable construction: Green building design and delivery (4th ed.). John Wiley & Sons.
4. Stitt, F. A. (1999). The ecological design handbook. McGraw-Hill.
5. The European Commission. (1999). A green Vitruvius: Principles and practices of sustainable architectural design. James & James.
6. Wines, J., & Jodidio, P. (2000). Green architecture: The art of architecture in the age of ecology. Taschen.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyze the environmental impacts of buildings and construction practices.
CO2	Apply green building concepts in sustainable design development.
CO3	Evaluate building performance through resource-efficient strategies.
CO4	Assess buildings using national and international rating systems.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	2
CO2	2	1	3
CO3	3	2	3
CO4	2	3	2



AR706	VENTILATION, AIR CONDITIONING, AND IAQ	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To understand principles of ventilation, air conditioning, and indoor air quality for healthy and energy-efficient buildings.
CLO2	To analyse system design, heat loads, and airflow for occupant comfort and environmental quality.
CLO3	To evaluate standards, codes, and guidelines related to IAQ, ventilation, HVAC, and fire safety
CLO4	To develop integrated building service strategies ensuring health, hygiene, safety, and sustainability.

COURSE CONTENT

Fundamentals of ventilation, natural ventilation principles, airflow mechanisms, stack effect and wind-driven ventilation; Mechanical ventilation systems, exhaust and supply systems, air changes per hour, ventilation effectiveness and performance.

Indoor Air Quality (IAQ), sources of indoor pollutants, particulate matter, VOCs, CO₂ levels, Sick Building Syndrome and Building Related Illness; Thermal comfort parameters, temperature, humidity, air velocity, adaptive comfort models and standards.

Air conditioning systems, classification and types, central and unitary systems, refrigeration cycle, heat load estimation, cooling and heating load calculations; HVAC system components, fans, ducts, filters, coils, diffusers, dampers and controls; Air distribution design, duct sizing, airflow patterns, energy-efficient HVAC strategies and passive cooling integration; Heating systems, basic principles, equipment and energy considerations; Fire safety fundamentals, fire dynamics, detection systems, smoke management, suppression systems and integration with HVAC.

Health and hygiene in buildings, crowding and occupancy density management, sanitation, waste removal, pest control, and maintenance practices; Standards and codes, IAQ guidelines, ventilation regulations, thermal comfort standards, fire safety codes, sustainable and healthy building practices.

LEARNING RESOURCES & REFERENCES

1. Allen, J. G., & Macomber, J. D. (2020). Healthy buildings: How indoor spaces drive performance and productivity. Harvard University Press.
2. Atkinson, J., Chartier, Y., Pessoa-Silva, C. L., Jensen, P., Li, Y., & Seto, W. H. (Eds.). (2009). Natural ventilation for infection control in health-care settings. WHO, Geneva.
3. Burroughs, H. E., & Hansen, S. J. (2020). Managing indoor air quality (5th ed.). River Publishers. <https://doi.org/10.1201/9781003151654>
4. Bureau of Indian Standards. (2026). SP 7: National building construction standards, Part 3, 4, and 8. BIS, India.
5. Heinsohn, R. J., & Cimbala, J. M. (2003). Indoor air quality engineering: Environmental health and control of indoor pollutants (1st ed.). CRC Press.



6. ISHRAE. (2020). ISHRAE guidelines for ventilation, thermal comfort, and HVAC design. Indian Society of Heating, Refrigerating and Air Conditioning Engineers.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply principles of ventilation and air conditioning to design systems ensuring thermal comfort and indoor air quality.
CO2	Analyse and evaluate HVAC systems, heat loads, and airflow for energy-efficient building performance.
CO3	Assess IAQ issues, health risks, and implement standards and guidelines for healthy indoor environments.
CO4	Develop integrated building service solutions incorporating HVAC, fire safety, hygiene, and sustainability.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	0	3
CO2	3	2	3
CO3	2	2	3
CO4	3	3	3



AR 708	ENERGY EFFICIENT LANDSCAPE DESIGN	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Develop understanding of thermodynamic relationships between landscape elements and energy exchange in built environments.
CLO2	Equip students with the ability to analyse site-specific climatic data and translate it into evidence-based landscape design decisions.
CLO3	Introduce quantitative tools for energy simulation, carbon sequestration estimation, and urban heat island assessment.
CLO4	Enable students to evaluate and apply sustainable water management and soil-carbon strategies in landscape projects.
CLO5	Build proficiency in selecting climate-appropriate plant species and material palettes for passive energy optimisation.
CLO6	Foster an integrative design approach that aligns landscape, architecture, and urban systems for holistic sustainability.

COURSE CONTENT

Urban climate fundamentals: heat balance equations, sensible and latent heat fluxes , Urban Heat Island (UHI) phenomenon: causes, measurement, and mapping techniques, Role of vegetation, paving, water bodies, and topography in microclimate modification, Thermal comfort indices: PET, UTCI, SET - calculation and application in outdoor spaces, Solar radiation analysis: shading studies, sky view factor, and solar envelopes. Wind patterns at landscape scale: Venturi effect, wind corridors, and shelter belts, Boundary layer climatology: concepts and application to site design.

Evapotranspiration and its role in latent heat exchange and ambient cooling, Transpiration-based cooling: LAI (Leaf Area Index), canopy cover, and albedo of vegetation, Strategic tree placement for building shading: solar geometry and seasonal shadow analysis, Wind management through planting design, Climate-adaptive plant selection: drought-resistant, native, and low-maintenance species, Biomass and carbon sequestration potential in urban planting schemes, Phytoremediation and soil-microbiome interactions for site ecological health.

Water cycle fundamentals in the urban context: runoff, infiltration, and evaporation dynamics, Water Sensitive Urban Design (WSUD): principles, frameworks, and policy context, Bioswales, rain gardens, and constructed wetlands, Permeable surfaces and porous pavements: material performance and energy implications, Blue infrastructure: cooling effects of water bodies, fountains, and misting systems, Rainwater harvesting for landscape irrigation: tank sizing and first-flush calculations, Greywater recycling in landscape irrigation systems: filtration and safety standards, Aquifer recharge and groundwater management strategies in landscape design, Energy generation through micro-hydro and tidal landscape interventions.



Albedo and Solar Reflectance Index (SRI) of landscape materials, , Embodied carbon in landscape materials: Life Cycle Assessment (LCA) methodology, Urban heat sink vs. heat island: role of thermal mass, heat capacity, and surface emissivity, Recycled and low-carbon materials: reclaimed stone, recycled aggregates, and bio-composites, Sustainable soil management: organic matter, carbon sequestration, and biochar amendment Hardscape and softscape balance: impervious area calculations and ecological footprint, Lighting design for energy efficiency in landscapes: LED systems and solar-powered fixtures, Outdoor furniture and infrastructure: material life cycles and maintainability criteria.

Green Infrastructure (GI) definitions, typologies, and planning scales: patch, corridor, and matrix, Ecosystem services framework: provisioning, regulating, cultural, and supporting services, Biodiversity and habitat connectivity strategies in urban landscape design, Urban forest management: tree inventory, canopy cover targets, and ecosystem service valuation, Environmental Impact Assessment (EIA) for landscape projects: tools and legal requirements, Energy-conscious master planning: integrating landscape with net-zero building strategies, National and international policy frameworks: GRIHA, LEED Neighbourhood, SITES rating system, Smart Cities Mission (India), Climate change adaptation and resilience: flood-proofing, heat-proofing, and biodiverse design, Community participation and social equity in green infrastructure planning.

LEARNING RESOURCES & REFERENCES

1. Beatley, T. (2016). Handbook of biophilic city planning & design. Island Press, Washington, D.C.
2. Hough, M. (2004). Cities and natural process: A basis for sustainability (2nd ed.). Routledge, London.
3. Lenzholzer, S. (2015). The climate-responsive city: Principles and urban design guidelines. Springer, Dordrecht.
4. Oke, T. R., Mills, G., Christen, A., & Voogt, J. A. (2017). Urban climates. Cambridge University Press, Cambridge.
5. Sustainable Sites Initiative. (2014). SITES rating system for sustainable land design and development. GBCI, Washington, D.C.
6. Thompson, J. W., & Sorvig, K. (2018). Sustainable landscape construction: A guide to green building outdoors (3rd ed.). Island Press, Washington, D.C.
7. Van der Ryn, S., & Cowan, S. (2013). Ecological design (10th anniversary ed.). Island Press, Washington, D.C.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply advanced knowledge of environmental systems to architectural design.
CO2	Demonstrate proficiency in climate-responsive and sustainable design methodologies.
CO3	Integrate interdisciplinary knowledge in architecture, ecology, and engineering.
CO4	Communicate design intent through drawings, models, and analytical documentation.
CO5	Understand, integrate and evolve solutions at varying levels and scales.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	3	2
CO5	2	3	3



AR710	ENERGY EFFICIENT AND SUSTAINABLE BUILDING DESIGN STUDIO	L	T	S	C
		0	0	6	6

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Analyse energy demand and optimise building performance toward Net Zero Energy Buildings, including demand reduction, system optimisation, and renewable integration.
CLO2	Integrate Building Information Modelling workflows with energy simulation tools to address sustainability issues related to interoperability, abstraction, and data exchange.
CLO3	Examine the influence of urban microclimate, including Local Climate Zones and Urban Heat Island effects, on sustainable energy performance.
CLO4	Analyse city-scale energy demand using simplified sustainable modelling approaches, including archetype-based representation of building stock.

