**II-SEMESTER**

| **INTEGRATED DESIGN STUDIO II** | | | |
|---|---|---|---|
| Course Code | MASA201 | CIE Marks | 100 |
| Teaching Hours/Week (L:S:SDA) | 02:08:00 | SEE Marks | 100 |
| Total Hours of Pedagogy | 10*16 = 160 hrs | Total Marks | 200 |
| Credits | 10 | Exam Hours | - |

**Course Learning objectives:**

The Course aims to bring Architects in coherence with Ecological and Climatological aspects of planning and design. This will reinforce them as rational thinkers integrated with creativity. Also giving a new meaning for technological expression in the field of Architecture and identity to design for being responsible for positive enhancement towards environment and society.

**Module**

**Studio design** with integration of vernacular, cultural, ecology and sustainability aspects in terms of city context, site study, site planning, building configuration, massing, functional zoning, daylight maximization, feasibility for natural or other passive ventilation and cooling, heating concepts, and efficient integration of MEP services.

Architectural integration of passive and hybrid cooling and ventilation systems, renewable energy systems for aesthetic uplift and green building elements and technology as not just an ADDON which can make the project compromise on the Architectural expression.

Daylight integration design with control strategies of Artificial lighting (As part of Integrated Design Studio project), with Simulation assignments of medium and Large scale projects, and corresponding Carbon Emission Reduction as per international Benchmarks.

Capital Expenditure (CAPEX), Operational Expenditure (OPEX) and Return of Investment (RoI).

**Project Deliverables:**

•Design Project Typology and site finalization, Site visit and annual Climatic analysis report (evaluation tools also to be used) (1 week),

•Research modules to be learnt with case studies and aspects to be incorporated in Studio project (2 weeks).

•Architectural, climatological concepts in relation to site, city and local materials and cultural context to be developed (2 weeks).

•Planning, Design methods, evaluation methodology in terms of Architecture, ECM analysis, CAPEX, OPEX and RoI, (5 weeks).

•Working on a design project towards finalization of plan, sections, elevations and materials finalization, Passive, active and hybrid system conceptualization and architectural incorporation of the same in an aesthetic manner as a response to climate, simulation evaluation and reporting - (6 weeks).

| | |
|---|---|
| **Teaching-Learning Process** | ***Direct method****: The lecture supported the conventional method of Blackboard and chalk to introduce concepts.*<br>***Interaction and discussion on drawing board, sketching and conceptualization, design development process, Computer Aided Design and Presentations****.*<br>***Evaluation by simulation****.*<br>***Blended learning:*** *Powerpoint presentation to elaborate more on key topics/online videos.* |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Viva voce is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in Viva is 50% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% in the sum total of the CIE (Continuous Internal Evaluation) and Viva-Voce taken together.

**Continuous Internal Evaluation:**

CIE marks shall be awarded by a committee composed of Principal/Dean, PG Course Coordinator/ HOD and Guide/ Co-guide of the department. The CIE marks awarded for PSC(professional supportive course),shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report.

**Viva voce Examination:**

1. The student needs to submit his/her report done throughout the semester, including the data collection for the Viva examination, at least one day prior to the Viva examination to the PG course coordinator/HOD.
2. The exam shall be conducted as a panel jury exam which shall be minimum of 30 mins/student, where the student shall present the works in form of sheets.
3. Discussions, presentation and the studies should cover all the topics.

**Suggested Learning Resources:**

**Books**

**Skill Development Activities Suggested**

- Guest Lecture from expert.
- Site visit.
- Indian and International Case Studies to understand.

