III Semester

DISSERTATION			
Course Code	2MAHD301	CIE Marks	100
Teaching Hours/Week (L:T:S:P)	28:0:140:0	SEE Marks(Viva)	100
Total Hours of Pedagogy	12	Total Marks	200
Credits	12	Exam Hours	-

Course Learning objectives:
The course aims to develop project formulation, strengthened by relevant research and synthesis of design solutions for the identified habitat theme.

Studio Outline

Teaching Learning Process

1. The dissertation is the complete assimilation of academic learning, professional experience, and research capabilities developed throughout the postgraduate program of the student.
2. The scope of the dissertation shall encompass a comprehensive investigation of issues related to human settlements, urban environments, and the evolving challenges associated with contemporary cities and regions. The study may focus on themes such as sustainable urban development, housing and habitat, public spaces, mobility, urban regeneration, heritage conservation, climate resilience, green and blue infrastructure, smart cities, disaster risk reduction, inclusive neighbourhoods, infrastructure planning, urban governance, and other emerging concerns affecting the built environment.
3. The dissertation would examine social, physical, economic, environmental, and urban conservation issues with participatory and infrastructure provision-led objectives.
4. The project definition, program development, design development process, and implementation framework are to form an integral part of the project. Each student is required to select and work on an area/ topic approved by the Institution. The topic should be based on current issues, research, and professional interests.
5. The proposed Design Solutions & interventions should emerge from the research findings and demonstrate a clear relationship between analysis and design.

Format and guidelines shall be as laid down by the Institution.

Dissertation Structure

The dissertation shall integrate both **research** and **design/project** components. Students may choose one of the following formats based on their interest and suitable justification:

Type I

- Research-based Dissertation – **70%**
- Research-based Project/Design – **30%**

Suitable for topics emphasizing research, theoretical inquiry, policy analysis, or empirical investigation, with the project demonstrating the application of research findings.

Type II

- Research-based Dissertation – **30%**
- Design Interventions and Practical Applications – **70%**

Suitable for design-oriented topics where research supports the development of comprehensive design or planning proposals.

In both formats, the research and project components shall be integrated, with research informing the design and the project demonstrating the practical application of the research outcomes. Students shall select the appropriate format based on the nature of their topic and research objectives, subject to institutional approval.

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:

Continuous Internal Evaluation will be based on

- Seminars, Assignments, Report submissions and Embedded studio assignments.
- Two Internal Reviews, two External Reviews, and Final Portfolio Submission for Studio component.

Semester End Examination:

Viva-voce: The viva voce shall be conducted in two phases, first for the background research work followed by design interventions. Weightage ratio can be based on Project Type I or II.

Suggested Learning Resources:

Books

- Rowe, P. G. (1987). Design thinking. MIT Press.
- Blake, G., & Bly, R. W. (1993). The elements of technical writing. Macmillan.
- Farthing, S. (2016). Research design in urban planning: A student's guide. SAGE Publications.
- MacCallum, D., Babb, C., & Curtis, C. (2019). Doing research in urban and regional planning. Routledge.
- Time-Saver Standards for Urban Design Watson, D., Plattus, A. J., & Shibley, R. G. (Eds.). (2003). Time-saver standards for urban design. McGraw-Hill.
- Prominski, M., & von Seggern, H. (2019). Design research for urban landscapes: Theories and methods. Routledge.

Web links and Video Lectures (e-Resources):

9. Research Methods in Urban Design: A Framework for Researching the Performance and Resilience of Places
https://www.researchgate.net/publication/371713646_Research_Methods_in_Urban_Design_A_Framework_for_Researching_the_Performance_and_Resilience_of_Places
10. Research Methods for Urban Design (KTH Royal Institute of Technology – Full Text PDF)
http://kth.diva-portal.org/smash/get/diva2:343485/FULLTEXT01.pdf
11. Directory of Open Access Books (DOAB) – Habitat Design Collection
http://directory.doabooks.org/discover?query=habitat+design&locale-attribute=en
12. CumInCAD – Research by Design in Architecture, Urban Design, and Planning
https://papers.cumincad.org/data/works/att/eef2.content.pdf