COURSE CONTENT

Energy Modelling and Calibration for High-Performance Buildings: Comparative simulation of base case, improved efficiency case, net zero scenario, and energy surplus configuration and grid interaction. Interpretation of annual energy balance and carbon implications. - passive load reduction versus active system optimisation - Renewable energy integration - modelling, system sizing, yield estimation.

BIM Integration and Sustainable Certification Frameworks: Preparation of BIM-linked energy models and preliminary certification scorecards based on simulated performance. BIM-enabled workflows for energy modelling (Revit to simulation engines) - Geometry translation, data loss, and simplification challenges - Integration with national and international (LEED, GRIHA, etc) frameworks - Mapping simulation outputs to certification credits - Parametric iteration to achieve sustainable compliance thresholds.

Modelling Urban Microclimate and Neighbourhood Energy Interactions: Neighbourhood-scale modelling examining temperature gradients, shading interactions, and their effect on building energy demand. Local Climate Zones (LCZ) - Urban Heat Island (UHI) - Surface energy balance - Outdoor thermal comfort indices - Coupling building energy models with microclimate simulations.

City-Scale Energy Modelling and Digital Twin Frameworks: Digital twin frameworks for cities: data integration, real-time monitoring, and simulation coupling. City energy balance modelling: supply, demand, storage, and distribution interactions Development of a simplified city-scale energy model using archetypes; construction of a conceptual digital twin linking building datasets, climate inputs, and energy flows; estimation of city-level energy balance under varying scenarios.

Climate Resilience, Resource Systems, and Future Scenarios: Simulation of future climate scenarios at building and city scale; evaluation of system robustness; comparison of resilience strategies under projected conditions. Climate resilience: extreme heat, variability, and stress conditions - Use of future climate files and scenario-based



simulation - Energy-water nexus and resource interdependencies - Infrastructure stress under peak demand conditions- Policy implications and urban sustainability indicators - Transition pathways towards low-carbon and climate-adaptive cities

LEARNING RESOURCES & REFERENCES

1. Attia, S. (2025). Net zero energy buildings (NZEB): Concepts, frameworks, and roadmap for project analysis and implementation. Butterworth-Heinemann, Netherlands.
2. Hensen, J. L. M., & Lamberts, R. (2012). Building performance simulation for design and operation. CRC Press, United Kingdom.
3. Lyu, Z. (2024). Handbook of digital twins. CRC Press.
4. Oke, T. R., Mills, G., Christen, A., & Voogt, J. A. (2017). Urban climates. Cambridge University Press.
5. Paolini, R., & Santamouris, M. (2022). Urban climate change and heat islands: Characterization, impacts, and mitigation. Elsevier, Netherlands.
6. Smith, D. K., & Tardif, M. (2012). Building information modeling: A strategic implementation guide for architects, engineers, constructors, and real estate asset managers. Wiley, Germany.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply strategies for optimising building energy performance towards Net Zero Energy Buildings.
CO2	Integrate BIM workflows with building energy simulation tools for sustainable design applications.
CO3	Examine the impact of urban microclimate on sustainable energy performance.
CO4	Analyse city-scale energy demand using simplified sustainable modelling approaches.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	3	2
CO2	2	3	1
CO3	3	1	2
CO4	2	1	3



PROGRAM ELECTIVE

AR711	ADVANCED ARCHITECTURAL ACOUSTICS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the fundamental principles of sound, vibration, and human hearing in relation to architectural acoustics.
CLO2	Analyse sound behaviour in enclosed spaces through concepts of absorption, reverberation, reflection, and diffusion.
CLO3	Evaluate acoustic performance and sound isolation strategies for buildings and urban environments.
CLO4	Apply acoustic design principles, simulation tools, and experimental methods to assess and improve built environments.

COURSE CONTENT

Fundamentals of Architectural Acoustics: Vibration, Frequency of Sound, Wavelength, Sound Spectrum, Velocity of Sound, Frequency, Sensitivity of Hearing, Inverse-Square Law, Common Sounds in Decibels, Noise Reduction with Distance.

Sound in Enclosed Spaces: Sound-Absorbing Treatment to Rooms, Sound Absorption Coefficient, Reverberation, Relative Efficiency of Sound Absorbers, Noise Reduction Coefficient, Reverberation Time. Room Acoustics: Sightline Basics, Reflection, Diffusion, and Diffraction, Pattern of Reflected Sound, Ray Diagrams, Ray-Diagram Graphics, Echoes, and Echo Control Principles.

Sound Isolation: Fundamentals of Sound Isolation, Vibration of Building Elements, Outdoor Barriers for Noise Control, Noise Reduction from Outdoor Thin-Wall Barriers. Speech Privacy: Principles of Speech Privacy Between Enclosed Spaces, speech intelligibility, design of rooms, Speaker and Listener Orientations, Annoyance, Intruding Speech, Background Noise.

Application/Assignments: Design and assessment of architectural acoustics, computer modelling and simulation, building systems noise control, and the urban soundscape. Review of acoustic design experimental methods, instruments, related software, and their application. Review of literature on architectural acoustics, IEQ, and understanding the state of current research.

LEARNING RESOURCES & REFERENCES

1. Egan, M. D. (2007). Architectural acoustics. J. Ross Publishing.
2. Ermann, M. (2021). Architectural acoustics illustrated (3rd ed.). John Wiley & Sons.
3. Grondzik, W. T., & Kwok, A. G. (2019). Mechanical and electrical equipment for buildings (13th ed.). John Wiley & Sons.
4. Long, M. (2024). Architectural acoustics (3rd ed.). Academic Press.
5. Mehta, M., Johnson, J. A., & Rocafort, J. (1999). Architectural acoustics: Principles and design. Prentice Hall.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyse the physical properties of sound and their influence on architectural design and occupant comfort.
CO2	Assess room acoustics and reverberation characteristics using appropriate acoustic parameters and design methods.
CO3	Develop design solutions for sound insulation, speech privacy, and noise control in buildings.
CO4	Conduct acoustic analysis using literature review, measurement techniques, and computer-based simulation tools for architectural applications.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	3	2



AR712	ADVANCED ARCHITECTURAL LIGHTING	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To understand the integration of occupant visual comfort, energy efficiency and daylight availability.
CLO2	To explore advanced building lighting concepts and perform advanced daylighting calculations.
CLO3	To understand the non-visual effects of light.
CLO4	To be exposed to the current daylighting research.

COURSE CONTENT

The role of static and dynamic daylight metrics (Daylight autonomy, Useful Daylight Illuminance, Annual sun exposure, Spatial daylight autonomy, Continuous daylight autonomy etc.) in performance-based design and their relevance in current architectural research. Limitations and future directions of climate-based daylighting metrics.

Advanced building lighting concepts. Daylighting Calculation methods: Conventional and advanced simulations of quantitative conditions, Ray Tracing Techniques, CIE Skies and Climate Based Daylight Modelling (CBDM).

2-phase, 3-phase, 4-phase, 5-phase and 6-phase daylight calculation methods using bidirectional scattering distribution function (BSDF).

Non-Visual Effects of Light: Physiology of the visual and circadian systems, Relationship between lighting, visual performance and circadian photobiology. Light and mood. The psychology of daylighting and windows. Investigation on the current trends in energy efficiency, visual comfort and daylighting research.

LEARNING RESOURCES & REFERENCES

1. Boubekri, M. (2014). Daylighting, architecture and health: Building design strategies. Routledge.
2. DiLaura, D. L., Houser, K. W., Mistrick, R. G., & Steffy, G. R. (2020). The lighting handbook (11th ed.). Illuminating Engineering Society.
3. Reinhart, C. (2021). Daylighting handbook I: Fundamentals, designing with the sun (2nd ed.). Building Technology Press.
4. Schiler, M. (1992). Simplified design of building lighting. John Wiley & Sons.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand the relationships among occupant visual comfort, energy efficiency, and daylight availability.
CO2	Carry out advanced daylighting analysis and design.
CO3	Understand the non-visual effects of light
CO4	Awareness about current daylighting research.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	1	1
CO2	2	3	3
CO3	3	1	2
CO4	3	2	2



AR713	CONTEMPORARY ARCHITECTURE	THEORIES	OF	L	T	S	C
				3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Develop a critical understanding of architectural philosophy and theory.
CLO2	Explore the relationship between space, culture, and human experience.
CLO3	Examine tectonic, technological, and systems-based approaches in architecture.
CLO4	Interpret the interdisciplinary perspectives that influence architectural thought and form.

