II-SEMESTER

INTEGRATED SUSTAINABLE STUDIO II			
Course Code	2MASA201	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 14 : 112 : 160	SEE Marks	100
Total Hours of Teaching and Learning	300 hrs	Total Marks	200
Credits	10	Exam Hours	-

Course Learning objectives:

The objective of this studio is to develop an integrated approach to sustainable architectural design by synthesising passive environmental strategies, active building systems, renewable energy technologies, and building performance within a coherent architectural proposal. The course develops the ability to resolve sustainable design at multiple scales, from master planning and building configuration to envelope design, technical detailing, and system integration supported by analytical evaluation, environmental simulation, and evidence-based decision-making.

Module

Integrated Systems Studio: Passive + Active + Renewable Integration

This studio advances from the application of individual passive strategies to the **integrated design of high-performance buildings.** The emphasis shifts from understanding climate as a design generator to **coordinating passive environmental principles with active building systems, renewable energy, and water and waste management**. Students are expected to develop integrated design solutions supported by environmental analysis, performance simulation, and evidence-based decision-making, demonstrating how technical systems enhance rather than compromise architectural intent.

Projects are at a **medium-to-large scale**, a campus, institutional complex, or cluster of interconnected buildings thereby introducing greater spatial, functional, and technical complexity than Semester I. The studio should also focus on the resolution of relationships between built forms: mutual shading, wind interaction between volumes, shared infrastructure, and the design of outdoor spaces between buildings with the same rigour as interior spaces. Project sites and climates are deliberately selected so that passive strategies alone cannot consistently achieve comfort. This is a curriculum decision that requires students to demonstrate, through psychrometric analysis, precisely where passive design's limits lie before specifying any active system.

This is the studio in which the building is detailed to the maximum resolution achieved anywhere in the program. The design process should extend through construction-level technical detailing, facade junctions, roof assemblies, services coordination sections and is verified through a full simulation suite using IES-VE or similar tools, water balance calculation, and renewable energy yield assessment.

Key areas of investigation include **HVAC system selection and integration, renewable energy systems, water and waste management design, building envelope optimisation, daylighting, site planning for mutual shading and wind, structural coordination, and technical detailing.** By the end of the semester, students should demonstrate an integrated architectural proposal in which architectural quality, environmental performance, technical feasibility, and building systems are resolved as a single coherent and buildable whole.

Teaching-Learning Process	***Direct method****: The lecture supported the conventional method of Blackboard and chalk to introduce concepts. Interaction and discussion on drawing board, sketching and conceptualization, design development process, Computer Aided Design and Presentations. Evaluation by simulation.* ***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/

DRAFT COPY

Co-guide of the department. The CIE marks awarded shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report.

Viva voce Examination:

- 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.
- 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.
- Discussions, presentations and the studies should cover all the topics.

Suggested Learning Resources:

Books

- Net Zero Energy Design: A Guide for Commercial Architecture by Tom Hootman
- Construction Details for Green Buildings by David Johnston and Kim Master
- High Performance Building Facades by Chris Leung and Craig Schwitter
- Building to Suit the Climate: A Handbook by Gerhard Hausladen, Petra Liedl, Mike de Saldanha
- Modern Architecture and Climate, Design before Air Conditioning by Daniel A. Barber
- Natural ventilation in non-domestic buildings

DRAFT COPY

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	2MASA202	CIE Marks	50
Teaching Learning hours (L:T:S:SL)	28 : 14 : 0 : 48	SEE Marks	50
Total Hours of Teaching and Learning	90 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 the holistic CRADLE to CRADLE approach. and NETZERO in terms of Energy, Water and Waste.

Module-1

Advanced HVAC: High-Performance and Innovative Systems:

- Radiant cooling and heating system, working principle, why they are more energy efficient than convective systems, design constraints (dew point control critical), and Indian climate applicability. Design parameters and typical COP comparison with conventional systems.
- Chilled beams - active and passive, design parameters, applicability by climate zone, coordination with ventilation systems, ceiling height requirements.
- Underfloor air distribution (UFAD) - how it differs from overhead distribution, energy implications, raised floor coordination with structural design.
- VRF systems in depth - how variable refrigerant flow works, zoning flexibility, heat recovery VRF for mixed-use buildings, efficiency parameters (COP, EER, IPLV) and how to compare systems.
- Phase Change Materials integrated with HVAC, PCM in AHU coils, PCM ceiling tiles, load shifting potential and demand Control Ventilation, CO2-based control of fresh air supply.
- Hybrid ventilation systems - the decision logic for when natural ventilation is supplemented with mechanical systems, mixed-mode strategies, and the controls logic that makes hybrid systems work.