**Course Outcomes**

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

| Sl. No. | Particulars | Blooms Level |
|---|---|---|
| CO1 | Students will be able to understand the vernacular, cultural, ecology and sustainability aspects in terms of city context, site study, site planning, building configuration, massing. | L1,L2,L3 |
| CO2 | Students will be able to understand the Architectural integration of passive and hybrid cooling and ventilation systems,daylight integration design with control strategies of Artificial lighting (As part of Integrated Design Studio project), with Simulation. | L3,L4 |
| CO3 | Students will be able to evaluate Capital Expenditure (CAPEX), Operational Expenditure (OPEX) and Return of Investment (RoI) | L4,L5 |

**Program Outcome of the SA Program**

| Sl. No. | Particulars | POs |
|---|---|---|
| 1 | Approach building design in context with city and site specific ecology aspects. | PO1 |
| 2 | Apply the knowledge of Vernacular architecture and passive design strategies and material technologies from ancient wisdom. | PO2 |
| 3 | Develop design skills in Energy and water Efficient Design and intelligent Buildings. | PO3 |
| 4 | Structure the research study, learning and incorporation of them in planning, design, reporting and implementation. | PO4 |
| 5 | Use simulation tools for improving overall building performance during the master planning, architectural planning, design and design development process, MEP design and development process. | PO5 |
| 6 | Appraise architectural design and assist for documentation for Green building certifications and environmental clearances. | PO6 |

**Mapping of COS and POS**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | **M** | **M** | **L** | **0** |
| **CO2** | **H** | **H** | **H** | **M** | **H** | **M** |
| **CO3** | **L** | **L** | **H** | **M** | **H** | **H** |

**II-SEMESTER**

| **RESOURCE CONSERVATION AND EFFICIENCY** | | | |
|---|---|---|---|
| Course Code | MASA202 | CIE Marks | 50 |
| Teaching Hours/Week (L:S:SDA) | 02:00:02 | SEE Marks | 50 |
| Total Hours of Pedagogy | 04*16 = 64 hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |

**Course Learning objectives:**

The Course extends the knowledge on Direct and indirect resources and embodied energy involved in the building industry, their present availability, extinctions, reduce, recycle, reuse and upcycling of materials at end of their life cycle.
To understand holistic CRADLE to CRADLE approach.
To understand Urban Design aspects of sustainability and approach to NETZERO in terms of Energy, Water and Waste.

**Module-1**

**Life Cycle Analysis (LCA)**: basics and related parameters as /goal definition and scope, Inventory analysis, impact assessment, Interpretation and evaluation, Integration of LCA in decision making, Life cycle Cost assessment.LCA software evaluations

**Module-2**

Project **Embodied Energy** types and understanding calculations for building, Materials and systems. Capital Expenditure (CAPEX), Operational Expenditure (OPEX) and Return of Investment (RoI), project Ecological Footprint, implication on climate change. Expert sessions by industrial experts.

**Module-3**

Case studies of **NET ZERO ENERGY, WATER and WASTE** projects around the world in different climate types. Methodology for **NET ZERO Carbon footprint** planning, design, and execution, Operation & Maintenance, NET ZERO Water and Waste.

**Module-4**

**Urban Design Sustainability approach:** Climatology considerations for Urban design in terms of UHIE, Wind patterns, Wind Chill, impact of urban landscape and water bodies on human comfort level micro climate, cooler urban interaction spaces, Solar Cities and smart cities, smarter integration of city level renewable energy with urban design.Software analysis for UHIE, Wind patterns, Shadow analysis etc. Case studies, reporting and presentation.

| | |
|---|---|
| **Teaching-Learning Process** | ***Direct method****: Lecture supported by conventional methods of Blackboard and chalk to introduce the concepts.*<br>***Blended learning:*** *Powerpoint presentation to elaborate more on key topics.* |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

Three Unit Tests each of 20 Marks (duration 01 hour 30 min)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 13th week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks(duration 01 hours)

At the end of the 16th week of the semester, the sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper will have ten questions.
- Each question is set for 20 marks.
- There will be 2 questions (with a maximum of four sub questions in one full question) from each module.
- Each full question will cover the contents under a module.
- The students have to answer 5 full modules, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

**Life cycle assessment LCA**


- Life Cycle Assessment: Principles and Practice by J.A.F.A. Keoleian and B.A. Menerey
- Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products by Mary Ann Curran


**Net Zero Energy Building Design**


- Net Zero Energy Buildings: A Guide to Designing, Building, and Operating High-Performance Buildings by Edward Mazria
- Net Zero Energy Design: Integrated Design Strategies for High-Performance Buildings by Thomas W. Heberlein and David J.


