I-SEMESTER

INTEGRATED SUSTAINABLE STUDIO I			
Course Code	2MASA101	CIE Marks	100
Teaching Learning hours (L:T:S:SL)	14 : 14 : 84 : 128	SEE Marks	100
Total Hours of Teaching and Learning	240 hrs	Total Marks	200
Credits	08	Exam Hours	-

Course Learning objectives:

The objective of the studio is to develop the ability to interpret climate as the primary generator of architectural form and spatial organization. The course also develops a critical understanding of passive design strategies, enabling students to evaluate both their potential and their limitations within different climatic contexts. By the end of the studio, students will be able to justify design decisions through measurable performance outcomes and demonstrate an integrated approach to climate-responsive and sustainable architectural design.

Module

Foundations Studio: Climate-Responsive Building Design

This studio introduces **climate as the primary generator** of architectural design. It is founded on the premise that architectural decisions like orientation, massing, envelope, material selection, and spatial organisation should emerge as deliberate responses to the climatic conditions of a site rather than as purely formal choices. To establish a rigorous understanding of climate-responsive architecture, the studio focuses exclusively on **passive environmental design strategies.** Mechanical systems are intentionally excluded from the primary design response, requiring students to achieve thermal comfort through architectural form, spatial organisation, envelope design, material selection, and passive environmental principles. This constraint enables students to critically evaluate the capabilities and limitations of passive design before integrating active systems in subsequent studios.

The studio explores **small to medium-scale building typologies** such as a community library, health centre, office, school, or cultural facility. Different students are assigned sites across different climatic zones so that the cohort collectively engages with the full range of passive strategies, and learns from one another's climate-specific solutions. The emphasis is on depth rather than scale, enabling students to develop projects that are thoroughly resolved, environmentally responsive, and supported by rigorous analysis.

Key areas of investigation include **climate analysis, solar geometry, shading and shielding strategies, daylighting, passive thermal comfort, natural ventilation, envelope performance, material properties.** The studio also examines vernacular and contemporary precedents as the basis for developing original climate-responsive design positions. Students investigate the relationship between **climate, building form, and occupant comfort** through manual calculation, analytical drawing, physical and digital modelling. The design process is iterative: hand calculation and analysis precede and inform simulation, not the reverse. This ensures students understand the physics before relying on software to verify it. By the end of the semester, students should be able to present an integrated architectural proposal in which every significant design decision is justified through climatic reasoning and supported by calculation, drawing, and simulation evidence.

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/ 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

- Sun, Wind and Light: Architectural Design Strategies by Mark DeKay and G.Z. Brown
- Climate Responsive Architecture by Arvind Krishan, Nick Baker, Simos Yannas, S.V. Szokolay — Tata McGraw-Hill 2001
- Sustainable Building Design For Tropical Climates
- Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting and More Using Natural Flows by David Bainbridge and Ken Haggard
- The Selective Environment by Dean Hawkes and Wayne Forster

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 that the Environment is a resource with potential for recurring economic returns in a sustainable manner.	L1,L2
CO2	Students will be able to understand the ability to monetize environmental assets by valuing them as significant and needing protection, while reducing intrusive development and promoting low-impact development in harmony with nature.	L2
CO3	Students will be able to evaluate the economic impact of environmental measures that reduce economic performance in traditional models, but also will be able to develop alternate revenue sources to reward the commitment to environmental protection and romote them with incentives.	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	H	M	L	0
CO2	H	H	H	H	L	0
CO3	H	L	L	L	L	0

I-SEMESTER

BUILDING PHYSICS AND HUMAN COMFORT

Course Code	2MASA102	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 give a technical understanding of climatic parameters which influence the building design and better utilization and operation of the building in terms of response to climate, occupants thermal comfort, visual comfort and energy efficiency.

Module-1

Climate Literacy and Weather Data:

- Indian climate zones - Moderate, Warm and Humid, Hot and Dry, Composite, COLD with annual variation patterns, dominant design drivers for each, and logic of why the same building typology performs differently across zones.
- Outdoor weather parameters: DBT, WBT, RH, AH, Solar Insolation, Wind velocity, Precipitation and hands-on measurement exercises on campus using available instruments.
- Theory of Sun path analysis (understanding Altitude angle, Azimuth angle, Angle of incidence, Angle of reflection, variation of solar radiation across the globe and reasons), Solar Passive architecture, sun path analysis, mutual shading, facade shading, basics of daylight assessment, optimization and still controlling the heat gain and corresponding thermal comfort.
- EPW weather file structure and what data is in the file, how it was collected, and its limitations.