COURSE CONTENT

The course will focus on creating a deep understanding of the transient yet perpetual nature of Architecture through philosophical, theoretical, and computational discourses. Principles of architecture and the timeline of various architectural theories, Studies in Tectonic culture, Technology and Meaning in architecture, Architectural philosophy and Aesthetics, Phenomenology in architecture, Configurational theory of architecture, Social logic of space, Systems basis of architectural structures, and Biological analogy of architecture. Principles of architecture and timeline of various architectural theories – Utility, Stability, Beauty, Contours of Theoretical development, Conventions of classical designs, Principles and rationales from the modern era. Studies in Tectonic Culture – Reflections on the scope of the tectonic, the Anglo-French origins of tectonic form, Modernisation and the New Monumentality. Transcultural form and the new tectonic metaphor, the Adoration of the joint.

Technology and meaning in architecture – A technology of habitation. The map and the territory, The question of meaning and the relationship between mechanics and meaning in architecture, Metaphorical technology. Aesthetics and Philosophy – The origin of aesthetics: from Plato to Neo-Platonism, Aesthetics of Genius: from Kant to Nietzsche, Aesthetics and Deconstruction: from Heidegger to Derrida. Phenomenology in architecture – The meaning of being, Dwelling and Building, Architecture and philosophy of the body in place: movement and experience.

Social Logic of Space – The logic of space, The analysis of settlement layouts, Buildings and their genotypes, Elementary buildings and their transformations, Spatial logic of arrangements: from structures to particular realities. Configurational theory of architecture – What architecture adds to a building. The need for an analytical theory of architecture, Non-discursive technique, non-discursive regularities: time as an aspect of space, Space is the machine.

Systems basis of architectural structures – The idea of integration, Systems thinking: architectural systems and developments in systems architecture, Integrated systems: envelope, structural, mechanical, interior, site and further potentials. Biological analogy of architecture – The classification analogy: Building types and natural species, The anatomical analogy: engineering structure and the animal skeleton, The ecological



analogy: environments of artefacts and organisms, Biotechnics: plants and animals as inventors.

LEARNING RESOURCES & REFERENCES

1. Bachman, R. L. (2003). Integrated Buildings: The systems basis of architecture. John Wiley & Sons.
2. Benjamin, A. (2000). Architectural Philosophy. The Athlone Press.
3. Carpo, M. (2017). The Second Digital Turn: Design beyond intelligence. MIT Press.
4. Frampton, K. (2001). Studies in Tectonic Culture: The poetics of construction in nineteenth and twentieth century architecture. MIT Press.
5. Hillier, B. (1996). Space is the Machine: A configurational theory of architecture. Space Syntax.
6. LaVine, L. (2001). Mechanics and Meaning in Architecture. University of Minnesota Press.
7. Pallasmaa, J. (2024). Atmospheres, Perception and Architecture: Essays on experiential space. Wiley.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand the evolution of architectural theories and principles.
CO2	Evaluate tectonics, technology, and aesthetics in architecture.
CO3	Analyse spatial configuration and social logic in built environments.
CO4	Apply systems and biological concepts in architectural design analysis.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	2
CO2	2	2	3
CO3	3	2	2
CO4	3	1	3



AR 714	ECONOMIC ENVIRONMENTAL RESOURCES AND STATISTICS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the role of economics in environmental resource management.
CLO2	Apply statistical methods to analyse environmental data.
CLO3	Evaluate the economic impacts of environmental policies.
CLO4	Analyse the sustainability of resource use and propose solutions for improving resource management.
CLO5	Interpret statistical models and reports related to environmental economics.

COURSE CONTENT

Introduction to Economic Environmental Resources: Definition and scope of environmental economics, the role of economics in environmental resource management, Key concepts: Market failure, externalities, public goods, and common-pool resources, approaches to valuing natural resources (contingent valuation, cost-benefit analysis), Economic value of ecosystem services, resource depletion and the economics of sustainability.

Statistical Methods in Environmental Economics: Overview of statistical methods for analysing environmental data, Descriptive statistics: Measures of central tendency, variability, Probability distributions relevant to environmental data (e.g., normal, Poisson). Statistical Tools and Resource Management: Designing environmental surveys and sampling techniques, analysing environmental data from field studies, dealing with missing data and bias in environmental studies, Evaluating the effectiveness of environmental policies using statistical methods, Case studies: Clean Air Act, Kyoto Protocol, Paris Agreement, Statistical tools for policy evaluation, Sustainable resource management and economic policies.

Econometrics and Environmental Data Analysis: Regression analysis: Simple and multiple regression, Correlation analysis, Time series analysis for environmental trends Machine learning techniques: Supervised and unsupervised learning, Statistical software and machine learning tools for environmental data analysis (e.g., R, Python, SPSS, TensorFlow, Scikit-Learn), Input-output models and their application to environmental economics, Measuring sustainable development: The role of the environment in economic growth.

Current Trends and Future Directions in Environmental Economics: The concept of the "triple bottom line" (environmental, social, and economic performance), Green economics and the future of environmental resource management, the role of technology and AI in sustainable economic development, emerging statistical and machine learning techniques for environmental economics, Ethical considerations and challenges in using AI for environmental decision-making.



LEARNING RESOURCES & REFERENCES

1. Callan, S. J., & Thomas, J. M. (2013). Environmental economics and management: Theory, policy, and applications (6th ed.). Cengage Learning.
2. Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). SAGE Publications.
3. Groat, L., & Wang, D. (2013). Architectural research methods (2nd ed.). Wiley.
4. Kibert, C. J. (2016). Sustainable construction: Green building design and delivery (4th ed.). Wiley.
5. Leedy, P. D., & Ormrod, J. E. (2019). Practical research: Planning and design (12th ed.). Pearson.
6. Tietenberg, T. H., & Lewis, L. (2018). Environmental and natural resource economics (11th ed.). Routledge.
7. United Nations Environment Programme. (2020). Global status report for buildings and construction. UNEP.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyse economic and environmental resource data using statistical tools to identify patterns, correlations, and trends relevant to built environment challenges.
CO2	Formulate research questions related to environmental resource utilisation and apply appropriate quantitative and qualitative methodologies to develop evidence-based architectural or planning solutions.
CO3	Prepare and present comprehensive reports documenting statistical analyses of economic and environmental resources in conformance with academic and professional reporting standards.
CO4	Apply advanced knowledge of economic-environmental principles and sustainability metrics to propose innovative, regulation-compliant design solutions that optimise resource efficiency in architectural projects.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	1	3	2
CO4	3	3	3



AR 715	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To provide a comprehensive understanding of the EIA framework, legal requirements, and the evolution of environmental policy.
CLO2	To train students in various assessment methodologies, including screening, scoping, and the prediction of impacts on air, water, land, and biological environments.
CLO3	To develop the ability to design Environmental Management Plans (EMP) that incorporate effective mitigation measures and monitoring protocols.
CLO4	To emphasize the importance of public participation, social impact assessment, and ethical considerations in the decision-making process.

COURSE CONTENT

Concept of environmental impact, Introduction to Environmental Impact Assessment (EIA) - definitions, terminology, and concepts, Evolution of EIA in the USA, Key features of the National Environmental Policy Act and its implementation, Role of the USEPA, Evolution of EIA in India, Sustainable development, Generalised EIA process flow chart, Screening, Initial environmental examination (IEE), Scoping, Public participation.

Environmental Risk assessment, Pollution prevention and Waste minimization, sustainable development (SD), Life cycle assessment. Global Environmental Issues. EIA - Screening and scoping criteria, Rapid and comprehensive EIA, Impact assessment methods, checklists, matrices, quantitative methods, networks, overlay mapping, Impact prediction and evaluation, Legislative and environmental clearance procedures in India and other countries, Siting criteria, CRZ, Public participation, Resettlement and rehabilitation.

Practical applications of EIA, EIA methodologies, Baseline data collection, Prediction and assessment of impacts on physical, biological and socio-economic environment, Environmental management plan, Post project monitoring, initial environmental examination (IEE), environmental impact statement (EIS), environmental appraisal, environmental audit (EA), Environmental impact factors and areas of consideration, measurement of environmental impact, organisation, scope and methodologies of EIA, case studies stressing physical aspects of environment, Evolution of EIA, EIA at project, Regional and policy levels, Strategic EIA, EIA process.

LEARNING RESOURCES & REFERENCES

1. Anjaneyulu, Y., & Manickam, V. (2017). Environmental impact assessment methodologies (2nd ed.). BS Publications.
2. Asolekar, S. R., & Gopichandran, R. (2005). Preventive environmental management: An Indian perspective. Foundation Books Pvt. Ltd., New Delhi.
3. Canter, L. W. (1996). Environmental impact assessment (2nd ed.). McGraw-Hill.