Skill Development Activities Suggested

- Site Documentation and Spatial Analysis: Conduct site reconnaissance, field documentation, regional and site analysis using GIS, spatial mapping, and environmental assessment techniques.
- Master Planning and Urban Design: Prepare land suitability studies, planning concepts, master plans, precinct plans, and integrated urban design proposals incorporating mobility, infrastructure, landscape, and public realm.
- Stakeholder Engagement and Implementation: Undertake stakeholder consultations, analyse planning policies, and develop implementation strategies including phasing, governance, and infrastructure planning.
- Digital Visualization and Communication: Develop professional planning presentations, reports, drawings, and digital visualizations using CAD, GIS, SketchUp, Rhino, Lumion, or equivalent software.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyze site conditions, land suitability, and environmental constraints to determine development potential in emerging urban areas.	IV
CO2	Develop integrated infrastructure and mobility plans addressing accessibility, services, and sustainability, applying regulatory frameworks, zoning norms, and development controls in preparing urban proposals	VI
CO3	Evaluate urban development models for context-appropriate application.	V
CO4	Design comprehensive master plans incorporating urban design guidelines, public realm quality, and spatial organization.	VI
CO5	Formulate feasible implementation strategies including phasing and stakeholder coordination.	VI

Program Outcome of this course

Sl. No.	Description	POs
1	Critically analyze complex urban, environmental, social, economic, and spatial issues using appropriate qualitative and quantitative research methods.	2, 3, 4, 6, 7, 8
2	Collaborate effectively with multidisciplinary teams and stakeholders to develop integrated and participatory design solutions.	6, 7, 9
3	Develop innovative, context-sensitive, sustainable, and implementable design and planning solutions that address identified research problems and societal needs.	1,3, 5, 8,9, 10
4	Integrate social equity, inclusivity, accessibility, and community participation into new habitat design interventions.	6, 7, 8

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	2	-	2	2	2	3	2
CO2	2	2	2	2	3	1	1	1	1	1
CO3	2	3	2	3	3	2	2	2	1	1
CO4	2	3	3	2	3	2	2	2	2	2
CO5	1	3	1	2	3	2	3	3	2	2
Average	**1.8**	**2.6**	**2.2**	**2.2**	**3**	**1.8**	**2**	**2.4**	**1.8**	**1.6**

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

	Low	Medium	High	No
Mapping Co-relation	**1**	**2**	**3**	**_**

III Semester

PROJECT PLANNING, ANALYSIS AND MANAGEMENT			
Course Code	2MAHD302A	CIE Marks	100
Teaching Hours/Week (L:T:S:P)	14:0:28:0	SEE Marks	-
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:

To familiarise students with the concepts, processes, and tools of project planning and formulation; develop an understanding of feasibility studies, cost-benefit analysis, and multi-criteria evaluation; build skills in project scheduling, budgeting, urban finance, and financial management; and develop competencies in project implementation, risk management, environmental impact assessment, and informed decision-making for architecture, habitat, urban design, and planning projects.

Syllabus Outline:

Project Planning and Formulation

- Concepts, terminology and processes of project planning.
- Urban projects, project life cycle and governance framework.
- Institutional structure and stakeholder roles.
- Public–Private Partnerships (PPP) and project governance.
- Management Information Systems (MIS) in project management.

Project Feasibility and Analysis

- Requirement analysis and feasibility assessment.
- Operational, business, environmental and infrastructure analysis.
- Project impact identification and assessment.
- Cost–Benefit Analysis (CBA).
- Opportunity cost, shadow pricing, cash flow analysis.
- Payback Period and Internal Rate of Return (IRR).

Project Evaluation and Scheduling

- Project evaluation techniques.
- Single and multi-criteria decision-making methods.
- Project scheduling and monitoring.
- Network techniques: **PERT** and **CPM**.
- Resource allocation and project performance monitoring.

Urban Finance and Budgeting

- Principles of urban finance.
- Municipal finance and budgeting.
- Municipal financial management and accounting.
- Value Capture Financing.
- Financial control, fiscal programming and cash flow management.
- Project budgeting and financial planning.

Project Implementation and Management

- Project implementation strategies and phasing.
- Cost, time and quality management.
- Environmental Impact Assessment (EIA).
- Risk assessment and disaster management.
- Leadership, team management and conflict resolution.
- Decision-making and change management.
- Emerging technologies and best practices in project management.

Assessment Details (Continuous Internal Evaluation – CIE)

The course shall be assessed entirely through **Continuous Internal Evaluation (CIE)** carrying **100 marks**. The **minimum passing mark** is **50% of the maximum marks (50 out of 100)**.

Continuous Internal Evaluation (CIE)

The assessment shall comprise the following components:

- Two Assignments – 25 marks each (Total: 50 marks)
- One Skill Development Activity (SDA) – 50 marks
- The total CIE shall be evaluated out of 100 marks.
- Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy through assignments, presentations, case studies, reports, and practical exercises, as appropriate to the course.