Module-2

Building Envelope Physics:

- Modes of heat transfer - conduction, convection, radiation along with manual calculations. U-value, R-value, thermal conductivity, thermal resistance, thermal bridging, thermal mass, thermal lag, and decrement factor.
- Solar properties of materials - SRI (Solar Reflective Index), SHGC (Solar Heat Gain Coefficient), VLT (Visible Light Transmittance), thermal emissivity. Manual calculation of solar heat gain through a glazed facade for a given orientation and time of year.
- Moisture and vapour movement through building fabric, vapour resistance, condensation risk, and dew point calculation.

Module-3

Passive Ventilation and Cooling:

- Natural ventilation principles: pressure difference driven, buoyancy driven, and combined. Venturi effect, wind shadow, positive and negative pressure facades, spacing-to-height ratio between buildings.
- Passive strategies - Cross ventilation; how to size and locate openings for a target air change rate, Stack ventilation and solar chimney; dimensional design method, not just the concept, Earth air tunnels and earth cooling; design parameters for Indian climates, Evaporative cooling; wind catchers, PDEC, direct and indirect with applicability analysis by climate zone, Nocturnal radiative cooling; conditions under which it works and does not work in India.
- Passive ventilation sizing - students learn to calculate required opening areas using simplified methods for a small building.

Module-4

Daylighting Fundamentals:

- Solar spectrum and human visual response - utilizable and non-utilizable daylight, photopic and scotopic vision, the role of colour temperature in visual comfort.
- Sky conditions across Indian climate zones - overcast sky, clear sky, intermediate sky and their implications for daylight availability and glare risk.
- Daylight metrics - Daylight Factor (manual calculation method), Direct Component, Sky Component, Externally Reflected Component, Ground Reflected Component. Introduction to CBDM metrics - DA, UDI, ASE.
- Visual comfort and glare - glare index, cone of vision, contrast ratios. How window size, position, and glazing specification affect both daylight penetration and glare risk simultaneously.
- Daylight design strategies - orientation, room depth-to-ceiling-height ratio, clerestories, light shelves, courtyards, atria.

Module-5

Outdoor Thermal Comfort and Urban Microclimate:

- Outdoor thermal comfort parameters - MRT, UTCI, PET and how they differ from indoor comfort metrics. Why a thermally comfortable building can sit within a thermally hostile outdoor environment.
- Urban Heat Island Effect - causes, measurement, and design mitigation at the building scale. Landscape typologies, surface materials, and building geometry as variables the architect controls.
- Wind in urban environments - funnelling, turbulence nodes, downdraft from tall buildings, sheltering effects. How building configuration at the neighbourhood scale affects pedestrian comfort.
- Impact of landscape on microclimate, tree canopy, green roofs, water features, permeable paving.

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.* ***Lab based learning with measurements and simulation evaluation tools***

