III-SEMESTER

BUILDING PERFORMANCE AND ANALYSIS STUDIO			
Course Code	MASA301	CIE Marks	100
Teaching Hours/Week (L:S:SDA)	02:08:00	SEE Marks	100
Total Hours of Pedagogy	10*16 = 160 hrs	Total Marks	200
Credits	10	Exam Hours	-

Course Learning objectives:

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

Module

Site selection, Building Typology selection, under a particular Climate type for campus planning and design project.

Campus level criteria based approach learning from LBC, GRIHA, IGBC, LEED Methodology for aspects like Built and unbuilt, Site ecology aspects like Flora, Fauna, Green Leaf index, Pre-and Post UHIE (simulation based), Pre-and Post-Percolation and achieving ZERO Discharge from site, ZERO discharge of construction waste, ZERO discharge of Organic waste and reused for campus landscape and energy generation from waste.

Campus planning and zoning, building configuration to reduce the direct solar heat gain in tropical climates and increase direct solar heat gain in COLD climate. Optimization of daylight utilization with integration of façade glazing optimization and appropriate building material selection for building envelope, Facade shading etc.

Building space planning , zoning and massing configurations as a climate response for sustainable space planning by regulation and utilization of wind, light, Solar access in integration with passive cooling, heating and other Hybrid systems and related energy savings.

Performance based Energy modeling of Larger scale residential, commercial, institutional, Industrial and Hospitality, Health care projects in line with the various green building tools methodology of defining Base case and arriving at recommended proposed case to attain required and exemplary level of energy efficiency.

MEP systems:Preliminary design, typology finalization and sizing of the systems for the respective above listed building typologies selected.

Simulation based NET ZERO Energy, Carbon emission approach including all master planning, Architecture and MEP aspects. Simulation based LCA and embodied energy analysis and methodology to reduce the project ecological footprint.

Understanding in detail all related criteria under the selected green building tool system and also learning the assessment tool in terms of using calculators, reporting, review etc.

Project Deliverables:

- Design Project Typology and site finalization, Site visit and annual Climatic analysis report (evaluation tools also to be used). Research modules to be learnt with case studies and aspects to be incorporated in Studio project (1 week).

- Simulation based campus planning, building configuration planning, floor plate optimization, massing configuration, envelope design and optimization, Material selection in terms of local context and ECM analysis, MEP system selection and preliminary analysis and calculations. (2 weeks)

- Planning, Design methods, evaluation methodology with green building assessment tools in terms of campus, Architecture, MEP, CAPEX, OPEX and RoI, LCA and embodied energy calculations (5 weeks).

- Working on design project towards finalization of plan, sections, elevations and materials finalization, Passive, active and hybrid system conceptualization and architectural incorporation of the same in an aesthetic manner as a response to climate, and reporting with presentation - (8 weeks).

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, presentation and the studies should cover all the topics.

Suggested Learning Resources:

Books

Skill Development Activities Suggested

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

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Students will be able to understand the campus level criteria based approach learning from LBC, GRIHA, IGBC, LEED, methodology for built and unbuilt, site ecology aspects etc.	L2,L3
CO2	Students will be able to understand performance based Energy modeling of Larger scale residential, commercial, institutional, Industrial and Hospitality, Health care projects in line with the various green building tools.	L4
CO3	Students will be able to evaluate simulation based NET ZERO Energy, Carbon emission approach including all master planning, Architecture and MEP aspects	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	**L**	**M**	**H**	**M**	**H**	**M**
CO2	**L**	**L**	**H**	**L**	**H**	**H**
CO3	**L**	**L**	**H**	**L**	**H**	**H**

III-SEMESTER

PEOPLE, ENVIRONMENT AND BUILDINGS			
Course Code	MASA302	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:
Sustainable development, Assessment and validation as per international standards of city planning and urban design, architecture, systems, materials, building operation and maintenance.
Attaining projects with NET ZERO, Environmental Impact is becoming a basic requirement for all sectors today.
Macro level sustainability aspects assessment and analysis using GIS and remote sensing empowers the analytical process and expense.