**Urban Design Sustainability approach**


- Alexander, C. Pattern Language, Oxford University Press, 1977.
- Farr, D. Sustainable Urbanism: Urban Design with Nature, John Wiley &Sons Inc,2007.
- Emmanuel., R., An urban approach to climate sensitive design: strategies for the tropics, Span Press, Taylor and Francis Group,2005.
- UDPFI Guidelines, Part I and Part II. Ministry of Urban development and Poverty Alleviation, Government of India,1996.

**Skill Development Activities Suggested**

- Lectures and Guest Lectures from experts.
- Indian and International Case Studies to understanding like Living Building Challenge – LBC or LEED or IGBC certified NETZERO Energy and CARBON projects etc.

**Web links and Video Lectures (e-Resources):**

**Course Outcomes**

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

| Sl. No. | Particulars | Blooms Level |
|---|---|---|
| CO1 | Understanding of design aspects in terms of Life cycle of the project and mitigation measures for extended responsibility and CRADLE to CRADLE approach. | L2 |
| CO2 | Understanding of project footprint on ecology resources and energy use intensity. | L1,L2 |
| CO3 | Understanding of micro and macro level aspects of sustainable approaches to urban design and its integration with urban space and functional planning. | L2 |
| CO4 | Understanding design of projects with ZERO impact on Energy, water and waste. | L3,L4 |

**Program Outcome of the SA Program**

| Sl. No. | Particulars | POs |
|---|---|---|
| 1 | Approach building design in context with city and site specific ecology aspects. | PO1 |
| 2 | Apply the knowledge of Vernacular architecture and passive design strategies and material technologies from ancient wisdom. | PO2 |
| 3 | Develop design skills in Energy and water Efficient Design and intelligent Buildings. | PO3 |
| 4 | Structure the research study, learning and incorporation of them in planning, design, reporting and implementation. | PO4 |
| 5 | Use simulation tools for improving overall building performance during the master planning, architectural planning, design and design development process, MEP design and development process. | PO5 |
| 6 | Appraise architectural design and assist for documentation for Green building certifications and environmental clearances. | PO6 |

**Mapping of COS and POS**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | **M** | **M** | **L** | **L** |
| **CO2** | **H** | **H** | **H** | **L** | **H** | **M** |
| **CO3** | **M** | **H** | **H** | **M** | **H** | **L** |
| **CO4** | **L** | **M** | **H** | **M** | **H** | **H** |

**II-SEMESTER**

| **GREEN BUILDING TECHNOLOGIES** | | | |
|---|---|---|---|
| Course Code | MASA203 | CIE Marks | 50 |
| Teaching Hours/Week (L:S:SDA) | 02:00:02 | SEE Marks | 50 |
| Total Hours of Pedagogy | 04*16 = 64 hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |

**Course Learning objectives:**

The Course aims to give an technical understanding of how to design buildings which are responding to climate, smart to regulate human comfort conditions, optimize energy based on usage percentage, inturn manage energy, water consumption, smart energy systems by using renewable resources with grid and off grid and captive energy generation systems (project level energy generations).

**Module-1**

Spectrally Selective Films, Electrochromic Glazing and films, PCM facades, NANOGEL panels, Building Integrated Photovoltaic, Heat reflective indoor blinds, Automated creative façades, shading and controls.

**Module-2**

**Renewable energy technologies, feasibility and applications today and future**: Solar PV and farms with Solar tracking system, Solar Hot water, Solar steam generation and cooking, Solar thermal power generation, Solar Air-conditioning, Solar pool heating, Solar Hot water with heat pump integration, Solar hot water with glycol heat exchanger, Micro and Mega wind energy systems, Helical Wind turbines, Hydro power (Macro and Micro)

**Module-3**

**Captive power generations:** Steam Plant, Gas turbine with centralized gas supply, Bio-Methanation gas supply to gas engine, Co-generation of power and waste heat for Vapour Absorption Machines (VAM chillers) for Air-conditioning, Super heat recovery for Hot water generation.