Suggested Learning Resources

Books

- Chandra, P. (2017). *Projects: Planning, analysis, selection, financing, implementation and review* (8th ed.). McGraw-Hill.
- Kerzner, H. (2003). *Project management: A systems approach to planning, scheduling, and controlling* (8th ed.). John Wiley & Sons.
- Krishnamurthy, & Ravindra, S. V. (2017). *Construction management* (2nd ed.). CBS Publishers & Distributors.
- Ramakrishna, K. (2010). *Essentials of project management*. PHI Learning.
- Srinath, L. S. (2001). *PERT and CPM: Principles and applications*. Affiliated East-West Press.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc23_ce59/preview
- https://onlinecourses.nptel.ac.in/noc23_mg124/preview
- NPTEL course on "Urban Governance And Development Management (UGDM)".
- https://www.coursera.org/learn/uva-darden-project-management
- https://execed.gsd.harvard.edu/integrated-project-management
- https://www.udemy.com/course/practitioners-guide-to-cost-benefit-analysis/
- https://www.youtube.com/watch?v=W2EdffbwgcM&list=PLyqSpQzTE6M88imldbh5qcexw-qXNikWR
- https://www.youtube.com/watch?v=iHSEXPazWEg

Skill Development Activities Suggested

- Project Simulation: Use project management software or tools to simulate the planning and execution of a project to manage tasks, resources, and timelines in a controlled environment.
- Risk Assessment - to identify potential risks in a project, assess their impact and develop risk mitigation strategies.
- Time Management on effective time management techniques, such as creating Gantt charts, using productivity tools, and setting milestones.
- Analysis of case studies: Urban projects feasibility and appraisal, Annual and Quarter Annual statements and Cash Flow statements.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To familiarise learners with project planning and analysis principles.	II
CO2	To develop comprehensive project proposals by defining objectives, scope, deliverables and evaluation criteria.	VI
CO3	To analyse risk assessment, conflict resolution and project management strategies.	II
CO4	To evaluate project appraisal techniques and financial feasibility methods.	V
CO5	To apply tools for social, economic, and environmental impact towards sustainable project planning.	III

Program Outcome of this course

Sl. No.	Description	Pos
1	To equip students with comprehensive project planning skills for effective execution of urban and regional projects.	1,2,3,4,6,9,10
2	To sensitize students on feasibility analysis, appraisal, evaluation, and	1,2,4,5,7,8

	regulatory compliance in line with legal requirements and industry best practices.	
3	To establish the correlation between urban planning, monitoring, and implementation through governance, finance, and human resource management in urban design.	1,3,4,9,10
4	To strengthen students' proficiency in comprehensive project planning skills with emphasis on practical application.	1,2,3,4,6,9,10

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	-	-	-	3	2	-	-
CO2	2	3	2	2	-	-	-	1	-	-
CO3	3	3	2	-	-	2	3	3	-	2
CO4	-	-	-	3	-	2	3	3	2	2
CO5	1	3	-	-	-	-	3	1	-	2
Average	1.8	2.2	1.2	0.6	0	0.8	2.4	2	0.4	1.2

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	Low	Medium	High	No
	1	2	3	-

III Semester

INFRASTRUCTURE PLANNING AND MANAGEMENT			
Course Code	2MAHD302B	CIE Marks	100
Teaching Hours/Week (L:T:S:P)	14:0:28:0	SEE Marks	-
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:

To understand the concepts, processes, institutional frameworks, and systems involved in planning, development, and management of urban infrastructure at different scales; assess existing infrastructure and forecast future demands based on population, land use, and urban growth; and develop an understanding of infrastructure management strategies, emerging technologies, and sustainable approaches for present and future urban development.

Syllabus Outline:

Concepts in Urban Infrastructure Planning and Management

- Types and characteristics of Infrastructure. Current Scenario and historical overview of Infrastructure Development nationally and internationally.
- Typical infrastructure planning steps. Planning and appraisal of major infrastructure projects; Screening of project ideas.
- Infrastructure Organizations and Systems. Governing Agencies and systems at National, state, and Local levels.
- Infrastructure management-Significance, Techniques and stakeholders. An overview of Urban Infrastructure in India.

Measurement and Forecasting of Infrastructure Demands

- Measurement and calculation of infrastructure capacity, adequacy, and quality: Their indicators and benchmarks.
- Qualitative and Quantitative techniques of assessing requirements. The factors influencing demand for infrastructure; Estimation and demand, forecasting principles and techniques.
- Review and application of techniques and models for servicing infrastructure demands; scenario development.

Economics of Infrastructure Development

- Models of Infrastructure Financing- Understanding through Case studies.
- Infrastructure Project Budgeting, Funding and Sources of Funding; Regulatory Framework.
- Development models and finance mechanisms.
- Evaluation of infrastructure investment at international communities.