4. Dhameja, S. K. (2018). Environmental engineering and management. S. K. Kataria & Sons.
5. Rau, J. G., & Wooten, D. C. (2020). Environmental impact analysis handbook (updated ed.). McGraw-Hill.
6. Welford, R. (2016). Corporate environmental management: Systems and strategies. Routledge.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Demonstrate the ability to interpret and apply national and international environmental regulations and guidelines to specific project types.
CO2	Conduct detailed baseline studies and apply quantitative and qualitative techniques to predict the magnitude and significance of environmental impacts.
CO3	Prepare professional Environmental Impact Statements (EIS) and technical reports that meet the standards of regulatory authorities.
CO4	Evaluate project alternatives and advocate for sustainable development by balancing economic growth with ecological preservation and social equity.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	2	3
CO2	2	3	2
CO3	1	2	3
CO4	1	2	3



AR 716	ENVIRONMENTAL LIGHTING	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To enable the students to understand the significance of environmental lighting on visual, functional and psychological aspects of design .
CLO2	To acquire knowledge about interior and exterior lighting design and details through case studies and assignments.
CLO3	To develop sustainable strategies for lighting based on the studies that could be applied in various contexts of design.
CLO4	To enable proficiency in executing lighting principles for a specific application.

COURSE CONTENT

Lighting Design – Effect of light on user orientation, room comprehension, form, structure and materials.

Impressions of visual clarity, spaciousness, relaxation, privacy etc. Interior lighting design requirements for offices, factories, commercial interiors, museums and galleries, etc.

Exterior lighting: Functional requirements, buildings and facades, pedestrian routes and surrounding areas, parking areas and landscape lighting.

Emergency lighting: Escape lighting, shutdown lighting and standby lighting, equipment and system design. Integration of daylight and artificial lighting. Economics of supplementary lighting.

Cost-effective day lighting design, energy efficiency and maintenance

Lighting cost, performance of lamps and luminaries. Estimating energy use. Energy saving developments.

LEARNING RESOURCES & REFERENCES

1. CIBSE. (2016). Lighting guide 6: The exterior environment. The Lavenham Press Ltd., Suffolk, UK.
2. Hopkinson, R. G. (1963). Architectural physics: Lighting. HMSO, London.
3. Michel, L. (1995). Light: The shape of space. Van Nostrand Reinhold, London.
4. Millet, M. S. (1996). Light revealing architecture. Van Nostrand Reinhold, New York.
5. Sorcar, P. C. (1987). Architectural lighting for commercial interiors. John Wiley & Sons, New York.
6. Tregenza, P., & Loe, D. (2019). The design of lighting (3rd ed.). Routledge.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	To understand the importance of environmental lighting in the realm of sustainable design
CO2	Capacity building in addressing cost effective lighting design issues while ensuring sustainability
CO3	To motivate contextual research in environmental lighting design with reference to sustainability.
CO4	To execute lighting principles for any specific application for sustainable environmental lighting.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	2	3
CO2	2	2	2
CO3	3	2	3
CO4	2	2	3



AR717	ENVIRONMENT AND SUSTAINABLE BEHAVIOUR	L	T	S	C
		3	-	-	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To develop an understanding of environmental psychology principles related to sustainable behaviour, perception, cognition, and attitudes.
CLO2	To examine theories of environmental behaviour relationships and their relevance in shaping human interaction with the physical environment.
CLO3	To analyse environmental awareness, responsibility, and decision-making processes including collective action and communication.
CLO4	To integrate environmental psychology with physical planning concepts aligned with the United Nations framework and Sustainable Development Goals for improving quality of life.

COURSE CONTENT

Overview of environmental psychology of sustainable behaviour. Environmental Perception and cognition, environmental attitudes and behaviour. Environmental awareness, environmental concern, environmental responsibility, Environmental commitment, and environmental assessment.

Ecological world views, Global values, Ecological self. environmentally relevant behaviour and attitudes, applied behaviour analysis, Theory of planned behaviour, commons dilemma, collective decision, environmental communication.

Introduction to the theories of Environment-Behaviour relationships. The nature and function of theories. Gerald Weisman, key concepts of the relationship between human behavior and the physical environment. Arousal approach, stimulation approach, Adaptation level, Brunswick's Lens model, Warren and Warren's Neighbourhood types, Brunswick's Lens model, James J Gibson's ecological approach to visual perception.

Changes in the Human Physical environment and the ecological revolution, psychology of interdependence, challenge of increasing Pro- Environmental and Behaviour, lack of environmental impact, the DO IT Process, Three stages of behaviour, three basic interventions. Behaviour change model with intervention approaches.

Overview of UN mandate for sustainable development. Physical Planning Process. Challenges in the Physical Planning Process. Theories by C. West Churchman & Morris Ginsberg, and Aaron Wildavsky. Planning for people's lives. Population, culture, lifestyle, demographics assessment as the context variables. Density, Perceived Density and Crowding. Quality of Life. Building types as responses to socio-cultural-demographic needs. Types of open spaces, streets. Concepts & concerns.

LEARNING RESOURCES & REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.



2. Carmona, M., Heath, T., Oc, T., & Tiesdell, S. (2021). Public places, urban spaces: The dimensions of urban design (3rd ed.). Routledge.
3. Gifford, R. (2022). Environmental psychology: Principles and practice (6th ed.). Optimal Books.
4. Steg, L., van den Berg, A. E., & de Groot, J. I. M. (Eds.). (2019). Environmental psychology: An introduction (2nd ed.). Wiley-Blackwell.
5. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations.

COURSE OUTCOMES

CO1	Ability to explain key concepts of environmental perception, cognition, attitudes, and behaviour in real-world contexts.
CO2	Enable to apply environment behaviour theories (e.g., arousal, adaptation, ecological approaches) in planning and design situations.
CO3	Enhance capacity to evaluate environmental behaviour using frameworks like the Theory of Planned Behaviour and commons dilemma.
CO4	Build capacity to synthesize environmental psychology and urban planning principles to design human-centred, sustainable environments considering population, density, culture, and quality of life.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	2	3
CO2	3	2	3
CO3	2	2	3
CO4	1	1	3



AR718	HIGH-PERFORMANCE FACADES	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the principles, materials, components, and integrated design approaches of high-performance façade systems.
CLO2	Examine innovative daylighting and solar control technologies used in advanced façade design.
CLO3	Analyse the performance of static and dynamic façade systems in relation to energy efficiency, daylighting, and occupant comfort.
CLO4	Apply simulation, analytical, and optimisation tools to evaluate and improve high-performance façade designs.

COURSE CONTENT

Introduction to facade systems, facade materials and components, the integrated design approach to facades, and the fundamental building physics determining facade performance.

Innovative daylighting systems: Optical light redirecting systems (OLS), Angular selective glazing systems, Ceramic frits, Building-integrated photovoltaics (BIPV), Granular design, Dynamic smart glazings, Dynamic light redirecting systems, Solar control facades, daylighting facades, double-skin facades, and adaptive façades.

Static and dynamic complex fenestration systems and their effects on energy efficiency, daylighting, and visual comfort. Electric light and daylighting responsive systems, shading control systems, use of photosensors and occupancy sensors in energy efficiency.

Various analytical procedures, optimisation, and simulation tools for the evaluation of high-performance facade designs.

LEARNING RESOURCES & REFERENCES

1. Capeluto, G., & Ochoa, C. E. (2017). Intelligent envelopes for high-performance buildings. Springer.
2. Dilaura, D. L., Houser, K. W., Mistrick, R. G., & Steffy, G. R. (2011). The lighting handbook. Illuminating Engineering Society of North America.
3. Kittler, R., Kocifaj, M., & Darula, S. (2012). Daylighting science and daylighting technology. Springer.
4. Konis, K., & Selkowitz, S. (2017). Effective daylighting with high-performance facades. Springer International Publishing.
5. Reinhart, C. (2018). Daylighting handbook 2: Daylighting simulations & dynamic facades. Building Technology Press.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Examine the role of high-performance façades in sustainable building design and indoor environmental quality.
CO2	Evaluate different advanced façade technologies, including smart glazing, BIPV, double-skin façades, and adaptive façade systems.
CO3	Assess the impact of façade systems on daylighting, visual comfort, shading performance, and energy consumption.
CO4	Develop and optimise façade design solutions using appropriate analytical methods and simulation tools.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3



AR719	HUMAN ECOLOGY AND BUILDING BIOLOGY	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To develop a holistic understanding of the interconnectedness between human life, the natural environment, and the built environment.
CLO2	To build awareness of how environmental conditions influence human physical health, mental well-being, and overall quality of life.
CLO3	To introduce students to the influence of social, cultural, psychological, and physiological factors in shaping human-centered built environments.
CLO4	To familiarize students with the principles of healthy, functional, and sustainable design and to sensitize them towards occupant well-being, environmental responsibility, and long-term sustainability in architectural practice.

