I-SEMESTER

INTEGRATED DESIGN STUDIO I			
Course Code	MASA101	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.

It will explore the technological expression in the field of Architecture and identity to design for being responsible for positive enhancement towards environment and society.

Module

Research Modules: Study reports and PPT presentations

- **Parametric Architecture design** approach integrating Aesthetics and sustainability aspects Case studies.
- **Water management systems from vernacular settlements:** (stepped wells, Jhalaras, Kunds), passive thermal comfort.
- **Renewable Energy sources:** Micro-wind, Micro hydro, Bio-methanization, Power generation by Magnets.
- **Climatological response by building envelope:** Solar Façade, Roof Pond/ Skytherm, Green walls, Green roofs, Roof radiation trap, Phase Change Materials (PCMs), EarthBerm Structures and corresponding energy efficient and passive thermal comfort.

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.

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 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, presentations and the studies should cover all the topics.

Suggested Learning Resources:

Books

- 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.
- The New Science of Building: How to Create Healthy, Energy-Efficient, and Sustainable Homes by Joseph Lstiburek
- Net Zero Energy Design: A Guide for Commercial Architecture by Tom Hootman
- Net Zero Energy Buildings: Case Studies and Lessons Learned" by Karsten Voss and Claus Steffan

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 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 promote 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 PASSIVE DESIGN			
Course Code	MASA102	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 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 types like Moderate, Warm and Humid, Hot and Dry, Composite, COLD and CLOUDY, annual variations and impact of it on built environment and climatological design approach in various climates of India and other climate typologies around the world. With Detailed understanding of weather outdoor parameters like DBT, WBT, RH, AH, Solar Insolation, Wind velocity, Precipitation, Inversion, Learning thorough measurements and relation between them.

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 planning configuration, massing and design with sun path analysis, mutual shading, facade shading sizing and design, basics of daylight assessment, optimization and still controlling the heat gain and corresponding thermal comfort.

Theory on Outdoor thermal comfort, wind movement and utilization (Venturi effect, wind shadow, Positive pressure façade, Negative pressure facades, Air turbulence nodes, spacing to height ratio between buildings), Urban Heat Island effect, impact of landscape typologies on the campus and city level planning of spaces, activities etc.

Module-2

Material Science: Thermal Physics basics (modes of heat transfer conduction, convection and radiation) and building material thermal and light properties: U-value, Thermal lag, Thermal conductivity, Thermal conductance, Thermal Emissivity, diffusivity, Sensible heat gain, Latent Heat gain, Thermal Resistance, Thermal Bridging, Solar Reflective Index - SRI, Solar Heat Gain Coefficient, Visible light transmittance and parameters, theory, calculations, Use of simple software tools for the same.

Module-3

Theory and manual calculations: Natural ventilation in buildings, basic principles and conceptual understanding of the Passive ventilation (solar Chimney, Stack ventilation, Cross ventilation enhancement by space planning, sizing and fenestration sizing and location), hybrid ventilation, Passive Cooling and heating (PDEC - wind catchers, trombe walls, Solarium, concepts and corresponding fluid dynamics, venturi effect and its benefits in space planning and facade design, Thermal storage wall, water wall, Transwall, Thermal storage / Isolated Gain, Evaporative cooling (Direct, indirect, Sensible evaporative cooling), Nocturnal radiative cooling, Passive desiccant cooling, Vary therm wall and related thermal comfort.

Lab-Demonstrations of passive strategies on the campus. Stack effect, Wind catchers,PDEC, External and internal shading, Heat reflective tiles and paints, Sun pipes, efficient glazing, could be designed.

Module-4

INDOOR Standard Human Thermal comfort and Adaptive Human Thermal comfort, Asymmetric thermal comfort: parameters for indoor occupant spaces (Dry Bulb Temperature, Wet Bulb Temperature, Relative Humidity, Absolute Humidity, Air density, CLO value, METABOLIC RATE Value, Air velocity, Mean Radiant Temperature, Zone Operational Temperature) and Introduction to Psychrometric charts, Bioclimatic chart, Design Day calculations, Diurnal temperature variations and benefits. Related WELLNESS factors.

Module-5

Daylight studies understanding Solar spectrum, Utilizable and non-utilizable daylight, types of sky conditions in various climates, Daylight factor, Direct component, reflected component, ground reflection, Sky component, Outdoor sky illuminance, Daylight guiding techniques into buildings like optical fiber based and sunpipes, Human eye light sensitivity and utilization, Visual discomfort glare and Glare index in respect to cone of vision of occupant towards the daylight source.

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 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

- **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

- **Daylight in the Built Environment and Integration with Artificial Lighting**
  - Daylighting and Integrated Lighting Design" by Christopher Meek, Kevin Van Den Wymelenberg, and Gregory Ward
  - Light: Nature's Creation, Science, and Technology by Howard E. Gruber
  - Lighting Design: Principles and Applications by Mark S. Rea

- **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 LIGHTING AND HVAC			
Course Code	MASA103	CIE Marks	50
Teaching Hours/Week (L:S:SDA)	02:01:00	SEE Marks	50
Total Hours of Pedagogy	03*16 = 48 hrs	Total Marks	100
Credits	03	Exam Hours	3

Course Learning objectives:

The Course aims to bring Architects in coherence with integration of electro mechanical systems with a creative aspect to it.

Enhances the capability of an architect to think of energy efficiency in projects which is not restrictive to built forms, but still within the international standards definitions.