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

- **Indoor Thermal Comfort**
    - Human Thermal Comfort By Ken Parsons
    - Thermal Comfort: Principles and Applications by Fanger et al.
    - Thermal Comfort: From Physiology to Architecture by Michael Humphreys
    - Thermal Comfort: A Handbook of Principles and Applications by Michael J. Humphreys
    - Indoor Environmental Quality and Thermal Comfort" by Yacine Ait-Mahieddine
    - Thermal Comfort: Analysis and Applications in Environmental Engineering" by Devdas Menon
- **Passive Heat and Cooling Design**
    - Passive Solar Architecture Heating, Cooling, Ventilation, Daylighting and More Using Natural Flows By David Bainbridge, Ken Haggard
    - Passive Solar Heating and Cooling Design by Edward Mazria
    - Passive Cooling: Design Strategies and Solutions by Mark J. DeKay
    - Passive Solar Design for the 21st Century by Bruce Anderson
    - Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows" by David A. Bainbridge
    - Passive Cooling" by James Kachadorian
- **Climate responsive ARCHITECTURE for tropical climates**
    - Climate Sensitive Architecture: Principles and Practice by Mark Baker
    - Tropical Architecture: Passive and Low-Energy Design by Victor Olgyay
    - The Architecture of Climate: Bioclimatic Building Principles by Givoni
    - Architecture and Climate: An Environmental History of British Architecture 1600-2000" by Dean Hawkes
    - Architecture and Climate: Designing for Low Energy Buildings" by Olgyay and Olgyay
    - Architecture in Hot Climates" by P. Olley and J. Olley
    - Designing for Climate Change: Strategies for Sustainable Buildings and Communities" by Peter F. Smith
    - Tropical Sustainable Architecture: Social and Environmental Dimensions" by Marie-Hélène Contal and Françoise Pambrun
    - Tropical Architecture: Critical Regionalism in the Age of Globalization" by Asia's urban think tank, the Urban Redevelopment Authority

Skill Development Activities Suggested

- Guest Lecture from Industrial experts.
- Site visits.
- Indian and International Case Studies to understand.

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 all tropical and cold climates of India and major climates worldwide.	L2
CO2	Starting points of climate responsive architecture planning and design.	L2,L3
CO3	Understanding vernacular architecture planning and design principles and resources utilization.	L1,L2
CO4	Understanding of Passive design aspects of climatological design for space ventilation, cooling, heating and related thermal comfort and related standards.	L4
CO5	Understanding of preferred human thermal comfort indoors for passive, active and hybrid systems and related standards.	L4
CO6	Understanding of Daylight utilization, controls and energy saving in relation with site planning, building planning, massing and façade design	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**	**H**	**M**	**L**	**0**
CO2	**H**	**H**	**H**	**H**	**L**	**0**
CO3	**H**	**H**	**M**	**M**	**H**	**0**
CO4	**H**	**H**	**H**	**M**	**H**	**M**
CO5	**L**	**M**	**H**	**M**	**H**	**0**
CO6	**L**	**M**	**H**	**M**	**H**	**0**

I-SEMESTER

FUNDAMENTALS OF BUILDING SERVICES			
Course Code	2MASA103	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 give sufficient understanding of building services systems to design around them intelligently. Enhances the capability of the student to think of energy efficiency in projects which is not restrictive to built forms, but still within the international standards definitions.

Module-1

Understanding Building Services:

- The full scope of building services - HVAC (heating, ventilation, air conditioning), plumbing and drainage, electrical supply and distribution, lighting, fire protection, lifts and escalators, building automation and controls, telecommunications and data
- Introduction to MEP load estimation at concept stage, rule-of-thumb calculations for lighting power density, plug load density, occupancy-driven ventilation requirements, and peak cooling load for different building typologies.
- Services and sustainability - the hierarchy of demand reduction first, passive systems second, efficient active systems third, renewable energy fourth.
- Services coordination basics - how structural grids, floor-to-floor heights, ceiling voids, and core locations are driven by services requirements.

Module-2

HVAC Fundamentals:

- Basic refrigeration cycle - how a vapour compression system works. COP definition and what drives it.
- HVAC system typologies - central plant with AHUs, split systems, VRF systems, DOAS at a conceptual level. What each system is, what building types it suits, and what its energy implications are.
- Indoor air quality fundamentals - CO_2 as a proxy for occupancy-driven ventilation demand, ASHRAE 62.1 ventilation rates, filter types and MERV ratings.
- ASHRAE standards overview - 55 (thermal comfort), 62.1 (ventilation), 90.1 (energy), what each covers and how they relate to each other and to ECBC 2017.

Module-3

Artificial Lighting Fundamentals:

- Light physics - the electromagnetic spectrum, luminous flux, luminous intensity, illuminance, luminance. The difference between lux and lumens and why both matter.
- Photometric parameters - CRI, colour temperature, LPD (Lighting Power Density), ballast factor, beam angle. How to read a luminaire datasheet and extract the parameters needed for design.
- Lighting technologies - LED, fluorescent legacy systems, metal halide, lifespan, and application comparison. Why LED has become the default and what its remaining limitations are.
- Lux levels by space type - IESNA and NBC 2016 requirements for offices, classrooms, hospitals, retail, industrial. Occupancy sensors, daylight sensors, dimming, time scheduling. How controls reduce actual energy consumption versus installed capacity.
- Circadian lighting and WELL Building Standard, the emerging science of light's effect on human health beyond visual task performance.