Infrastructure Contract Management:

- Tendering and Contractual Procedures; Public Bids and Private Bids.
- Understanding of preparation and submission of Contract, laws & Legal framework of Infrastructure project construction.
- Understanding laws pertaining to environment and pollution control clearances.

Challenges in Infrastructure Planning:

- Mapping and Mitigation of risks in Infrastructure projects; Economic and Demand Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects.
- Legal and Contractual issues In Infrastructure at International borders, Challenges In Construction and Maintenance of Infrastructure.

Assessment Details (Continuous Internal Evaluation – CIE)

The course shall be assessed entirely through **Continuous Internal Evaluation (CIE)** carrying **100 marks**. The **minimum passing mark** is **50% of the maximum marks (50 out of 100)**.

Continuous Internal Evaluation (CIE)

The assessment shall comprise the following components:

- Two Assignments – 25 marks each (Total: 50 marks)
- One Skill Development Activity (SDA) – 50 marks
- The total CIE shall be evaluated out of 100 marks.
- Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy through assignments, presentations, case studies, reports, and practical exercises, as appropriate to the course.

Suggested Learning Resources

Books

Divan, S., & Rosencranz, A. (2001). *Environmental law and policy in India: Cases, materials and statutes* (2nd ed.). Oxford University Press.

Goodman, A. S., & Hastak, M. (2006). *Infrastructure planning handbook: Planning, engineering, and economics*. McGraw-Hill.

Leelakrishnan, P. (2016). *Environmental law in India* (4th ed.). LexisNexis.

Web links and Video Lectures (e-Resources)

1. https://onlinecourses.nptel.ac.in/noc22_hs64/preview
2. https://archive.nptel.ac.in/courses/105/106/105106188/
3. https://nptel.ac.in/courses/105106115
4. https://archive.nptel.ac.in/courses/124/107/124107007/

Skill Development Activities Suggested

1. Audit systems for working of Urban management bodies.
2. Study the principles of Infrastructure case studies and Best Practices.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the role of physical and social infrastructure in Habitat Development.	II
CO2	To understand the roles, functions, and relationships between various parastatal and civic bodies in urban management.	IV
CO3	Understanding the institution, policy, finance systems and management of infrastructure	II
CO4	To evaluate the role of contract management in infrastructure planning and management	III
CO5	To understand the Challenges in Infrastructure Planning and Management.	II

Program Outcome of this course

Sl. No.	Description	Pos
1	To analyse and understand the role of infrastructure in Sustainable Habitat Design	1,2,7,8
2	To understand the working of urban management bodies with respect to the site area.	1,3,9,10
3	To analyse existing Urban Infrastructure and its shortcomings using a qualitative and quantitative approach	2,3,6,7,8,10

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	-	-	1	-	2	2	1	-	2
CO2	2	1	-	1	1	2	2	2	-	2
CO3	2	1	-	1	2	2	2	2	-	2
CO4	-	-	-	3	-	2	3	3	2	2
CO5	1	3	-	-	-	-	3	1	-	2
Average	1.8	1	0.6	1.2	1.2	2	2	1.4	0.6	2

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	Low	Medium	High	No
	1	**2**	**3**	**-**

III Semester

LANDSCAPE URBANISM & ECOLOGY IN HABITAT SYSTEMS			
Course Code	2MAHD302C	CIE Marks	100
Teaching Hours/Week (L:T:S:P)	14:0:28:0	SEE Marks	-
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:
To understand ecological processes, landscape systems, and their influence on habitat formation at multiple scales; develop skills in ecological mapping, landscape assessment, and blue-green infrastructure planning; and formulate landscape-led strategies for resilient, climate-responsive, and sustainable habitat design.

Studio Outline

INTRODUCTION TO LANDSCAPE URBANISM AND HABITAT ECOLOGY

- Evolution of Landscape Urbanism
- Ecology as a framework for habitat design
- Landscape as urban infrastructure
- Principles of Ecological Urbanism
- Habitat systems and socio-ecological networks
- Landscape processes influencing settlement patterns
- Concepts of resilience, regeneration and ecosystem services

ECOLOGICAL LANDSCAPE ANALYSIS

- Natural systems analysis
- Topography, geology and landform interpretation
- Watersheds and hydrological systems
- Soil characteristics and ecological suitability
- Vegetation structure and biodiversity assessment
- Climate-responsive landscape analysis
- Landscape character assessment
- Ecological sensitivity mapping
- Multi-layer GIS based analysis