**Module-4**

**IOT based sensor technology and Integrated Building management systems (IBMS)** monitoring and control and Energy Management Systems (EMS), IAQ monitoring and management systems with related ASHRAE codes of design standards, Space utilization pattern and intensity analysis helping in arriving at infrastructure revision approaches, cost control etc.

| | |
|---|---|
| **Teaching-Learning Process across all modules** | ***Direct method****: Lecture supported by conventional methods of Blackboard and chalk to introduce the concepts.*<br>***Blended learning:*** *Powerpoint presentation with case studies from India and worldwide to elaborate more on key topics.* |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

Three Unit Tests each of 20 Marks (duration 01 hour 30 min)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 13th week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks(duration 01 hours)

At the end of the 16th week of the semester, the sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper will have ten questions.
- Each question is set for 20 marks.
- There will be 2 questions (with a maximum of four sub questions in one full question) from each module.
- Each full question will cover the contents under a module.
- The students have to answer 5 full modules, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

- Large-Scale Solar Power System Design: An Engineering Guide for Grid-Connected Solar Power Generation, 1st Edition - Peter Gevorkian.
- Solar Engineering of Thermal Processes Fourth Edition John A. Duffie (Deceased) Emeritus Professor of Chemical Engineering William A. Beckman Emeritus Professor of Mechanical Engineering Solar Energy Laboratory University of Wisconsin-Madison.
- A-B-C of Captive Power Plants -GoutamBandopadhyay.
- Power Generation Operation and Control – Allen J Wood, Bruce F Wollenberg.
- Renewable Energy and Smart Grid technologies, V.K.Jain and Sudhir Kumar.
- SCADA and Power Systems – Praveen Arora.
- SCADA in Energy Management – Tanuj Kumar Bisht.
- Building Management System for Beginners – HAMZA MOHAMED ANSARI.
- Sustainable Smart Grid for SELF-RESILIENT Electricity Sector. – Dr. Neeraj Kumar, Dr. Nitin S Patil, Dr. V.M.Nikale.
- Sustainable Facades, AJLA AKSHAMIJA – Perkins and Wills.
- Dynamic Façade Systems – Impact Evaluation through Simulation and Calculation – SinzianaRasca.
- IoT for Green Building Management WayesTushar, Senior Member, IEEE, Nipuni Wijeratne, Wen-Tai Li, Member, IEEE, Chau Yuen, Senior Member, IEEE, H. Vincent Poor, Fellow, IEEE, Tapan Kumar Saha, Senior Member, IEEE, and Kristin L. Wood

**Skill Development Activities Suggested**

- Guest Lecture from expert.
- Site visits / Interaction with practitioners

**Web links and Video Lectures (e-Resources):**

- C. Arumugam et al._Air-conditioning cost saving and CO2 emission reduction perspective of buildings designed with PCM integrated blocks and roofs Sustain. Energy Technol. Assessments (2021)
- Q. Al-Yasiri et al._Incorporation of phase change materials into building envelopes for thermal comfort and energy saving: a comprehensive analysis J. Build. Eng.
- Solar Power in Building Design the Engineer's Complete Design Resource By Peter Gevorkian.

**Course Outcomes**

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

| Sl. No. | Particulars | Blooms Level |
|---|---|---|
| CO1 | Understanding of alternative systems of energy generation. | L2 |
| CO2 | Understanding of renewable energy based cooling and heating systems. | L2 |
| CO3 | Understanding of integrated energy management and technology based indoor environment and climate responsive systems, controls and management. | L3,L4 |
| CO4 | Understanding of new technologies for building envelope heat gain and heat loss control. | L3,L4 |

**Program Outcome of the SA Program**

| Sl. No. | Particulars | POs |
|---|---|---|
| 1 | Approach building design in context with city and site specific ecology aspects. | PO1 |
| 2 | Apply the knowledge of Vernacular architecture and passive design strategies and material technologies from ancient wisdom. | PO2 |
| 3 | Develop design skills in Energy and water Efficient Design and intelligent Buildings. | PO3 |
| 4 | Structure the research study, learning and incorporation of them in planning, design, reporting and implementation. | PO4 |
| 5 | Use simulation tools for improving overall building performance during the master planning, architectural planning, design and design development process, MEP design and development process. | PO5 |
| 6 | Appraise architectural design and assist for documentation for Green building certifications and environmental clearances. | PO6 |