Module-4

Acoustic Fundamentals:

- Sound basics and room acoustics: decibels, frequency, wavelength, and how human hearing perceives them. Reverberation time, absorption, reflection, diffusion. How room geometry and surface materials determine acoustic quality. Sabine's formula for reverberation time.
- Airborne and impact sound transmission - STC (Sound Transmission Class) and IIC (Impact Isolation Class) ratings for walls, floors, and doors. How to read these ratings and select assemblies for a required performance level.
- Acoustic design strategies - acoustic zoning in building planning (separating noisy and quiet spaces), buffer zones, orientation of noise-sensitive spaces away from external noise sources, mechanical noise control.
- Noise criteria for occupied spaces - NC curves. Connection to HVAC duct velocity and equipment selection.

Module-5

Integrated Services and Architectural Design:

- Case studies of buildings where services integration is architecturally expressed - The Edge Amsterdam, Bullitt Center Seattle, CEPT Faculty of Technology Ahmedabad, and Indian examples where passive and active systems are architecturally visible rather than hidden above ceilings.
- Design review methodology - how to evaluate a design scheme against services performance criteria before engaging MEP engineers. Checklists for ventilation, lighting, acoustic, and thermal performance at schematic stage.

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.* ***Lab based learning with measurements and simulation evaluation tools***

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

Basics of HVAC

- Simplified Design of HVAC Systems By William Bobenhausen
- HVAC Systems and Equipment: Design and Applications by William M. C. Boyce
- Fundamentals of HVAC Systems by William M. C. Boyce
- HVAC Systems and Controls: A Practical Guide by William H. McShane
- HVAC Design Sourcebook" by W. Larsen Angel
- Fundamentals of HVAC Systems" by Robert McDowall.

Basics of Lighting

- International Lighting Design By V. Lorenzo Porcelli, Donna Green
- Lighting Design: Principles and Applications by Mark S. Rea
- Lighting Design Handbook by Bill Speck
- Lighting Design: A Visual Approach by Mark S. Rea and Richard K. Weller
- Lighting Design Basics" by Mark Karlen and Christina Spangler
- Architectural Lighting: Designing with Light and Space" by Herve Descottes and Cecilia E. Ramos

Skill Development Activities Suggested

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

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Basics of HVAC systems and related parameters for design of MEP as integral part of building design.	L2,L3
CO2	Understanding of application and feasibility analysis parameters of conventional and innovative HVAC system technologies worldwide for integral design	L2
CO3	Technical and aesthetical aspects of lighting design for an integrated approach. Also related energy efficiency with daylight integration	L3
CO4	Design of lighting with understanding of standards in an innovative approach	L3

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	M	H	M	H	M
CO2	L	M	H	H	M	L
CO3	L	L	M	M	H	L
CO4	L	L	H	M	H	L

I-SEMESTER

DIGITAL TOOLS FOR ENVIRONMENTAL ANALYSIS - I

Course Code	2MASA104	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:

Understanding and Measuring - To equip students with the foundational knowledge, measurement vocabulary, and introductory simulation skills required to evaluate a building's environmental performance. The course positions performance evaluation as an integral design instrument rather than a post-design audit.

Module-1

Conceptual Foundations

Introduction to building performance evaluation. The difference between cognitive modeling (mental models), analytical modeling (calculations), and simulated modeling (software). Overview of the integrated design process and where performance evaluation intervenes schematic, design development, construction, post-occupancy.

Module-2

Human Comfort Evaluation

Understanding climate **ClimateConsultant** and **CBE Thermal Comfort Tool.** Adaptive thermal comfort model and when it applies, PMV (Predicted Mean Vote) and PPD (Predicted Percentage Dissatisfied), ASHRAE 55 Standard: Standard thermal comfort model, ISHRAE etc. Understanding the gap between designed comfort and occupied comfort.