Module-1

Introduction to Green building assessment tools like LEED, ECBC, IGBC, GRIHA, EDGE, LBC, WELL, BEE INDIA etc. Assignments for detailed understanding of criteria are of above listed Green building assessment tools under various building typologies.

Module-2

Environmental Impact assessment - EIA: Scoping and Screening, Baseline Studies, Impact Identification, Impact assessment and Evaluation, Stakeholders Engagement, Cumulative Impact assessment, Mitigation and management plans, Environmental monitoring and Auditing, Reporting and documentation as per EIA draft 2020..

Module-3

Sustainable Community Development: Economic development, environmental protection, Social Equality and inclusion, culture, Sustainable Transportation, Green Urbanism and infrastructure, Affordable and sustainable housing, Community engagement and participation, Education and awareness.

Module-4

Disaster Resilient infrastructure: Introduction to Resilient infrastructure and Management, Prevention Of Hazard, Structural and Non-Structural Mitigation Measures, Existing Framework for Disaster Resilient infrastructure and Management, Community Based Disaster Resilient infrastructure and management.

Module-5

GIS and Remote sensing: Introduction to Geographical Information System (GIS), Application of GIS System And Remote Sensing, Overview Of Remote Sensing, Remote Sensing Technology, Data Processing

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

Environmental Impact Assessment (EIA)

- Environmental Impact Assessment: A Practical Guide by David J. Canter
- Environmental Impact Assessment: A Guide to Best Practice by the International Association for Impact Assessment
- Environmental Impact Assessment: An Introduction by David Wood
- Environmental Impact Assessment: Theory and Practice by Michael B. Gerrard

Sustainable Community Development

- Sustainable Development: A Global Perspective by John J. Kirton and Peter W. Evans
- Sustainable Development: From Concept to Practice by Michael Redclift and David Goodman.
- Sustainable Development: The Role of Local Actors by David Gibbs and David Humphreys

Resilient Infrastructure and management

- Arnold, C and Reitherman, R. Building Configuration and Seismic Design. JohnWiley and Sons, New York,1982.
- Carter, WN. Disaster Management: A Disaster Manager's Handbook, AsianDevelopment Bank, Manila,1990.
- Farrington, K. Natural Disasters – The Terrifying forces of nature, Grammery Books, London,1999.
- Sharma, VK. Disaster Management, Rawat Publications, Jaipur,1995.

- United Nations. Disaster Prevention and Mitigation, United Nations DisasterRelief Organization,1986.

GIS and Remote sensing

- Lillesand, T.M. and Kiefer, R.W, Remote sensing and image interpretation, John Wiley and sons, New York,2004.
- GolfriedKonechy, Geoinformation: Remote sensing, Photogrammetry and Geographical Information Systems, CRC press, 1st Edition,2002.
- Burrough, P.A. and McDonnell, R.A., Principles of Geographic Information systems Oxford University Press, New York,2001.
- Lintz, J. and Simonet, Remote sensing of Environment, Addison Wesley Publishing Company, New Jersey,1998.

Skill Development Activities Suggested

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

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Understanding of national and international Green building assessment tools for substantiating the sustainability approach and innovations.	L1,L2
CO2	Understanding intangible impacts of any development and construction project on the environment during construction and post construction throughout its life cycle.	L2
CO3	Understanding of Sustainability development methodology and various aspects critical to be planned for long-term sustainability and accommodate future developments and changes along its life cycle.	L2
CO4	Understanding of disaster management aspects to plan and design resilient infrastructure and construction.	L4

Program Outcome of the SA Program

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

Mapping of COS and POS

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

III-SEMESTER

PROFESSIONAL TRAINING / INTERNSHIP			
Course Code	MASA303	CIE Marks	-
Teaching Hours/Week (L:S:SDA)	-	SEE Marks	100
Total Hours of Pedagogy	-	Total Marks	100
Credits	03	Exam Hours	-

Course Learning objectives:

To provide exposure to the various aspects of Sustainable development and Architecture practice. Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently

Module

The student will be exposed to preparation of sustainable drawings, detailed project reports, preparation of feasibility report, computer applications in design and drafting, filing system in respect of documents, drawing and preparation of tender documents.