BLUE-GREEN INFRASTRUCTURE & ECOLOGICAL NETWORK

- Blue infrastructure and urban hydrology
- Ecological corridors and habitat connectivity
- Urban forests and biodiversity networks
- Nature-Based Solutions (NbS)
- Water Sensitive Urban Design (WSUD)
- Sponge City principles
- Ecosystem services assessment
- Carbon sequestration and urban heat mitigation

ECOLOGICAL DESIGN FRAMEWORKS FOR HABITAT SYSTEMS

- Landscape structure planning
- Open space hierarchy
- Ecological restoration strategies
- Urban biodiversity enhancement
- Stormwater landscape systems
- Productive landscapes
- Public realm ecology
- Climate adaptation strategies
- Landscape performance indicators

LANDSCAPE SCALE DESIGN INTERVENTIONS

- Ecological master planning

- Blue-green network planning
- Landscape framework plans
- Public open space design
- Ecological streetscapes
- Wetland and waterfront landscape strategies
- Nature-positive urban interventions
- Landscape detailing for resilient habitats

Assessment Details (both CIE and Viva)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) - Viva 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% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Assessment Details (both CIE and SEE)

Two Assignments – Total: 25 marks

One Skill Development Activity (SDA) – 25 marks

The total CIE shall be evaluated out of 50 marks. Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy through assignments, presentations, case studies, reports and practical exercises, as appropriate to the course. Deliverables may be linked to the design brief of Habitat Design Studio-II(2MAHD201) so that analytical outputs feed back into the studio.

Suggested Learning Resources:

Books

g) McHarg, I., "Design with Nature", Wiley, 1969.
h) Waldheim, C., "The Landscape Urbanism Reader", Princeton Architectural Press, 2006.
i) Mostafavi, M. & Doherty, G. (Eds.), "Ecological Urbanism", Lars Müller Publishers, 2010.
j) Spirn, A.W., "The Granite Garden: Urban Nature and Human Design", Basic Books, 1984.
k) Corner, J. (Ed.), "Recovering Landscape: Essays in Contemporary Landscape Architecture", Princeton Architectural Press, 1999.
l) Forman, R.T.T., "Urban Ecology: Science of Cities", Cambridge University Press, 2014.
m) Benedict, M.A. & McMahon, E.T., "Green Infrastructure: Linking Landscapes and Communities", Island Press, 2006.
n) Lister, N.-M., "Projective Ecologies", Actar, 2014.
o) Hough, M., "Cities and Natural Process: A Basis for Sustainability", Routledge, 1995.

Web links and Video Lectures (e-Resources):

- Landscape Performance Series (Landscape Architecture Foundation)
- UN-Habitat – Nature-Based Solutions
- IUCN Global Standard for Nature-Based Solutions
- EPA Green Infrastructure Resources
- World Resources Institute – Urban Development

Skill Development Activities Suggested

- Ecological mapping using GIS/QGIS
- Landscape character assessment
- Hydrological and watershed analysis
- Vegetation and biodiversity documentation
- Climate-responsive landscape analysis

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyze ecological processes, landscape systems and environmental factors influencing habitat development.	Analyse
CO2	Evaluate natural systems, biodiversity, hydrology and landscape characteristics using ecological mapping techniques.	Evaluate
CO3	Assess blue-green infrastructure and ecosystem services to support resilient habitat planning.	Evaluate
CO4	Formulate landscape-led ecological strategies integrating Nature-Based Solutions and climate-responsive planning principles.	Apply
CO5	Develop ecological framework plans and landscape design interventions that strengthen sustainable habitat systems.	Create

Program Outcome of this course

Sl. No.	Description	Pos
1	Analytical Skills	2
2	Application of Research	3
3	Generate Designs/Solution5	5
4	Environmental Concern (this studio should have a stronger emphasis here than Semester I)	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	-	-	-	2	-	-	-
CO2	2	3	2	-	-	-	-	1	-	-
CO3	-	3	2	-	-	-	3	3	-	2
CO4	-	-	-	3	-	2	3	3	2	2
CO5	1	3	-	-	3	2	3	1	-	2
Average	1.2	2.4	1.2	0.6	0.6	0.8	2.2	1.6	0.4	1.2

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	**Low**	**Medium**	**High**	**No**
	1	**2**	**3**	**-**

III Semester

DATA ANALYTICS FOR SOCIAL AND SPATIAL RESEARCH			
Course Code	2MAHD303A	CIE Marks	50
Teaching Hours/Week (L: T:S:P)	14:0:0:28	SEE Marks **(Viva)**	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:

To develop a rigorous foundation in research paradigms, problem formulation, and methodology for social and spatial habitat studies; build competency in quantitative and qualitative data analysis, including statistical, fieldwork, interview, coding, and thematic analysis methods; integrate mixed-method approaches to examine patterns of inequality, community interaction, and resource access; and develop skills in research communication, analytical visualisation, and presentation of findings for academic and professional design practice.