Module-3

Introduction to Rhino + Grasshopper environment

Introduction to **Rhino + Grasshopper environment** setup and interface logic, **Ladybug tools:** EPW weather file import, sun path diagrams, radiation analysis, wind rose, outdoor thermal comfort (UTCI), **Honeybee:** basic energy model setup zones, constructions, schedules, loads, **Butterfly:** introduction to CFD for wind analysis around buildings. Running a simple shoebox energy model and interpreting outputs.

Module-4

Introduction to other Simulation Software

Introduction to **PreDesign, Sefaira** as an early-stage building performance simulation tool. **EC3** to reduce the embodied carbon of construction materials. **One click LCA** for whole-building life cycle assessment, embodied carbon analysis, and green building certification. Opaque 3 to analyze the thermal performance of opaque building elements such as walls and roofs.

Module-5

Introduction to Python Scripting

Why scripting matters in parametric performance evaluation, Python basics: variables, loops, functions, libraries. Simple scripts: automate sun hour calculations, export simulation outputs to CSV, batch rename files. Using Python within Grasshopper (GhPython component).

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

- "Building Performance Evaluation: From Delivery Process to Life Cycle Phases" — Wolfgang F.E. Preiser & Andrea Hardy
- "Sun, Wind & Light: Architectural Design Strategies" — Mark DeKay & G.Z. Brown
- "A Pattern Language for Performance-Based Design" — Wolfgang Preiser
- "Fundamentals of Integrated Design for Sustainable Building" — Marian Keeler & Bill Burke
- "Algorithmic Architecture" — Kostas Terzidis
- "The Grasshopper Primer" — Andrew Payne & Jason Fierro (Mode Lab)
- Python for Everybody: Powerful Object-Oriented Programming by Bill Lubanovic
- James Douglas "Building Adaptation", Elsevier, Oxford2002.
- Clarke, J.A., Energy Simulation in building design, Adam Hilger Ltd, Bristol,1985
- Automate the Boring Stuff with Python by Al Sweigart

Web links and Video Lectures (e-Resources):

- MIT OpenCourseWare — 4.401 Introduction to Building Technology https://ocw.mit.edu
- CBE Thermal Comfort Tool https://comfort.cbe.berkeley.edu

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Understanding experimental techniques for building assessment.	L2,L3
CO2	Understanding the impact of built form on the environment.	L2
CO3	Understanding issues and opportunities with current assessment modes /evaluation tools.	L2
CO4	Understanding scripting to customize the program.	L2,L3

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	**M**	**M**	**H**	**M**	**H**	**M**
CO2	**H**	**M**	**H**	**M**	**H**	**L**
CO3	**M**	**L**	**H**	**M**	**H**	**L**
CO4	**0**	**0**	**L**	**L**	**H**	**L**

I-SEMESTER

SUSTAINABILITY AND ENVIRONMENT			
Course Code	2MASA105	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	-

Course Learning objectives:

The Course aims to provide understanding of origins of sustainability from the global to the individual. It will help designers and thinkers with a clear understanding of impacts of building and infrastructure on the macro and micro level ecological aspects. Also expanding their knowledge on the global impacts, their role to mitigate the negative impacts.

Module-1

The Idea of Sustainability:

- Introduction to the term sustainability, the origin, Rachel Carson; Silent Spring (1962), The Club of Rome and Limits to Growth (1972), The 1972 Stockholm Conference, E.F. Schumacher; Small is Beautiful (1973), The Brundtland Report (1987), Our Common Future 1987, The Rio Earth Summit (1992), The Paris Agreement (2015).
- Environmentalism vs Ecologism, The roots of sustainability, The three pillars and their problems, Circle of Sustainability, The SDGs.

Module-2

The Planetary Crisis:

- Ecological footprint, Footprint calculation methodology, Global biocapacity, India's biocapacity, Ecological deficit and ecological reserve, Earth Overshoot Day, Fair Earth Share.
- Earth's energy balance, building sector's specific contribution, Climate feedbacks and tipping points, Implications for building design. India's Climate Vulnerability.