**Mapping of COS and POS**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **H** | **M** | **M** | **H** |
| **CO2** | **L** | **M** | **H** | **H** | **H** | **L** |
| **CO3** | **L** | **M** | **H** | **M** | **H** | **M** |
| **CO4** | **L** | **M** | **H** | **M** | **H** | **M** |

**II-SEMESTER**

| PERFORMANCE EVALUATION OF BUILDING - II | | | |
|---|---|---|---|
| Course Code | MASA204 | CIE Marks | 100 |
| Teaching Hours/Week (L:S:SDA) | 01:02:01 | SEE Marks | - |
| Total Hours of Pedagogy | 04*16 = 64 hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | - |

**Course Learning objectives:**

The Course aims to give an technical understanding pre-construction and post construction evaluation of how to design buildings which are responding to climate, smart to regulate human comfort conditions, optimize energy based on usage percentage, in turn manage energy, smart energy systems by using renewable resources with grid and off grid and captive energy generation systems (project level energy generations).

**Module-1**

**Introduction to Building Performance Evaluation**

Emerging role of performance evaluation in building design and Master Planning. Integrated approach to environmental design. Cognitive, analytical and simulated modeling and design of buildings.

Integrated energy modeling, thermal zoning simplification for simpler un complicating the model with softwares like IES-VE, DESIGN BUILDER EnergyPlus, Rhino Grasshopper integrated with all LADYBUG, HONEYBEE and Butterfly tools plugins, Basics of PYTHON Scripting.

**Module-2**

**Performance evaluation of project at pre construction stage**

site planning, UHEI, Building floor plate optimization, planning configuration, functional zoning, Massing optimization for mutual shading, direct solar heat control, daylight maximization, Parametric architecture analysis, Energy Conservation Measures (ECM-Design stage),Anticipated CO2 emission and embodied energy carbon footprint,

**Module-3**

**Post construction evaluation**

Post construction evaluation for all parameters with softwares like IES-VE, DESIGN BUILDER EnergyPlus, Rhino Grasshopper integrated with all LADYBUG, HONEYBEE and Butterfly tools plugins.

**Assessment Details (only CIE)**

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 50% of the maximum marks.

**Continuous Internal Evaluation:**

Integration between the Integrated sustainable studio and Performance Evaluation of Building is mandatory. Assignments can be given to aid this.

Three major assignments

- First assignment at the end of 5th week of the semester
- Second assignment at the end of the 10th week of the semester
- Third assignment at the end of the 13th week of the semester

Other exercises during the studio time or can be given as assignments through the duration of the semester.
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs.

At the end of the 16th week of the semester, the sum of three assignments, exercise, and quiz/seminar/group discussion will be out of 100 marks.

**Suggested Learning Resources:**

**Books**

- IES Building Performance Modelling Student Handbook.
- Design Builder Performance Modelling Tutorials.
- RETSCREEN Renewable Energy analysis software Tutorials.

**Web links and Video Lectures (e-Resources):**

- Ladybug, HoneyBee, Butterfly learning online tutorials in integration with Rhino Grasshopper.

**Course Outcomes**

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

| Sl. No. | Particulars | Blooms Level |
|---|---|---|
| CO1 | Understanding of sustainable site planning and infrastructure for Large scale projects. | L2 |
| CO2 | Understanding of Building planning and design aspects with integration of sustainability parameters. | L2 |
| CO3 | Pre-construction evaluation of conceptualization, design finalization of building and MEP. | L4,L5 |
| CO4 | Post construction and operational evaluation of the implemented sustainability concepts to be working as they have to. | L4,L5 |

**Program Outcome of the SA Program**

| Sl. No. | Particulars | POs |
|---|---|---|
| 1 | Approach building design in context with city and site specific ecology aspects. | PO1 |
| 2 | Apply the knowledge of Vernacular architecture and passive design strategies and material technologies from ancient wisdom. | PO2 |
| 3 | Develop design skills in Energy and water Efficient Design and intelligent Buildings. | PO3 |
| 4 | Structure the research study, learning and incorporation of them in planning, design, reporting and implementation. | PO4 |
| 5 | Use simulation tools for improving overall building performance during the master planning, architectural planning, design and design development process, MEP design and development process. | PO5 |
| 6 | Appraise architectural design and assist for documentation for Green building certifications and environmental clearances. | PO6 |