COURSE CONTENT

The dynamic interrelationship between the built environment, the natural ecosystem, and human physical and psychological well-being. The principles of human ecology and building biology, emphasizing how environmental conditions influence human health, comfort, and behavior.

Human well-being in relation to physiological systems and their responses to environmental factors such as air, light, water, sound, and materiality. The role of social and community spaces in enhancing quality of life, fostering a sense of belonging, and supporting shared human experiences.

The impact of open spaces and landscape on stress reduction and mental health, the role of biophilic design in improving cognitive function, and the importance of daylighting, acoustic comfort, and indoor environmental quality (IEQ) in creating healthy indoor environments. Indoor air quality, thermal comfort, and ergonomic considerations in relation to occupant health and productivity. Study of building materials in terms of its embodied energy, ecological footprint, and their influence on environmental sustainability and occupant well-being.

Concepts of energy exchange between buildings and occupants are introduced from a building biology perspective, alongside concepts on environmentally responsible and renewable materials. Mental health, informed design approaches, including the impact of spatial environments on mood, stress levels, mental fatigue, and overall energy levels.

Environmental impact assessment in the context of human ecology and long-term sustainability of built environments. Performance evaluation of buildings based on occupant well-being, comfort, and productivity, promoting a holistic approach to designing healthy, sustainable, and human-centered environments.



LEARNING RESOURCES & REFERENCES

1. Dorian Lucas (2021). *Ecological Buildings: New Strategies for Sustainable Architecture*. Braun Publishing.
2. Graham, Peter (2002). *Building Ecology: First Principles for A Sustainable Built Environment*.
3. Frederick R. Steiner (2016). *Human Ecology: How Nature and Culture Shape Our World*.
4. Robert Dyball, Barry Newell (2014). *Understanding Human Ecology: A Systems Approach to Sustainability*.
5. Ziehe, H. (2009). *Building biology: The basis of holistic design*. Müller Verlag.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyse the interrelationship between human life, the natural environment, and the built environment to inform integrated spatial design decisions
CO2	Evaluate the influence of environmental conditions on human physical health, mental well-being, and overall quality of life.
CO3	Analyse the role of social, cultural, psychological, and physiological factors in shaping human-centered and context-responsive built environments.
CO4	Apply principles of healthy, functional, and sustainable design to create built environments that enhance occupant well-being, comfort, productivity, and long-term environmental sustainability.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	2
CO2	2	1	3
CO3	2	2	2
CO4	2	2	3



AR720	INTELLIGENT BUILDINGS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To understand the convergence of Building Management Systems (BMS), IoT, and communication networks for seamless data exchange.
CLO2	To explore strategies for optimizing energy consumption, water usage, and life-cycle costs through automated controls and predictive maintenance.
CLO3	To focus on enhancing occupant comfort, health, and productivity via intelligent climate control, lighting, and air quality monitoring.
CLO4	To implement sophisticated automated systems for fire safety, access control, and emergency response management.

COURSE CONTENT

Significance of Intelligent buildings. Artificial intelligence, knowledge-based systems, artificial neural networks, genetic algorithms, fuzzy controls. Composition of intelligent buildings – physical building intelligence, building management and operation. Economical and technical aspects of intelligent building technologies. Facilities management for intelligent buildings.

Building automation systems - approaches, application – lighting, security, fire detection, office automation, vertical transportation, surveillance. Technologies – field devices, digital controllers, system controllers, man-machine interface, Sensors. Automation control strategies. Case Studies.

LEARNING RESOURCES & REFERENCES

1. Clements-Croom, D. (Ed.). (2004). Intelligent buildings: Design, maintenance and operation. Thomas Telford, London.
2. Goyal, S. (2021). Advanced controls for intelligent buildings. CRC Press.
3. Harrison, A., & Loe, E. (1997). Intelligent buildings in South East Asia. Spon Press.
4. Nigginton, M., & Harris, J. (2002). Intelligent skins. Architectural Press, Oxford.
5. Sinopoli, J. (2009). Smart building systems for architects, owners, and builders. Butterworth-Heinemann.
6. So, A. T. P., & Chan, W. L. (1999). Intelligent building systems (The International Series on Asian Studies in Computer and Information Science). Springer.
7. Wang, S. (2010). Intelligent buildings and building automation. Spon Press.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Evaluate and select appropriate sensors, actuators, and software frameworks for various building automation requirements.
CO2	Quantify the reduction in carbon footprint and resource wastage achieved through smart building interventions.
CO3	Analyze real-time building performance data to troubleshoot operational issues and improve system responsiveness.
CO4	Develop architectural designs that are scalable and adaptable to emerging technologies and changing environmental conditions.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	3	3
CO2	1	3	3
CO3	1	3	3
CO4	1	3	3



AR721	LIFE CYCLE ANALYSIS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Learn to define the objective and scope of an LCA
CLO2	Collect primary data from inventories and secondary data from the database
CLO3	Quantify the environmental impacts of products, using various impact assessment methods
CLO4	Interpret the results of an LCA through the prism of uncertainty and support the decisions using an LCA

COURSE CONTENT

An Introduction to Sustainability Concepts and Life Cycle Analysis, Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Character of Environmental Problems).

Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools).

Life Cycle Assessment – Detailed Methodology and ISO Framework (Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework), Life Cycle Inventory and Impact Assessments (Unit Processes and System Boundary Data Quality, Procedure for Life Cycle Impact Assessment, LCIA in Practice with Examples, Interpretation of LCIA Results).

Factors for Good LCA Study (ISO Terminologies, LCA Steps Recap, Chemical Release and Fate and Transport, and Green Sustainable Materials), Design for Sustainability (Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles, and Environmental Cost Analysis), Case Studies.

LEARNING RESOURCES & REFERENCES

1. Curran, M. A. (Ed.). (2012). Life cycle assessment handbook: A guide for environmentally sustainable products. Wiley.
2. Curran, M. A. (Ed.). (2016). Life cycle assessment: A review of the methodologies and applications. Wiley.
3. Finkbeiner, M. (Ed.). (2016). Special types of life cycle assessment. Springer.
4. Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (2018). Life cycle assessment: Theory and practice. Springer Nature.
5. Klöpffer, W., & Grahl, B. (2014). Life cycle assessment (LCA): A guide to best practice. Wiley.



6. Sonnemann, G., & Margni, M. (Eds.). (2015). Life cycle sustainability assessment for decision-making: Methodologies and case studies. Springer.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand sustainability concepts and life cycle thinking in architecture
CO2	Describe the methodology and phases of LCA
CO3	Analyze life cycle inventory and impact assessment using standard methods
CO4	Evaluate data quality, uncertainty, and sensitivity in LCA studies and apply LCA tools

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	3	2
CO2	2	3	3
CO3	1	3	3
CO4	1	3	3



AR722	NET ZERO AND CARBON NEUTRAL BUILDINGS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Develop an understanding of climate-responsive design principles and net-zero building concepts.
CLO2	Familiarize students with passive and active strategies for improving energy efficiency and reducing carbon emissions in buildings.
CLO3	Introduce renewable energy systems, carbon management methods, and lifecycle assessment approaches in sustainable architecture.
CLO4	Enable students to explore assessment tools, certification systems, and case studies related to net-zero and carbon-neutral buildings.

COURSE CONTENT

Climate Change, Net Zero and Carbon Neutrality - Climate change and global warming, Greenhouse gases and carbon cycle, Role of the built environment in carbon emissions, Concepts of Net Zero Energy (NZE), Net Zero Carbon (NZC), and Carbon Neutral Buildings, Operational and embodied carbon, Decarbonization pathways, international climate agreements and sustainability frameworks, Global net-zero targets, Whole-life carbon approach.

Passive Design and Low-Carbon Building Strategies - Climate-responsive and bioclimatic design, Thermal comfort and psychrometric analysis, Heat flow and building science fundamentals, Site planning and orientation, Solar shading, daylighting, and natural ventilation, Thermal mass and passive cooling, High-performance building envelopes, Glazing systems, insulation, fenestration, and low-carbon design strategies.

Energy Efficiency and Building Performance Optimization - Building energy demand and load profiling, Energy modelling and simulation tools, HVAC systems and energy recovery technologies, Efficient lighting and smart controls, Building automation systems, Indoor environmental quality and occupant comfort, Energy benchmarking, BIM integration, post-occupancy evaluation, Performance optimization for net-zero buildings.

Renewable Energy Integration and Carbon Management - Renewable energy integration in buildings, Solar photovoltaic and solar thermal systems, Wind and geothermal systems, Smart grids, net metering, and energy storage, Carbon accounting and greenhouse gas footprint calculations, Embodied carbon and lifecycle assessment, Low-carbon materials and circular economy approaches, Carbon sequestration and offset strategies.

Net Zero Assessment, Certification and Case Studies - Net-zero and carbon-neutral building assessment methods, LEED Zero, IGBC, GRIHA, BREEAM, and Living Building Challenge certification systems, Whole-life carbon assessment, Life cycle costing and economic feasibility, ESG and green financing frameworks, Building retrofits and adaptive reuse, Policy and governance strategies, National and international case studies of net-zero and carbon-neutral buildings.