Module-3

How cities work and Consume:

- Linear and Cyclical Consumption, Ecological consequence of linear consumption, Principles of circular economy, hierarchy of cyclical strategies, nature of needs versus wants.
- Urban metabolism, Key flows in cities, Manuel Castells: The Space of Flows, Urban information flows and smart cities.

Module-4

Alternative Models of Living:

- Eco-Villages, Ecological design principles, Case study both in India and Abroad, Critical evaluation of eco-villages.
- Sustainable Cities, Frameworks for evaluating sustainable city performance, Case study both in India and Abroad, Sustainable cities and scale.

Module-5

Agency, Ethics, and Action:

- Spatial Agency, Conventional architecture model and Other Ways of Doing Architecture, Case examples. Systems thinking and leverage points, Personal Sustainability Ethic, Sustainability ethic as an architect.
- One major exercise covering all the understanding of the above modules.

Teaching-Learning Process across all modules	***Direct method**: The lecture supported the conventional method of Blackboard and chalk to introduce sustainability as a long term process and not one time effort. Discussions, Debate, Industry interactions for the same.* ***Blended learning:** Powerpoint presentation to elaborate more on key topics/online video's/ live examples of projects etc.*

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:

The CIE marks awarded for PCC (Professional Core 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:

- 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 20 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:

- Our Common Future - Brundtland Commission
- Silent Spring - Rachel Carson.
- The Most Comprehensive Plan Ever Proposed To Reverse Global Warming - Paul Hawken
- This Changes Everything: Capitalism Vs The Climate - Naomi Klein
- Spatial Agency: Other Ways of Doing Architecture
- Principles Of Sustainability By Simon Dresner, 2005 Earth Scan
- Sustainable Architecture By Simon Guy And Steven Moore 2005, Spon Press
- The Uninhabitable Earth: Life After Warming - David Wallace-Wells
- Why We Build — Rowan Moore.

Web links and Video Lectures (e-Resources):

- Global Footprint Network — https://www.footprintnetwork.org
- Our World in Data — https://ourworldindata.org
- Carbon Brief — https://www.carbonbrief.org
- Down to Earth — https://www.downtoearth.org.in — Best India-specific environmental journalism.
- Spatial Agency database — https://www.spatialagency.net
- Global Ecovillage Network — https://ecovillage.org

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Students have an understanding of the implication of building industry on climate change and Biodiversity.	L2
CO2	To have understanding of approaches with lower ecological footprint for the master planning and building design.	L2
CO3	Understanding of importance towards water resources and decision making of project carrying capacity accordingly to try and achieve NETZERO water footprint.	L2,L3
CO4	Understanding of importance towards Waste segregation, management, upcycling and use of waste for power generation. This helps in achieving NETZERO waste footprint.	L2,L3

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	H	M	L	L
CO2	H	M	H	H	M	L
CO3	L	L	M	M	H	L
CO4	L	L	H	M	H	L

I-SEMESTER

SUSTAINABLE DEVELOPMENT LAWS IN INDIA - ELECTIVE COURSE			
Course Code	2MASA106A	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 developed to focus on regulatory mechanisms and commitments to environmental protection and regulation, while ensuring that long terms goals of country can be achieved - a perspective on why regulation is needed in the larger scheme of things, while we also look at how and what day to day impacts are there on businesses, development and implementation of projects.

Module-1

Introduction to Sustainable Development and Legal Framework: Concept of sustainable development in the Indian context. Evolution of environmental law and policy in India. International conventions influencing Indian legislation (Rio Declaration, Paris Agreement, UN SDGs). Constitutional provisions: Articles 48A and 51A(g).

Module-2

Key Environmental and Resource Management Laws: Environment (Protection) Act, 1986. Water (Prevention and Control of Pollution) Act, 1974. Air (Prevention and Control of Pollution) Act, 1981. Forest Conservation Act, 1980; Biological Diversity Act, 2002. Coastal Regulation Zone (CRZ) Notification.

Module-3

Building, Planning, and Energy Regulations: National Building Code (NBC) provisions related to sustainability. Energy Conservation Building Code (ECBC) and Eco-Niwas Samhita. Green rating systems: GRIHA, IGBC, LEED India – legal and voluntary alignment. Urban and regional planning acts integrating sustainability principles.