Module-2

Lifecycle Analysis and Embodied Carbon:

- Life Cycle Assessment methodology, goal and scope definition, system boundaries, functional unit, inventory analysis, impact assessment, interpretation.
- Embodied carbon calculation, global warming potential of key structural and envelope materials. How to estimate a building's embodied carbon using available databases (ICE database, EC3 tool).
- Capital Expenditure, Operational Expenditure, and Return on Investment, how to build a simple financial model for a sustainable design decision.
- Ecological footprint, what it measures and what a building project's footprint includes beyond operational energy. Land use, water consumption, waste generation, and transportation impacts.
- CRADLE to CRADLE framework, how circular economy principles apply to building material selection and building design for disassembly.
- LCA software introduction - OpenLCA or One Click LCA running a simplified whole-building LCA for a defined scope.

Module-3

Water Systems Design:

- Water demand calculation - occupancy-based water demand estimation for different building typologies. Students calculate daily water demand for their studio project.
- Rainwater harvesting system design - catchment area calculation, first flush calculation, storage tank sizing, water quality treatment requirements.
- Greywater recycling - sources, treatment levels required, reuse applications, system sizing. Design parameters for a simple greywater treatment and reuse system.
- Wastewater treatment at building scale - packaged STP systems, constructed wetlands, phytoremediation. Selection criteria by site type and capacity.
- Water efficient fixtures - flow rates, flush volumes, and the calculation methodology for water use reduction credits under GRIHA and LEED.

DRAFT COPY

Module-4

Waste Systems Design:

- Waste characterisation, types of waste generated, organic, recyclable (paper, plastic, metal, glass), biomedical (healthcare), e-waste, construction waste. Waste generation rates by building type.
- Waste segregation system design, At-source segregation requirements, storage area sizing and location (NBC 2016 requirements), wet waste (organic) versus dry waste (recyclable) versus hazardous waste streams.
- Organic waste treatment systems, Design parameters: retention time, aeration requirements, space requirements. Output: compost for landscape use.
- Bio-methanation, Vermiculture, Construction waste management.

Module-5

NET ZERO Design Methodology:

- NET ZERO Energy: Definition, boundary conditions, accounting methodology. The difference between site energy, source energy, and carbon-equivalent accounting.
- NET ZERO Carbon: Operational carbon versus embodied carbon. The trajectory to net zero over a building's lifecycle.
- NET ZERO Water: Water balance methodology, how to calculate site water balance, strategies to achieve zero discharge.
- NET ZERO Waste: Construction waste management plan, operational waste streams, and the design decisions that affect waste generation.
- Case studies of three to four exemplary projects in different Indian/international climate zones achieving net zero performance, analyzed in terms of the strategies used and metrics achieved.

DRAFT COPY

Teaching-Learning Process	***Direct method**: Lecture supported by conventional methods of Blackboard and chalk to introduce the concepts.* ***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 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 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.

Skill Development Activities Suggested

- Lectures and Guest Lectures from experts.
- Indian and International Case Studies to understand 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

DRAFT COPY

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	2MASA203	CIE Marks	50
Teaching Learning hours (L:T:S:SL)	28 : 14 : 0 : 48	SEE Marks	50
Total Hours of Teaching and Learning	90 hrs	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

The Course aims to build professional-level understanding of renewable energy technologies, advanced building envelope systems, and integrated building management and optimize energy based on usage percentage, in turn manage energy, water consumption, smart energy systems by using renewable resources with grid and off grid and captive energy generation systems.

Module-1

Advanced Building Envelope as Performance System:

- High-performance glazing systems, Spectrally selective glass, Low-E coatings, Double and triple glazing, Reading and interpreting a glazing specification.
- Electrochromic glazing, NANOGEL panels, Aerogel granule insulation in translucent panels, Vacuum Insulated Panels (VIPs), Structural constraints and panel size limitations.
- Automated and kinetic facade systems, PCM facades.
- Envelope moisture management, Vapour barriers versus vapour-open membranes, rain screen principle, drainage cavity design, thermal bridging at junctions.

DRAFT COPY

Module-2

Solar Energy Systems and BIPV:

- Solar resource assessment, Global horizontal irradiance, direct normal irradiance, diffuse horizontal irradiance. Solar resource maps for India.
- Solar PV system, Cell type: monocrystalline, polycrystalline, thin film. System configurations, Sizing methodology, Inverter types.
- Building Integrated Photovoltaics (BIPV), Building Applied PV (PAPV), BIPV typologies, BIPV glazing, Electrical yield calculation for BIPV, Case studies of architecturally resolved BIPV.
- Solar thermal systems, Flat plate collectors versus evacuated tube collectors: working principle, efficiency curve, temperature range, Indian market availability. System configurations: open loop versus closed loop with heat exchanger, drain-back system for freeze protection.
- Solar thermal for space heating, Solar air conditioning, Coefficient of performance, minimum driving temperature required, applicability analysis. Solar pool heating

Module-3

Wind, Hydro, and Ocean Energy Systems:

- Wind energy fundamentals, Urban wind energy, Rural and campus-scale wind energy, small wind turbines (1 kW to 100 kW), Building-integrated wind turbines. Micro-hydro energy, Feasibility conditions, Applicability in Indian context.
- Ocean energy, Wave energy, Tidal energy, Ocean Thermal Energy Conversion (OTEC), Site-specific feasibility assessment methodology.