LEARNING RESOURCES & REFERENCES

1. Kibert, C. J. (2016). Sustainable construction: Green building design and delivery (4th ed.). John Wiley & Sons.
2. Lechner, N. (2015). Heating, cooling, lighting: Sustainable design methods for architects (4th ed.). Wiley.
3. Szokolay, S. V. (2014). Introduction to architectural science: The basis of sustainable design (3rd ed.). Routledge.
4. Vale, B., & Vale, R. (2009). The new autonomous house: Design and planning for sustainability. Thames & Hudson.
5. World Green Building Council. (2019). Bringing embodied carbon upfront: Coordinated action for the building and construction sector to tackle embodied carbon. World Green Building Council.
6. UK Green Building Council. (2021). Net zero whole life carbon roadmap for the built environment. UKGBC.
7. Yeang, K. (2008). Eco Design: A manual for ecological design. Wiley-Academy.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Interpret the relationship between climate change, energy use, and carbon emissions in the built environment.
CO2	Examine passive design strategies, building envelope systems, and energy-efficient technologies for sustainable buildings.
CO3	Analyze renewable energy integration, carbon accounting methods, and lifecycle impacts of building materials.
CO4	Evaluate net-zero and carbon-neutral buildings using performance assessment tools, certification frameworks, and case study analysis.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	2
CO2	2	1	3
CO3	3	2	3
CO4	2	3	3



AR 723	POST OCCUPANCY EVALUATION OF BUILDINGS	L	T	S	C
		1	0	2	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To introduce the principles, concepts and significance of Post Occupancy Evaluation in assessing building performance.
CLO2	To provide practical exposure to Post Occupancy Evaluation methods and techniques for assessing the performance of existing buildings.
CLO3	To train students in conducting field-based studies related to occupant satisfaction, environmental quality, accessibility, and energy performance.
CLO4	To enable students to prepare analytical evaluation reports and propose design or retrofit recommendations based on observed building performance and user feedback

COURSE CONTENT

Introduction to Post Occupancy Evaluation and its role in assessing building performance. Identification of performance parameters including functional efficiency, user satisfaction, accessibility, indoor environmental quality, thermal comfort, daylighting, ventilation, acoustics, and energy use.

Field-based techniques and methods for POE including walkthrough evaluations, behavioural observation, occupant surveys, interviews, questionnaires, and environmental measurements. Introduction to basic instruments and tools used for environmental monitoring and energy assessment.

Collection, documentation, analysis, and interpretation of qualitative and quantitative data related to building performance. Preparation of performance benchmarks and comparison with standards such as GRIHA, LEED, IGBC and relevant building codes and guidelines. Students shall conduct a detailed Post Occupancy Evaluation study of an existing building. The exercise shall include site visits, field measurements, user interaction, data analysis, graphical documentation, and preparation of a comprehensive report highlighting building performance, occupant satisfaction, environmental impact and recommendations for improvement or retrofit strategies.

LEARNING RESOURCES & REFERENCES

1. ASHRAE. (2023). ASHRAE Standard 55: Thermal environmental conditions for human occupancy. ASHRAE.
2. Bechtel, R. B., & Churchman, A. (2002). Handbook of environmental psychology. John Wiley & Sons.
3. Douglas, J. (2006). Building adaptation. Butterworth-Heinemann.
4. Preiser, W. F. E., White, E., & Rabinowitz, H. (2015). Post-occupancy evaluation. Routledge.
5. Wilde, P. de. (2005). Building performance evaluation. Wiley.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Conduct Post Occupancy Evaluation studies using appropriate field-based methods and techniques.
CO2	Measure and assess building performance parameters related to occupant satisfaction, environmental quality, accessibility, and energy use.
CO3	Collect, document, analyse and interpret qualitative and quantitative data obtained from existing buildings.
CO4	Prepare comprehensive analytical reports and propose recommendations for improving building performance and occupant well-being

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	2
CO2	3	2	2
CO3	2	1	3
CO4	2	3	3



AR724	RESEARCH METHODS	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Interpret research philosophies and paradigms in relation to architectural and planning inquiry.
CLO2	Conduct systematic literature reviews and identify research gaps.
CLO3	Design research frameworks using appropriate qualitative and quantitative methods.
CLO4	Communicate research findings effectively through academic writing and presentations.

COURSE CONTENT

Research aims and questions; research philosophy and paradigms in architectural and planning inquiry. Literature search and review; use of libraries, databases, and digital repositories; identification of research gaps; aim and structure of a literature review. Scholarly communication; introduction to academic writing; writing and publishing journal papers; preparation and presentation of conference papers; visual and oral presentation of research.

Analysis of research problems; formulation of hypotheses and variables; principles of research design; sampling strategies; experimental and quasi-experimental approaches; field surveys, observational studies, simulations, and theoretical models; laboratory investigations relevant to building science and urban systems.

Behavioural research: data collection methods including questionnaires, interviews, and structured and unstructured observation; unobtrusive and obtrusive measures; scaling techniques such as Likert and semantic differentials; issues of reliability, validity, and bias. Physical research: laboratory and field-based measurements; instrumentation and resources; environmental data acquisition related to thermal, acoustic, and air quality parameters.

Data analysis and interpretation; integration of qualitative and quantitative findings; development of coherent research narratives for application in architecture and planning contexts.

LEARNING RESOURCES & REFERENCES

1. Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.
2. Groat, L. N., & Wang, D. (2013). Architectural research methods. John Wiley & Sons.
3. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4. Silverman, D. (2020). Doing qualitative research (5th ed.). SAGE Publications.
5. Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.



6. Zeisel, J. (2006). Inquiry by design. Environment/ behavior/ neuroscience in architecture, interiors, landscape, and planning.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Explain key research paradigms and their relevance to built environment studies.
CO2	Perform structured literature search and prepare critical reviews.
CO3	Develop research designs including sampling, variables, and methods.
CO4	Present research outcomes in written and oral academic formats.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	1	2	3
CO2	3	1	2
CO3	2	3	1
CO4	3	2	1



AR725	SMART CITIES	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To understand the evolution, concepts, components, and planning frameworks of smart cities in relation to sustainable urban development.
CLO2	To examine smart urban systems, infrastructure services, governance models, and ICT-enabled planning approaches.
CLO3	To analyse smart mobility, smart energy, smart environment, and smart utility systems for efficient urban management.
CLO4	To develop strategies for smart city planning, retrofitting, redevelopment, and integrated urban infrastructure development.
CLO5	To evaluate smart city policies, standards, participatory governance systems, and implementation frameworks in Indian and global contexts.

COURSE CONTENT

Introduction to cities and urban transformation; evolution of urban settlements, industrial revolution and changing city structures; urbanization trends, opportunities and challenges; sustainable development and urban prosperity; concepts and evolution of smart cities; principles, characteristics and components of smart cities; smart city indicators, standards and performance frameworks; role of governance, innovation and digital transformation in urban planning.

Smart city planning process and policy framework; predictive modelling and data-driven planning; prerequisites and categories of smart cities; integrated planning approaches, citizen participation and collaborative governance; open data systems and urban analytics; institutional frameworks and smart city governance; smart city mission of India; challenges, limitations and ethical concerns in smart city planning and implementation.

Smart infrastructure and urban systems; smart mobility systems, intelligent transport systems and ICT-enabled transportation; smart energy systems, renewable energy integration, smart grids and electric mobility; smart water supply, wastewater and waste management systems; smart environmental monitoring and climate-responsive urban infrastructure; disaster resilience, safety systems and sustainable infrastructure management approaches.

Smart governance, economy and urban services; e-governance, participatory governance and digital public services; smart economy, innovation ecosystems, SMEs and sharing economy; crowd sharing, co-creation and entrepreneurship; smart buildings and intelligent infrastructure systems; urban informatics, IoT applications and ICT architecture for smart cities; applications of artificial intelligence, GIS, sensors and real-time monitoring technologies in planning and urban management.

Smart city development strategies and implementation frameworks; retrofitting, redevelopment and greenfield development approaches; pan-city smart solutions and



area-based development; financing mechanisms, PPP models and investment strategies; monitoring and evaluation frameworks for smart city performance; national and international case studies of smart city planning, governance and infrastructure systems with special reference to Indian smart cities.