Syllabus Outline:

Research Design For Habitat Studies

- Research paradigms (positivism, interpretivism, critical realism, pragmatism) and their implications for method choice; the research process from problem identification to dissemination; formulating the problem statement and objectives for the M.Arch Dissertation.
- Conceptualising variables (independent, dependent, moderating, confounding) and levels of measurement; operationalising abstract habitat concepts — liveability, spatial equity, walkability, social cohesion — into measurable indicators; types of research design with Indian city examples.
- Data collection instruments and sampling: household surveys, questionnaire design (Likert scales), pilot testing and Cronbach's alpha; Indian secondary sources (Census, NSSO, NFHS, SECC); sampling strategies (random, stratified, cluster, purposive, snowball).

Quantitative Analysis: Statistics For Habitat Data

- Descriptive statistics and visualisation (histograms, box plots, Q-Q plots); R/SPSS as the analytical environment — import, clean, recode data, and plot with ggplot2; probability distributions relevant to habitat data.
- Hypothesis testing: null/alternative hypotheses, Type I/II error, p-values, confidence intervals, effect sizes; parametric tests (t-tests, ANOVA, Pearson) and non-parametric alternatives (Mann-Whitney, Kruskal-Wallis, Spearman, chi-square); interpreting significance for habitat policy and design.
- Regression analysis: simple/multiple linear regression, multicollinearity and residual diagnostics; logistic regression for binary habitat outcomes; factor analysis/PCA for composite habitat quality indices from Census or survey data.

Qualitative Methods And Mixed-Methods Integration

- Foundations of qualitative research (phenomenology, grounded theory, ethnography, case study, PAR); primary methods — interviews, FGDs, cognitive mapping, photo-voice, transect walks; ethical protocols for habitat fieldwork.
- Mixed-methods designs (convergent, explanatory sequential, exploratory sequential, embedded); integration via triangulation, joint displays, and quantitising/qualitising; a practical dissertation workflow combining ward surveys with household interviews.

Spatial Statistics, Social Network Analysis And Geodemographics

- Spatial statistics: Global Moran's I, LISA cluster mapping, spatial regression (Spatial Lag/Error Models) and Geographically Weighted Regression using PySAL, or GWR4.
- Geodemographic profiling: composite deprivation indices from Census/SECC via PCA and cluster analysis; Indian applications — slum-free city plans, Smart Cities vulnerability profiling, AMRUT benchmarking, PM Awas Yojana targeting — and what profiling misses.
- Social Network Analysis: nodes, edges, degree/betweenness/eigenvector centrality, ego and whole-network analysis, community detection (Louvain, Girvan-Newman); applications in social capital, governance networks, and RWA information flows using Gephi or NetworkX.

Research Communication And Dissertation Analytics

- Systematic literature review methodology: scoping, search strings, screening, PRISMA flow diagram; bibliometric/citation network mapping with VOSviewer or Bibliometrix; writing a thematic, gap-oriented critical review.
- Structuring the dissertation methodology chapter (2MAHD301): paradigm justification, research design, data sources, sampling, analytical methods, ethics, and limitations; data visualisation for research communication; writing up mixed-methods findings.
- Research ethics: informed consent, privacy in location-linked data, licensing/attribution, reproducibility and open science, avoiding p-hacking and HARKing; positionality, reflexivity, and ethics review processes for community-based habitat research in India.

Continuous Internal Evaluation (CIE) The assessment shall comprise the following components:

- Two Assignments – Total: 25 marks
- One Skill Development Activity (SDA) – 25 marks
- The total CIE shall be evaluated out of 50 marks. CIE methods are defined topic-wise and may include studio discussions, tutorial exercises, reviews, CIE tests, quizzes, seminar presentations, analytical assignments, report writing, and dissertation-linked micro-projects in spatial analysis and space syntax. Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy. Deliverables may be linked to the Habitat Design Dissertation (2MAHD301) so that analytical outputs feed back into the dissertation.