Module-1

Basics of Heating Ventilation and Air-conditioning:

- Brush up on basics of HVAC and related thermal comfort parameters from undergraduate syllabus.
- Introduction to ASHRAE standards.
- Introduction to Latest HVAC technologies today in the national and international market with their positive impact on energy efficiency, thermal comfort and wellness aspects.
- Critical aspects understanding of all HVAC components and their role in energy efficiency of the systems. Understanding of efficiency parameters COP, EER, IPLV, SEER, Watt/CFM, Diversity factors for efficient system sizing based on building typology and functional schedules.
- Energy efficiency control components, VFD, EC motors, Direct drive fans.

Module-2

Understanding working principles of:Radiant cooling and heating, chilled beams, Phase Change Materials (PCMs) integrated HVAC systems, Under floor Air distribution, Individual thermal comfort control. Introduction to ASHRAE standards for all components of HVAC.

Air quality control components: Filter types and standards, UV sterilizers, Ionizers, Scrubbers.

Module-3

Basics of Artificial lighting design learning by measurements: Introduction to Basics of light physics, Luminaire Photometric and parameters (CRI, Color temperature, Wattage, Lumens, LUX, Foot candle, Ballast factor, Ballast Power factor, Light Power Density, Lux sensors, Occupancy sensors, Dual sensors) etc and various lighting technologies with understanding of its selection parameters, application parameters,

Module-4

Introduction to IESNA standards. Critical aspects of understanding of all Lighting components and their role in energy efficiency of the systems. Related WELLNESS factors with Lux levels and circadian lighting.

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 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

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

PERFORMANCE EVALUATION OF BUILDING - I			
Course Code	MASA104	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:
To investigate the simulation and audit techniques for assessing the energy performance, environmental response and impact of built form.

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

Environmental Assessment Methods
Modeling and experimental techniques for building assessment/evaluation and design. Standard Human Thermal comfort and Adaptive Human Thermal comfort parameters . Understanding of ASHRAE thermal comfort tools, PMV tools. Issues and opportunities with current assessment modes/evaluation tools.

Module-3

Integrated Modeling
Introduction to Integrated energy modelling, thermal zoning simplification for the model with softwares like IES-VE, DESIGN BUILDER EnergyPlus, Rhino Grasshopper integrated with all LADYBUG, HONEYBEE and Butterfly tools plugins.

Module-4

Python Scripting
Introduction to Python scripting to build capability of customizing the programs for parametric architectural modeling integrated with sustainable design, analysis and arriving at solutions .

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

- Python for Everybody: Powerful Object-Oriented Programming by Bill Lubanovic
- Kabele, K., Modeling and analyses of Passive solar systems with computer simulation, in Proc. Renewable energy sources, PP. 39 – 44, Czech Society for Energetics Kromeriz 1998.
- 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
- Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes
- Fluent Python: Clear, Concise, and Effective Programming by Luciano Ramalho
- Effective Python: 90 Specific Ways to Write Better Python by Brett Slatkin

Web links and Video Lectures (e-Resources):

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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 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	**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	MASA105	CIE Marks	50
Teaching Hours/Week (L:S:SDA)	03:00:01	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 create designers and thinkers with 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

Introduction to Basics of **Climate change and Global Warming** worldwide scenario, Global agreements, Policies. Direct and In-direct impacts of Climate change policies and agreements on Building industries.

Module-2

Introduction to Basics of **Biodiversity loss, over-exploitation of natural resources**, air & water pollution and their relationship with the built environment.

Module-3

Basics of hydrology and water sustainability and management With introduction to Site Ecology related to hydrology (flora, Fauna, Urban Agriculture, and Water efficient Landscape), Rain water harvesting and ground water table improvisation techniques, rainwater storage systems, Wastewater treatment (recycle) and REUSE, efficient irrigation systems, Water efficient water fixture selection. Government policies in India and worldwide.

Understanding the critical design considerations for Water management system design at Urban services planning, campus level, low rise buildings, high-rise buildings, sky scrapers, industrial buildings, Health care projects, Institutional projects, Mass transport buildings and related Energy, water use and efficient systems

Module-4

Basics of Waste management: With introduction to Types of Waste segregation methodology, Recyclable Waste reuse and Upcycling, Power generation from organic waste, worm composting, Government policies in India and worldwide.

Understanding the critical design considerations for Waste management system design at Urban services planning, campus level, low rise buildings, high-rise buildings, sky scrapers, industrial buildings, Health care projects, Institutional projects, Mass transport buildings and related Energy, water use and efficient systems

Module-5

Understanding **vernacular Architecture** Case study projects in terms of climatological response by Sustainable Architectural master planning, building zoning, planning, massing, material selection in terms of local availability and methodology of usage, Passive ventilation, cooling and heating methods used, Thermal comfort research from literature studies (or Thermal comfort Audits if given access) etc.

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 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

- DRAWDOWN: The Most Comprehensive Plan Ever Proposed To Reverse Global Warming - PAUL HAWKEN
- THIS CHANGES EVERYTHING: CAPITALISM VS THE CLIMATE - NAOMI KLEIN
- 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

Skill Development Activities Suggested

- Guest Lecture from expert.
- 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 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	MASA116A	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 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	MASA116B	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 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	MASA116C	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 as an elective with the focus on understanding the idea of sustenance as being maintainable over a longtime. 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 — — —