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.

Viva voce Examination:

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

Course Outcomes

At the end of the course the student shall have

- Training Report: This shall contain copies of only such drawings, which have been dealt, drafted or designed by students. It shall also contain a brief description of works handled during the training.
- Report Study – This shall include a detailed critical study of a project from the office related to Sustainable development.

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

Sl. No.	**Particulars**	**Blooms Level**
CO1	Gain practical experience within the industry in which the internship is done.	L3
CO2	Acquire knowledge of the industry, experience the activities and functions of professionals.	L3,L4
CO3	Identify areas for future knowledge and skill development.	L4
CO4	Expand intellectual capacity, credibility, judgment, intuition	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
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Mapping of COS and POS

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

III-SEMESTER

RESEARCH METHODOLOGY			
Course Code	MASA304	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	-

Course Learning objectives:
At the end of the course the student will be able to: develop the research skills in a systematic manner which will impart the ability to select appropriate research methodology, experimental design, follow professional ethics and academic integrity, and develop written presentation skills.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.
Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale.
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.
Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Teaching-Learning Process	

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.

Viva voce Examination:

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

Suggested Learning Resources:

Books

- Research Methodology: Methods and Techniques, C.R. Kothari, GauravGarg,New Age International,4th Edition, 2018.
- Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar, SAGE Publications,3rd Edition, 2011.
- Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
- Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009

Skill Development Activities Suggested

- Guest lecture
- Review of research papers
- Workshops / seminars by industry experts
- Site visits / case studies

Course Outcomes

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

Sl. No.	Particulars	Blooms Level
CO1	Prepare an extensive literature study and data collection from the field and presentation in the form of drawings, relevant details/codes, schematic charts, reports and photographs	L3
CO2	Develop a hypothesis to be tested through the research methodology designed for the purpose with innovative insight on specific issues thereby undertaking academic research independently.	L3
CO3	Experiment with research processes.	L4
CO4	Propose areas for further research and development	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	**M**	**H**	**L**	**H**	**L**	**M**
CO2	**M**	**M**	**L**	**H**	**H**	**L**
CO3	**M**	**M**	**H**	**H**	**M**	**M**
CO4	**L**	**H**	**H**	**H**	**H**	**M**

III-SEMESTER

SUSTAINABLE LANDSCAPE - ELECTIVE COURSE			
Course Code	MASA315A	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 sustainable Landscape. Landscape design methods for water efficiency and corresponding energy use reduction, Water efficient irrigation systems and automated controls for water saving, Sustainable landscaping integrated with food production to achieve ZERO food miles, Urban planning and design aspects of sustainable landscaping along with its importance for maintaining ecological balance and reduced heat island effect.

Module-1

Principles of Sustainable Landscape Design: Role of landscape in sustainable architecture and urban design. Climate responsive planting strategies in Indian contexts. Ecological balance, biodiversity enhancement, and resilience to climate change. Understanding urban heat island effect and mitigation through landscape.

Module-2

Water Efficiency and Energy Reduction in Landscapes: Water-sensitive landscape planning. Strategies for reducing irrigation water demand through native and adaptive species selection. Relationship between water efficiency in landscapes and reduced building energy use (e.g., cooling load reduction).

Module-3

Water-Efficient Irrigation Systems and Smart Controls: Drip irrigation, micro-sprinklers, and subsurface irrigation systems. Automated irrigation controls: sensors, timers, and IoT-based systems for water savings. Rainwater harvesting and greywater reuse in landscaping.

Module-4

Productive Landscapes for Zero Food Miles: Integration of edible gardens, rooftop farming, and community agriculture in urban areas. Permaculture and agroforestry principles. Food–energy–water nexus in sustainable landscapes.

Module-5

Urban Planning and Sustainable Landscape Integration: Landscape integration in master planning and urban public spaces. Green infrastructure: green belts, parks, bioswales, and green corridors. Landscape-based strategies for reducing heat island effect in Indian cities. Case studies from Indian and global sustainable urban landscapes.