Suggested Learning Resources

Books

- Creswell, J.W. and Creswell, J.D., "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", SAGE Publications, 5th Edition, 2018.
- Field, A., "Discovering Statistics Using IBM SPSS Statistics", SAGE, 5th Edition, 2018.
- Bryman, A., "Social Research Methods", Oxford University Press, 5th Edition, 2016.
- Singleton, A.D., Spielman, S. and Folch, D., "Urban Analytics", SAGE Publications, 2017.
- Saldãna, J., "The Coding Manual for Qualitative Researchers", SAGE, 4th Edition, 2021.
- Bivand, R.S., Pebesma, E. and Gómez-Rubio, V., "Applied Spatial Data Analysis with R", Springer, 2nd Edition, 2013.
- Wasserman, S. and Faust, K., "Social Network Analysis: Methods and Applications", Cambridge University Press, 1994.
- Farthing, S., "Research Design in Urban Planning: A Student's Guide", SAGE Publications, 2016. [Directly referenced in old Dissertation Phase I syllabus — MAHD302]
- D'Ignazio, C. and Klein, L.F., "Data Feminism", The MIT Press, 2020.

Web links and Video Lectures (e-Resources)

https://www.r-project.org/ and https://posit.co/download/rstudio-desktop/ (R statistical computing language and RStudio IDE)

2. https://mospi.gov.in/ (Ministry of Statistics and Programme Implementation — NSSO and NFHS datasets for Indian habitat research)

3. https://censusindia.gov.in/ (Census of India — PCA, HH-series, DCHB, town-level tables)

4. https://gephi.org/ (Gephi — open-source network visualisation and SNA platform)

5. https://www.qsrinternational.com/nvivo/ (NVivo qualitative data analysis software)

6. https://www.prisma-statement.org/ (PRISMA guidelines for systematic literature reviews)

7. https://www.vosviewer.com/ (VOSviewer — bibliometric and citation network mapping)

8. https://shodh.inflibnet.ac.in/ (Shodhganga — Indian ETD repository for M.Arch and PhD dissertations in Architecture and Planning)

Skill Development Activities Suggested

1. Research problem and literature review map: identify the dissertation's central research problem; search Google Scholar, Shodhganga, and JSTOR; screen 40 sources, select 15, map them in VOSviewer; write a 600-word thematic review of three key debates.
2. Survey design and pilot test: design a 20-item structured questionnaire on a habitat-related theme; pilot with n≥25 respondents; test reliability with Cronbach's alpha; produce descriptive statistics and three publication-quality

charts.

3. Inferential analysis exercise: using a secondary dataset (Census/NSSO) for the dissertation study city, run and interpret a chi-square test, a Spearman correlation, and a simple linear regression in a 500-word analytical note.
4. Qualitative coding sprint: conduct two 30-minute semi-structured interviews; transcribe and code in NVivo/ATLAS.ti; produce a five-theme thematic map with supporting quotes and a 300-word positionality reflection.
5. Spatial deprivation and network analysis: compute Local Moran's I for one socio-spatial indicator at ward level and/or map a community network in Gephi (degree, betweenness centrality); present both as an integrated analytical brief.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Articulate research paradigms, design types, variable measurement, and data collection strategies for social and spatial habitat research, and apply these to formulate a robust framework for the M.Arch Dissertation.	I, II
CO2	Apply descriptive and inferential statistical methods — hypothesis testing, correlation, regression, factor analysis — to analyse social, demographic, and Census datasets relevant to habitat conditions in Indian cities.	III, IV
CO3	Conduct qualitative data collection and analysis and integrate qualitative and quantitative findings through mixed-methods designs for habitat inquiry.	III, IV
CO4	Use spatial autocorrelation, geographically weighted regression, social network analysis, and geodemographic profiling to identify patterns of inequality, community structure, and resource access within habitat systems.	IV, V
CO5	Produce a rigorous dissertation methodology chapter, conduct systematic literature reviews, create analytical visualisations, and communicate findings to academic, professional, and community audiences with ethical reflexivity.	V, VI

Program Outcome of this course

Sl. No.	Description	Pos
1	Systematic knowledge of quantitative, qualitative, and mixed-methods research approaches applicable to social and spatial inquiry in habitat design and planning.	1, 2, 3
2	Rigorous analytical skills in statistical reasoning, qualitative data coding, spatial autocorrelation, and social network analysis, enabling evidence-based understanding of living habitat systems.	2, 3, 4, 5
3	Direct application of research methodology — instrument design, sampling, analytical methods, scholarly writing — to the concurrent M.Arch Dissertation, producing a defensible methodology chapter as a core CIE deliverable.	1, 3, 4, 9
4	Hands-on proficiency in contemporary research tools — R, NVivo, Gephi, VOSviewer, PySAL — building capacity for independent, reproducible, and ethically rigorous research practice.	3, 4, 6, 10