**Mapping of COS and POS**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | **M** | **L** | **H** | **M** |
| **CO2** | **M** | **H** | **H** | **M** | **H** | **M** |
| **CO3** | **L** | **L** | **H** | **M** | **H** | **M** |
| **CO4** | **L** | **L** | **M** | **L** | **H** | **M** |

**II-SEMESTER**

| **SUSTAINABLE INTERIORS - ELECTIVE COURSE** | | | |
|---|---|---|---|
| Course Code | MASA215A | CIE Marks | 100 |
| Teaching Hours/Week (L:S:SDA) | 01:01:00 | SEE Marks | - |
| Total Hours of Pedagogy | 02*16 = 32 hrs | Total Marks | 100 |
| Credits | 02 | Exam Hours | - |

**Course Learning objectives:**
This elective focuses on the integration of sustainable design principles in interior architecture, enabling students to create spaces that are healthy, resource-efficient, and culturally responsive. The course covers material selection, indoor environmental quality, energy efficiency, and lifecycle thinking for interior spaces. Students will develop skills to design interiors that minimize ecological impact while enhancing occupant well-being.

**Module-1**

Fundamentals of Sustainable Interior Design: Definition and principles of sustainable interiors. Relationship between interior architecture and sustainable building design. Role of interiors in occupant health, comfort, and productivity. Overview of green interior design standards and rating systems (GRIHA Interiors, LEED ID+C, WELL Building Standard).

**Module-2**

Material Selection and Lifecycle Assessment: Criteria for sustainable interior materials (renewable, recycled, low embodied energy). VOC emissions and indoor air quality considerations. Lifecycle assessment of finishes, furniture, and fittings. Case studies of eco-friendly material applications in interiors.

**Module-3**

Indoor Environmental Quality (IEQ) : Natural and artificial lighting strategies. Acoustic comfort and noise reduction techniques. Thermal comfort through passive and active systems. Indoor air quality management (ventilation, filtration, humidity control).

**Module-4**

Energy and Resource Efficiency in Interiors: Energy-efficient lighting and appliances. Smart interior systems for energy and water management. Adaptive reuse of furniture and interior elements. Integration of renewable energy within interior spaces.

**Module-5**

Contextual and Cultural Dimensions of Sustainable Interiors: Use of local crafts and indigenous design in interiors. Designing for adaptability and long-term use. Minimalist and low-impact design approaches. Post-occupancy evaluation of sustainable interiors.

**Suggested Learning Resources:**

- *Sustainable Residential Interiors* – Annette Stelmack, Debbie Hindman
- *Sustainable Commercial Interiors* – Penny Bonda, Katie Sosnowchik
- *Green Interior Design* – Lori Dennis
- Bureau of Energy Efficiency (BEE) and GRIHA publications on interior sustainability.
- Selected case studies and research articles from *Journal of Interior Design* and *Energy and Buildings*.

**II-SEMESTER**

| **SYSTEM THINKING AND TECHNOLOGY - ELECTIVE COURSE** | | | |
|---|---|---|---|
| Course Code | MASA215B | CIE Marks | 100 |
| Teaching Hours/Week (L:S:SDA) | 01:01:00 | SEE Marks | - |
| Total Hours of Pedagogy | 02*16 = 32 hrs | Total Marks | 100 |
| Credits | 02 | Exam Hours | - |

**Course Learning objectives:**
This elective equips students with the ability to approach construction as an integrated system, applying systems thinking principles and leveraging modern technologies for sustainable outcomes. It focuses on understanding the interconnections between design, materials, labour, logistics, and performance, while evaluating technological interventions for efficiency, safety, and ecological impact.

**Module-1**

Foundations of Systems Thinking: Principles of systems thinking applied to construction. Understanding construction as a socio-technical system. Interdependencies between stakeholders, processes, and resources. Life-cycle thinking in construction projects.

**Module-2**

Mapping and Analysing Construction Systems: Tools for mapping construction workflows and supply chains. Identification of feedback loops, bottlenecks, and inefficiencies. Systems modelling in pre-construction planning. Case studies on systemic failures and successes in construction projects.