LEARNING RESOURCES & REFERENCES

1. Batty, M. (2018). Inventing future cities. MIT Press.
2. Bureau of Indian Standards. (2021). Smart city assessment framework for Indian cities. BIS, New Delhi.
3. Satyam, S., & Calzada, I. (2017). The smart city transformations: The revolution of the 21st century. Bloomsbury.
4. Stimmel, C. L. (2016). Building smart cities: Analytics, ICT, and design thinking. CRC Press.
5. United Nations Human Settlements Programme. (2022). World cities report 2022: Envisaging the future of cities. UN-Habitat, Nairobi.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Explain concepts, components and planning frameworks of smart cities.
CO2	Analyze smart urban systems, ICT infrastructure and governance approaches.
CO3	Evaluate smart mobility, energy, environment and utility infrastructure systems.
CO4	Apply smart city planning strategies including retrofitting and redevelopment approaches.
CO5	Prepare integrated and implementation-oriented smart city development proposals.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	2	1
CO2	3	2	2
CO3	2	3	3
CO4	2	3	3
CO5	3	3	3



AR 726	SOUTH INDIAN TEMPLE ARCHITECTURE	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the architectural features and historical significance of South Indian temples.
CLO2	Analyse the role of South Indian temples in cultural and heritage tourism.
CLO3	Examine the impact of tourism on temple preservation and conservation.
CLO4	Develop strategies for sustainable tourism that supports both temple conservation and tourism growth.
CLO5	Explore the role of architecture in attracting tourists to religious and heritage sites.
CLO6	Critically assess the balance between religious practices and the commercialization of temple tourism.

COURSE CONTENT

Introduction to South Indian Temple Architecture: Overview of South Indian architectural traditions, Importance of temples in South Indian culture and religion, Key periods in the development of South Indian temple architecture, The historical, cultural, and religious significance of South Indian temples, Role of temples in regional and international tourism, The relationship between architectural heritage and tourism in South India.

Regional Variations in South Indian Temples: Distinct architectural styles and regional differences across Tamil Nadu, Kerala, Karnataka, and Andhra Pradesh, The emergence of unique temple features in different regions (e.g., Kerala's wooden temples, Karnataka's Hoysala temples), Influence of local traditions, religious practices, and regional rulers on temple design, Case study: The temples of Karnataka (e.g., Chennakesava Temple, Belur).

Temple Architecture as a Cultural Attraction: The significance of South Indian temples as heritage attractions, Role of temples in religious tourism: Pilgrimages and festivals, the role of architectural features in attracting tourists (e.g., gopurams, sculpture, mandapas), Temple-based cultural tourism: Music, dance, and ritual performances.

Conservation and Preservation of South Indian Temples: Challenges in the conservation and restoration of ancient temples, Efforts to protect and preserve temple architecture and heritage (UNESCO World Heritage Sites, ASI initiatives), Modern threats: Pollution, natural disasters, tourism, and encroachment, Case studies of conservation efforts: Brihadeeswarar Temple, Meenakshi Temple.

Contemporary Issues and Future trends in South Indian Temple Architecture: The role of modern technology and innovation in the restoration of heritage temples, Architectural trends and changes in the construction of contemporary temples, The intersection of religion, architecture, and tourism, Future of South Indian temple architecture and heritage



preservation, The future of temple tourism: Trends, challenges, and opportunities, Innovations in temple conservation for tourism sustainability.

LEARNING RESOURCES & REFERENCES

1. Fergusson, J. (1910). History of Indian and Eastern architecture. John Murray.
2. Gopinatha Rao, T. A. (2017). Elements of Hindu iconography. Motilal Banarsidass.
3. Hardy, A. (2007). The temple architecture of India. John Wiley & Sons.
4. Kramrisch, S. (1991). The Hindu temple. Motilal Banarsidass.
5. Michell, G. (1998). The Hindu temple: An introduction to its meaning and forms. University of Chicago Press.
6. Muthiah, S. (1993). The splendour of South India. UBS Publishers' Distributors, New Delhi.
7. Srinivasan, K. R. (2010). Temples of South India. National Book Trust.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand and interpret the historical evolution, spatial organization, and stylistic features of South Indian (Dravidian) temple architecture.
CO2	Analyse architectural components and evaluate their structural, symbolic, and cultural significance.
CO3	Develop research-based documentation, drawings, and analytical reports on selected South Indian temple complexes following academic and professional standards.
CO4	Apply advanced architectural knowledge to propose sustainable conservation, reinterpretation, or design solutions inspired by South Indian temple principles.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	3
CO2	2	3	1
CO3	2	1	3
CO4	2	3	2



AR727	SUSTAINABLE TECHNOLOGY	MATERIALS	AND	L	T	S	C
				3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To introduce the principles of sustainability, energy efficiency, and environmental responsibility in the built environment.
CLO2	To develop an understanding of the environmental impacts and assessment methods of building materials and construction practices.
CLO3	To familiarize students with recyclable, renewable, and alternative materials along with sustainable construction technologies.
CLO4	To explore energy-efficient building systems, green building frameworks, and climate-responsive design strategies.

COURSE CONTENT

Energy, Sustainability and Built Environment - Energy efficiency and conservation in buildings; resource consumption and environmental degradation; energy use in India and the building sector; factors affecting building energy use; pre-building, construction, and post-occupancy stages; climate change, greenhouse gases, and carbon footprint; embodied energy and embodied carbon; production and transportation energy of materials; ecological footprint and sustainability principles; introduction to sustainable architecture and green building concepts.

Environmental Impact and Assessment of Building Materials - Environmental impacts of conventional materials; embodied energy calculations and material comparisons; recycling processes and embodied energy reduction; processing and transportation energy; Life Cycle Assessment (LCA) and Life Cycle Costing (LCC); indoor environmental quality and low-emitting materials; construction waste management and material reuse; regional materials and sustainable resource management; case studies of sustainable building materials.

Recyclable, Renewable and Alternative Materials - Recyclable and renewable materials; sustainable materials and life cycle design; biodegradable and non-biodegradable materials; recycled content and resource reuse; regional and rapidly renewable materials; fly ash bricks, gypsum products, stabilized mud blocks, and eco-boards; recycled steel and industrial waste-based materials; bamboo-based products and engineered bamboo systems; vernacular materials and alternative technologies; green material rating and certification systems.

Sustainable Construction Techniques and Practices - Sustainable construction principles and development approaches; site planning, ecology, and community-sensitive development; health, energy, water, and cultural considerations; self-help and community-based construction; adaptation, repair, reuse, and retrofitting strategies; portable and adaptable architecture; rat-trap bond construction, filler slab roofing, and cavity walls; thermally efficient envelope systems; technologies by CBRI, BMPTC, and Laurie Baker; prefabrication and modular sustainable systems.



Energy Efficient Technologies and Green Building Systems - Energy-efficient construction technologies; solar passive and climate-responsive design; daylighting and natural ventilation; intelligent and smart building systems; building energy analysis and simulation; energy conservation technologies; lighting efficiency and thermal comfort; indoor environmental quality; IGBC, GRIHA, LEED, and ECBC frameworks; sustainable site planning, water conservation, and energy efficiency; case studies of sustainable and energy-efficient buildings.

LEARNING RESOURCES & REFERENCES

1. Birdie, G. S., & Ahuja, T. D. (2010). Building materials, technology and design. Dhanpat Rai Publishing Company.
2. Calkins, M. (2009). Materials for sustainable sites: A complete guide to the evaluation, selection, and use of sustainable construction materials. John Wiley & Sons.
3. Jagadish, K. S., Reddy, B. V. V., & Nanjunda Rao, K. S. (2007). Alternative building materials and technologies. New Age International Publishers.
4. Kibert, C. J. (2022). Sustainable construction: Green building design and delivery (5th ed.). John Wiley & Sons.
5. McLennan, J. F. (2004). The philosophy of sustainable design. Ecotone Publishing.
6. Smith, P. F. (2021). Architecture in a climate of change: A guide to sustainable design (4th ed.). Routledge.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyze the relationship between building design, material selection, energy use, and environmental impact.
CO2	Evaluate building materials and construction techniques using sustainability assessment methods and life cycle approaches.
CO3	Apply sustainable materials, construction practices, and energy-efficient technologies in architectural design.
CO4	Integrate green building principles, rating systems, and climate-responsive strategies into sustainable built environment solutions.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	3
CO2	3	2	3
CO3	2	1	3
CO4	2	2	3



AR728	THEORY AND PRINCIPLES OF THERMAL COMFORT	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the principles of thermal comfort, including heat transfer and human physiological responses.
CLO2	Examine thermal comfort theories and models used in built environments.
CLO3	Develop skills in conducting field studies and analysing thermal comfort-related data
CLO4	Familiarize with standards, guidelines, and adaptive strategies for indoor environmental quality.

COURSE CONTENT

Principles of heat transfer between the human body and the environment. Metabolic heat production, heat loss by conduction, convection, radiation, and evaporation, and vasomotor adjustment. Theories of thermal comfort – Rational/Climate chamber, field study, adaptive approach, and evaluation. The physiology and psychophysics of thermal comfort and heat balance. Thermal balance as a method of defining thermal comfort.

The field study is an approach to defining the conditions for thermal comfort. The theory and practice of user surveys in comfort work and in building appraisal. Standards, guidelines, and legislation for the indoor environment. Low-energy adaptive buildings. Occupant interactions with building controls – windows, fans, blinds, etc.