Module-4

Land Use, Climate Resilience, and Heritage Protection Laws: Town and Country Planning Acts (state-specific). Land acquisition and land use zoning for sustainable projects. Climate change mitigation and adaptation policies. The Ancient Monuments and Archaeological Sites and Remains Act (heritage-sensitive development).

Module-5

Implementation, Compliance, and Case Studies: Environmental Impact Assessment (EIA) process and legal requirements. Public Interest Litigation (PIL) in environmental matters. Case studies of landmark judgements in sustainable development and environmental protection. Best practices for integrating legal compliance into architectural design workflows.

Suggested Learning Resources:

- Environmental Law in India – P. Leelakrishnan
- Sustainable Development Law, Principles, Practices and Prospects – Marie-Claire Cordonier Segger, Ashfaq Khalfan
- Textbook on Environmental Law – Shyam Divan, Armin Rosencranz
- Relevant Acts, Rules, and Notifications from the Ministry of Environment, Forest and Climate Change (MoEFCC), Bureau of Energy Efficiency (BEE), and state-level planning authorities.
- Selected Supreme Court and National Green Tribunal (NGT) judgements.

I-SEMESTER

MATERIAL SCIENCE - ELECTIVE COURSE			
Course Code	2MASA106B	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 explores the science, properties, and applications of building materials with a strong focus on sustainability. The course encourages critical thinking on the environmental impact, life-cycle performance, and cultural appropriateness of materials in architecture. Students will examine both conventional and alternative materials, innovations in sustainable material technologies, and the integration of material science into architectural design for resilience and reduced ecological footprint.

Module-1

Fundamentals of Material Science, Basic physical, chemical, and mechanical properties of building materials. Understanding material behavior under different environmental and load conditions.

Module-2

Sustainable material sourcing and Life cycle analysis, Principles of sustainable material selection. Life-cycle assessment (LCA) for environmental impact evaluation. Cradle-to-cradle and circular economy approaches in material use.

Module-3

Traditional and Indigenous Materials in modern contexts, Hybrid approaches combining traditional and modern materials. Preserving cultural identity through material choice.

Module-4

Innovative and Emerging sustainable materials, Low carbon cement alternatives, Bio based materials, smart materials, recycled and upcycled materials.

Module-5

Performance, testing and Applications, Methods for testing and evaluating material performance. Durability, thermal performance, and moisture control. Fire resistance, acoustic properties, and structural applications. Integrating material selection with passive and active building strategies.

Suggested Learning Resources:

- Materials for Sustainable Sites – Meg Calkins
- Sustainable Construction Materials (Series) – Khatib, J.M.
- Building Materials: Properties and Performance – Lawrence W. Fung
- Selected research papers and case studies from journals such as Construction and Building Materials, Journal of Cleaner Production, and Energy and Buildings.

I-SEMESTER

INDIGENOUS KNOWLEDGE SYSTEM - ELECTIVE COURSE			
Course Code	2MASA106C	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 as an elective with the focus on understanding the idea of sustenance as being maintainable over a long time. Traditional knowledge systems allow us to understand lifestyle and cultural choices that have become ingrained in people from simple dietary choices to planning principles based on resource availability to infrastructure management.

Module-1

Study of Traditional buildings case studies and analysis based on climate, cultural practices and beliefs and an understanding of passive and active systems used as climatic responses that have sustained overtime.

Module-2

Study of Traditional Planning principles and zoning laws driven by industry and type of work.

Module-3

Understanding the impact of available resources and infrastructure in the development of sustained cultural and traditional practices such as building construction, social space creation and management and infrastructure development, ownership and operations.

Module-4

Traditional stimulants for trade, economic activity and other requirements that drove local economies. Traditional methods and practices related to water harvesting, management and curation of and maintenance of public spaces, gardens and amenities

Module-5

Ecologically sensitive responses of various traditional knowledge systems to their surrounding context, climate and other natural and environmental phenomena.

Suggested Learning Resources:

- Traditional Ecological lKnowledge: Learning from Indigenous Practices for Environmental Sustainability, MelissaK.Nelson, DanielShilling
- Sustaining Traditional Agricultural Practices for Food Security, VKDubey, Shailendra Nath Ghosh

— — — END OF SEMESTER — — —