**Module-3**

Technological Interventions in Sustainable Construction:Building Information Modelling (BIM) for integrated project delivery. Digital twin technology for construction monitoring. IoT, sensors, and real-time data in site management. Robotics, automation, and 3D printing in construction.

**Module-4**

Case Studies in Integrated Systems: Net Zero Energy Buildings and Positive Energy Districts. Water-sensitive urban design systems. Climate-adaptive architecture using smart controls. Indian and international examples of system-led sustainable projects.

**Module-5**

From Analysis to Action: Leveraging systems thinking for policy and decision-making. Strategies for resilience in design through technology. Life-cycle approach and circular economy principles.

**Suggested Learning Resources:**

- *Thinking in Systems: A Primer – Donella Meadows.*
- *BIM Handbook: A Guide to Building Information Modeling – Chuck Eastman et al.*
- *Sustainable Construction: Green Building Design and Delivery – Charles J. Kibert.Sustainable Residential Interiors* – Annette Stelmack, Debbie Hindman
- *The Systems View of Life* – Fritjof Capra, Pier Luigi Luisi.
- *Smart and Sustainable Built Environments* – Jay Yang, Peter S. Brandon, Andrew C. Sidwell.
- Research papers from *Sustainable Cities and Society*, *Energy and Buildings*, and *Journal of Urban Technology*.

**II-SEMESTER**

| **POST OCCUPANCY EVALUATION OF BUILDINGS - ELECTIVE COURSE** | | | |
|---|---|---|---|
| Course Code | MASA215C | CIE Marks | 100 |
| Teaching Hours/Week (L:S:SDA) | 01:01:00 | SEE Marks | - |
| Total Hours of Pedagogy | 02*16 = 32 hrs | Total Marks | 100 |
| Credits | 02 | Exam Hours | - |

**Course Learning objectives:**

The Course is designed with the focus on sick Building Syndrome reasons, analysis and solutions during Planning, design of new projects and also Retrofit solutions for existing projects. Post-Occupancy comfort and wellness survey and analysis methodology and Occupants performance assessment case studies with understanding on tangible and intangible benefits to users, employers etc

**Module-1**

Understanding Sick Building Syndrome (SBS) and Building-Related Illness (BRI): Definition, symptoms, and distinction between SBS and BRI. Causes: poor ventilation, contaminants, psychological factors, HVAC issues. SBS in the Indian climatic and cultural context. Regulatory guidelines and WHO recommendations.

**Module-2**

Planning and Design Strategies to Prevent SBS in New Buildings: Indoor Environmental Quality (IEQ) parameters: thermal, visual, acoustic, and air quality. Material selection for low emissions and VOC control. Spatial planning for occupant well-being. Role of passive and active design in preventing SBS.

**Module-3**

Post-Occupancy Comfort and Wellness Survey Methodologies: Designing and administering occupant surveys. Data collection methods: walkthroughs, spot measurements, continuous monitoring. Tools and software for IEQ measurement. Case study reviews of POE surveys linked to SBS identification.

**Module-4**

Retrofit Strategies for Existing Buildings with SBS Issues: Diagnosing problems in existing buildings through POE. HVAC and ventilation upgrades. Lighting and acoustic improvements. Behavioral interventions and operational changes.

**Module-5**

Occupant Performance Assessment and Benefits Evaluation: Linking indoor environment improvements to productivity and health outcomes. Measuring tangible benefits: reduced absenteeism, energy savings, maintenance cost reduction. Measuring intangible benefits: improved morale, job satisfaction, brand value. Case studies from workplaces, educational institutions, and healthcare facilities.

**Suggested Learning Resources:**

- Sick Building Syndrome: What It Is and Tips for PreventionOccupants Health Safety 2016.
- Approaches for predicting long-term sickness absence. Re: Schouten et al. "Screening manual and office workers for risk of long-term sickness absence: cut-off points for the Work Ability Index"_Scand J Work Environ Health 2015
- *Building Evaluation Techniques* – Wolfgang F.E. Preiser, Harvey Z. Rabinowitz, Edward T. White.
- *Sick Building Syndrome: Concepts, Issues and Practice* – Sabah A. Abdul-Wahab.

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