Organise and execute a comfort survey or post-occupancy building evaluation and analyse its results. Collection and analysis of energy use data from building records, on-site measurement and visualisation techniques. Collection of energy and comfort data and analysis using simulation and monitoring. Knowledge of the setting and use of thermal comfort standards for buildings.

LEARNING RESOURCES & REFERENCES

1. ASHRAE. (2017). ASHRAE handbook—Fundamentals (Chapter: Thermal comfort). American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
2. Fanger, P. O. (1970). Thermal comfort: Analysis and applications in environmental engineering. McGraw-Hill.
3. Heschong, L. (1979). Thermal delight in architecture. MIT Press.
4. Mora, R., & Bean, R. (2018). Thermal comfort: Designing for people. ASHRAE Journal.
5. Nicol, F., & Humphreys, M. (2012). Adaptive thermal comfort: Principles and practice. Routledge.
6. Parsons, K. (2014). Human thermal environments: The effects of hot, moderate, and cold environments on human health, comfort, and performance (3rd ed.). CRC Press.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Explain heat transfer processes and human thermal comfort mechanisms.
CO2	Evaluate different thermal comfort models and their applications.
CO3	Apply survey methods and standards to assess indoor comfort conditions.
CO4	Analyse energy use, occupant behaviour, and building performance for improved comfort.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	2
CO2	3	2	2
CO3	3	3	2
CO4	3	2	3



AR729	URBAN ENVIRONMENT	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	To introduce the concepts, characteristics, and components of urban environments and urban systems.
CLO2	To understand the relationship between urbanization, resource consumption, and environmental sustainability.
CLO3	To examine urban environmental issues, climate impacts, and the Urban Heat Island phenomenon.
CLO4	To familiarize students with methods of assessing urban environmental quality and sustainable planning approaches.

COURSE CONTENT

Introduction to urban environments as systems of resource supply and consumption. Relationship between urban growth, infrastructure development, resource demand, and environmental sustainability. Changing trends in urban systems and their environmental impacts.

Characteristics of urban environments and analysis of the present urban scenario. Study of major urban environmental issues, including pollution, waste management, traffic congestion, loss of green spaces, and environmental degradation due to rapid urbanization.

Impact of urbanization on climate and urban microclimates. Overview of climate-related urban issues and studies on the Urban Heat Island effect, its causes, impacts, and mitigation strategies.

Principles and values of quality of life in urban environments. Assessment methods using environmental, social, economic, and spatial indicators related to livability and environmental quality.

Planning instruments and strategies for urban environmental management, including sustainable planning approaches, environmental regulations, and green infrastructure. Case studies of urban environmental models and sustainable urban practices.

LEARNING RESOURCES & REFERENCES

1. Beatley, T. (2011). Biophilic cities: Integrating nature into urban design and planning. Island Press.
2. Farr, D. (2018). Sustainable urbanism: Urban design with nature (2nd ed.). Wiley.
3. Girardet, H. (2015). Creating regenerative cities. Routledge.
4. Lehmann, S. (2019). Reconnecting the city: The historic center as a model for the sustainable city. Palgrave Macmillan.
5. Register, R. (2017). Eco Cities: Rebuilding cities in balance with nature (2nd ed.). New Society Publishers.



6. Spirn, A. W. (2014). The granite garden: Urban nature and human design. Basic Books.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyze the characteristics and functioning of urban environmental systems and resource dynamics.
CO2	Evaluate major urban environmental issues and the impacts of urbanization on climate and ecological balance.
CO3	Assess quality of life and environmental conditions using appropriate urban environmental indicators and assessment methods.
CO4	Apply sustainable planning strategies and environmental management approaches in urban development contexts.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	3	1	2
CO2	3	1	3
CO3	2	2	2
CO4	2	1	3



AR730	URBAN MICROCLIMATE	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the principles of urban climatology and microclimate factors influencing outdoor environments.
CLO2	Analyse the relationship between urban form, climate, and human thermal comfort.
CLO3	Evaluate the impact of vegetation, materials, solar access, airflow, and built form on urban microclimate.
CLO4	Apply microclimate design strategies and simulation approaches in urban planning and design.

COURSE CONTENT

Issues affecting the design of significant places and spaces between buildings through informed knowledge.

Scales of climatic study, Urban Energy Balance, Urban Heat Island. Urban air flow. Energy balance of Human beings in an Urban space, Microclimate design strategies in Urban space.

Thermal preferences, Application of Climatology in Urban Planning and Design. Effect of Vegetation, Materials, Tall Buildings, Daylight, Wind speed, Pedestrian Thermal comfort, safety, over shadowing, solar envelopes.

Thermal comfort in outdoor spaces, People and Open spaces, building layout for daylight, spacing, orientation, solar access, Building form, Landscaping.

Modelling the Urban Microclimate, Case studies.

LEARNING RESOURCES & REFERENCES

1. Brown, R. D., & Gillespie, T. J. (1995). *Microclimatic Landscape Design: Creating Thermal Comfort and Energy Efficiency*. Wiley, London.
2. Emmanuel, R. (2005). *An Urban Approach to Climate-Sensitive Design: Strategies for the Tropics*. Taylor & Francis, London.
3. Erell, E., Pearlmutter, D., & Williamson, T. (2011). *Urban Microclimate: Designing the Spaces Between Buildings*. Earthscan, New York.
4. Littlefair, P. J., Santamouris, M., Alvarez, S., & Dupagne, A. (2000). *Environmental Site Layout Planning: Solar Access, Microclimate and Passive Cooling in Urban Areas*. BRE Publications CRC Ltd., London.
5. Oke, T. R., Mills, G., Christen, A., & Voogt, J. A. (2017). *Urban Climates*. Cambridge University Press, Cambridge.
6. Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 Pandemic: Impacts on Cities and Major Lessons for Urban Planning, Design, and Management. *Science of the Total Environment*, 749, 142391.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand urban climate concepts, energy balance, and urban heat island phenomena.
CO2	Assess thermal comfort conditions and climatic behaviour in outdoor urban spaces.
CO3	Analyse the influence of urban design parameters, such as building form, orientation, spacing, vegetation, and materials, on the microclimate.
CO4	Develop climate-responsive urban design strategies using microclimate modelling and case study analysis.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	2	3
CO4	3	2	3



AR731	URBAN SUSTAINABILITY AND PLACE MAKING	L	T	S	C
		3	0	0	3

COURSE LEARNING OBJECTIVES (CLO)

CLO1	Understand the relationship between urban development, sustainability, and environmental resource management.
CLO2	Analyse urban systems and infrastructure networks at regional, neighbourhood, and building scales.
CLO3	Examine the influence of urban morphology and spatial configuration on residential energy consumption.
CLO4	Interpret placemaking principles and participatory design approaches for creating inclusive and resilient public spaces.

COURSE CONTENT

Urban Development and Sustainability: How human choices and actions led to the exploitation of natural resources and climate change. Urban development patterns are also studied with a focus on issues due to urbanization and the exploitation of natural resources. The ideas of inclusive, equitable, and sustainable growth of towns and cities.

Regional Urban Systems. Macro to Micro Scale: Urban-level services and infrastructure facilities that are involved in shaping neighbourhoods. Understanding the various systems that are responsible for running an ideal neighbourhood, like water management, land use, transportation planning, and other public infrastructure facilities linked with the functioning of the building units.

Urban Form and Residential Energy Consumption: Direct impact of urban morphology on the energy performance of buildings created due to the spatial configuration of the city's urban blocks. Understanding the basic structure of urban morphology and urban design characteristics that affect energy consumption.

Place Making and Urban Life – An essential element in Urban design: Placemaking as a holistic approach to understanding the user perspectives in developing a neighbourhood or simply a public space. The process of placemaking, which strengthens the community and people to create opportunities for participatory design.

LEARNING RESOURCES & REFERENCES

1. Chen, X., Orum, A. M., & Paulsen, K. E. (2013). Introduction to cities: How place and space shape human experience. Wiley-Blackwell.
2. Oliveira, V. (2016). Urban morphology: An introduction to the study of the physical form of cities. Springer.
3. Phillips, E. B. (2010). Thinking about cities. In City lights: Urban-suburban life in the global society (3rd ed.). Oxford University Press.
4. Rode, P. (2014). Cities and energy: Urban morphology and heat energy demand. London School of Economics and Political Science.
5. Steemers, K. (2000). Energy and environment in architecture. E & FN Spon.



COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand the impacts of urbanization, resource exploitation, and climate change on sustainable urban development.
CO2	Evaluate urban systems such as transportation, land use, water management, and public infrastructure in shaping sustainable neighbourhoods.
CO3	Analyse the relationship between urban form, urban morphology, and building energy performance.
CO4	Apply placemaking and participatory design principles to develop inclusive, healthy, and community-oriented urban spaces.

Mapping of Course Outcome with Programme Outcomes

	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	3	2	3
CO4	2	2	3