Suggested Learning Resources:

- *Sustainable Landscape Construction: A Guide to Green Building Outdoors* – J. William Thompson & Kim Sorvig
- *Design with Nature* – Ian McHarg
- Centre for Science and Environment (CSE) – *Water Sensitive Urban Design Manuals*
- IGBC, GRIHA, and LEED guidelines for sustainable landscapes

III-SEMESTER

ENERGY AUDITING - ELECTIVE COURSE			
Course Code	MASA315B	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 course equips students with the knowledge and skills to conduct professional energy audits, focusing on built environments and campus-scale systems in the Indian context. Students will learn to evaluate energy performance, identify conservation opportunities, integrate renewable energy strategies, and align recommendations with ECBC, ISO 50001, and other applicable standards.

Module-1

Fundamentals of Energy Auditing: Scope, objectives, and types of energy audits (walk-through, detailed, investment-grade). Regulatory frameworks: ECBC 2017, ISO 50001, BEE Guidelines. Role of energy auditing in sustainable architecture and climate action. Benchmarking and Key Performance Indicators (KPIs).

Module-2

Data Collection & Measurement Tools: Inventory of energy-consuming systems: HVAC, lighting, plug loads, motors, pumps. Instruments & techniques: lux meters, anemometers, clamp meters, thermal imaging, ultrasonic flow meters. Data logging, trend analysis, and seasonal variations. Safety protocols during field audits.

Module-3

Building Envelope & System Performance Analysis: Envelope heat gain/loss calculations. HVAC efficiency evaluation and load profiling. Lighting system performance and daylight integration. Water–energy nexus: water pumping, treatment, and distribution efficiency.

Module-4

Identifying Energy Conservation Measures (ECMs): Low-cost / no-cost measures vs. capital-intensive retrofits. Renewable energy integration: solar PV, solar thermal, wind, biomass. Automation & control systems for demand management. Lifecycle cost analysis (LCCA) and payback calculation.

Module-5

Audit Reporting, Simulation & Case Studies: Structure and content of an energy audit report. Use of simulation software: DesignBuilder, eQuest, RETScreen. Indian and global case studies of successful energy audits and retrofits. Campus-scale and district-level audit approaches.

Suggested Learning Resources:

- Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
- De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
- Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley (Interscience publication).
- Industrial Energy Management and Utilisation -L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
- Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
- Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

III-SEMESTER

INTELLIGENT BUILDINGS - ELECTIVE COURSE			
Course Code	MASA315C	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 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. Biophilic and Biomimetic design can also be explored.

Module-1

Intelligent Buildings: The Creative–Technical Spectrum: Definitions and evolution of Intelligent Buildings. International standards & performance benchmarks (IB definition by CIBSE, ISO). The architect's role in merging design creativity with electromechanical integration.

Module-2

Electromechanical Systems for Energy Efficiency: Building Management Systems (BMS) and Building Automation Systems (BAS). Integration of HVAC, lighting, water management, and security systems. IoT-enabled monitoring and adaptive controls.Demand-side energy optimization and renewable integration (solar PV, wind, hybrid).

Module-3

Beyond the Built Form: Site & Environmental Integration: Smart infrastructure beyond buildings: intelligent landscapes, outdoor lighting, and microclimate control. Passive–active system synergy in master planning. Energy-efficient public spaces and urban furniture with embedded smart technologies.

Module-4

Biophilic & Biomimetic Approaches in Intelligent Buildings: Principles of biophilic design and their integration with intelligent systems. Biomimetic strategies for façade design, ventilation, and daylight optimization. Case references: natural systems inspiring control algorithms, material choice, and form.

Suggested Learning Resources:

- Clements-Croome, D.J. – *Intelligent Buildings: An Introduction*
- Wong, J.K.W. & Wang, S.W. – *Intelligent Building Systems*
- ISHRAE Handbook on HVAC & Controls.
- Kellert, S.R. – *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*.

— — — END OF SEMESTER — — —