Module-4

Captive Power, Cogeneration, and Bio-energy Systems:

- Captive power generation, Applicability in Indian context. Load shedding strategies, Gas turbine based captive power, Combined Heat and Power (CHP), Combined Cooling, Heat, and Power (CCHP). Waste heat recovery for hot water generation.
- Bio-methanation, anaerobic digestion process, bacteria types (acidogens, acetogens, methanogens), retention time, temperature requirements. Digestate management, Biomass energy.

Module-5

Intelligent Building Systems:

- IOT sensor technology in buildings, sensor types and their measurement principles, Building Management Systems (BMS), Integrated Building Management Systems (IBMS), Energy Management Systems (EMS), Indoor Air Quality monitoring and management.
- Commissioning and Handover, Monitoring-Based Commissioning (MBCx), Post-occupancy evaluation.

Teaching-Learning Process across all modules	***Direct method**: Lecture supported by conventional methods of Blackboard and chalk to introduce the concepts.* ***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 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 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

DRAFT COPY

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

DRAFT COPY

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

DIGITAL TOOLS FOR ENVIRONMENTAL ANALYSIS - II

Course Code	2MASA204	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 0 : 42 : 64	SEE Marks	-
Total Hours of Teaching and Learning	120 hrs	Total Marks	100
Credits	04	Exam Hours	-

Course Learning objectives:

Designing and Optimizing - Students to move from foundational simulation literacy to professional-grade building performance evaluation capability. The course develops competency in full building energy modeling, pre-construction performance optimization, post-construction evaluation and calibration, and automated simulation workflows.

Module-1

Introduction to Advanced Energy Modelling

IES-VE: interface, model building, ApacheSim, MacroFlo, RadianceIES. Thermal zoning strategy, how to simplify a complex building into a defensible energy model without losing accuracy. **EnergyPlus:** model setup, zone definition, HVAC system assignment, simulation outputs. Emerging role of performance evaluation in building design and Master Planning. Integrated approach to environmental design. Calibrating a model against actual consumption data.

Module-2

Pre-Construction Performance Evaluation

Building massing optimization: parametric studies using Grasshopper + Honeybee. Test 3–5 massing options against each other on EUI, daylight, and solar heat gain. Floor plate optimization for daylight penetration, Facade and fenestration optimization: WWR studies, shading device sizing. Anticipated CO_2 emissions and embodied energy carbon footprint at design stage.

Module-3

Post-Construction Performance Evaluation

What changes between design simulation and actual operation. Measurement and Verification (M&V) methodology: IPMVP protocols. Post-occupancy evaluation (POE) framework: comfort surveys + measured data. Identifying performance gaps and proposing retrofit.

Module-4

Site level Modelling

ENVI-met to model the interactions between buildings, vegetation, soil, water, and the atmosphere at the neighborhood scale. UHEI simulation, pre- and post-development heat island comparison.

Module-5

Advanced Python for Performance Workflows

Introduction to Eppy (Python library for EnergyPlus IDF manipulation). Introduction to machine learning concepts in building performance. Pandas and NumPy for processing large EnergyPlus output files. Matplotlib / Plotly for visualizing simulation results.

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.

DRAFT COPY

Suggested Learning Resources:

Books

- "Building Energy Modeling with OpenStudio" — Larry Brackney, Andrew Parker, Daniel Macumber & Kyle Benne
- "IES Virtual Environment User Guide" — IES Ltd
- "Building Performance Evaluation: From Delivery Process to Life Cycle Phases" — Wolfgang F.E. Preiser & Andrea Hardy
- "Post-Occupancy Evaluation" — Wolfgang Preiser, Harvey Rabinowitz & Edward White
- "Lessons from 40 Years of Monitoring Buildings" — Various authors in Building Research & Information journal

Web links and Video Lectures (e-Resources):

- ENVI-met Documentation and Tutorials https://www.envi-met.com/documents/
- "IES VE Masterclass" — IES YouTube Channel https://www.youtube.com/@IESVirtualEnvironment

Course Outcomes

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

DRAFT COPY

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 MASA 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	2MASA205A	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 14 : 0 : 32	SEE Marks	-
Total Hours of Teaching and Learning	60 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.

DRAFT COPY

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	2MASA205B	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 14 : 0 : 32	SEE Marks	-
Total Hours of Teaching and Learning	60 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*.

DRAFT COPY

II-SEMESTER

POST OCCUPANCY EVALUATION OF BUILDINGS - ELECTIVE COURSE			
Course Code	2MASA205C	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 14 : 0 : 32	SEE Marks	-
Total Hours of Teaching and Learning	60 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.

DRAFT COPY

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.

— — — END OF SEMESTER — — —