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	1	-	-	3	2	-	2
CO2	3	3	3	3	1	-	-	1	-	2
CO3	2	3	2	-	-	2	-	3	2	2
CO4	2	3	3	3	1	1	3	2	2	3
CO5	2	2	3	2	2	-	3	1	3	3
Average	1.8	2.6	3	2.2	1.4	0.8	2.4	0.6	2.4	1.2

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	Low	Medium	High	No
	1	**2**	**3**	**-**

III Semester

SPATIAL ANALYSIS AND SPACE SYNTAX IN BUILT ENVIRONMENTS			
Course Code	2MAHD303B	CIE Marks	50
Teaching Hours/Week (L:T:S:P)	14:0:0:28	SEE Marks (Viva)	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:

To develop a theoretical and practical understanding of spatial configuration, movement, and social interaction in built environments; build skills in axial, segment, VGA, and isovist analysis using space syntax and GIS-based techniques; examine relationships between spatial configuration, pedestrian movement, land use, economic activity, social interaction, and safety; and apply configurational analysis to evaluate urban environments and develop evidence-based strategies for Habitat Design research and practice.

Syllabus Outline:

Theory of Spatial Configuration in Built Environments

- Configurational theory — Hillier and Hanson's social logic of space; convex spaces, axial lines, isovists; permeability and connectivity.
- Justified graphs and spatial depth — nodes and edges; spatial genotype; Indian building typologies.
- Evolution of Space Syntax — axial, segment and angular analysis; urban morphology and Indian settlement forms.

Space Syntax Methods: Axial, Segment and Visibility Analysis

- Axial map analysis — integration, choice, mean depth, connectivity, intelligibility.
- Segment analysis (axial and street-centreline networks) — angular, metric and topological; integration, choice and NACH at multiple radii.
- Visibility Graph Analysis (VGA) and isovists — visual integration, clustering, controllability; isovist area, perimeter, compactness, occlusivity.

Advanced Spatial Analysis of the Built Environment

- Morphological metrics — fractal dimension, lacunarity; block shape indices; street sinuosity and tortuosity.
- Kernel Density Estimation (KDE) and Angular Segment Analysis using GIS and open-source spatial tools; integration with street-network, Census and land-use data.
- Multi-variate profiling — PCA, OLS and Geographically Weighted Regression (GWR) linking configuration, land use, movement and economy.

Empirical Evidence: Space Syntax and Habitat Systems

- Pedestrian movement — natural movement theory, movement economy, attractors and generators; count surveys for validation.
- Land use — integration, retail vitality, property values, heritage tourism; Indian case studies (Ahmedabad, Jaipur, Varanasi, Hampi); configurational barriers.
- Social interaction, health and safety — co-presence, walkability, CPTED; critical perspectives on gender, disability and informal settlements.

Syntactic Design Evaluation and Research Communication

- Design evaluation — comparing street layouts for integration and movement; street hierarchy, block permeability; Post-Occupancy Evaluation (POE).
- Dissertation analysis — axial/segment maps, integration and NACH; spatial barriers and underperforming streets as design opportunities.
- Research communication — syntactic maps, diagrams and overlays; critical review; ethics and technological determinism.

Assessment Details (both CIE and Viva) The weightage of Continuous Internal Evaluation (CIE) is 50%

and for the Semester End Exam (SEE) - Viva 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% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE) The assessment shall comprise the following components:

Two Assignments – Total: 25 marks

One Skill Development Activity (SDA) – 25 marks

The total CIE shall be evaluated out of 50 marks. CIE methods are defined topic-wise and may include studio discussions, tutorial exercises, reviews, CIE tests, quizzes, seminar presentations, analytical assignments, report writing and dissertation-linked micro-projects in spatial analysis and space syntax. Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy. Deliverables may be linked to the Habitat Design Dissertation (2MAHD301) so that analytical outputs feed back into the dissertation.

Suggested Learning Resources

Books

1. Hillier, B. and Hanson, J., "The Social Logic of Space", Cambridge University Press, 1984.

2. Hillier, B., "Space is the Machine: A Configurational Theory of Architecture", Cambridge University Press, 1996.

3. Klarqvist, B., "A Space Syntax Glossary", Nordisk Arkitekturforskning, 1993.

4. Peponis, J., Wineman, J., Rashid, M., Kim, S.H. and Bafna, S., "On the Generation of Linear Representations of Spatial Configuration", Environment and Planning B, Vol. 24, 1997.

5. Hillier, B., Penn, A., Hanson, J., Grajewski, T. and Xu, J., "Natural Movement: or, Configuration and Attraction in Urban Pedestrian Movement", Environment and Planning B, Vol. 20, 1993.

6. Porta, S., Crucitti, P. and Latora, V., "The Network Analysis of Urban Streets: A Primal Approach", Environment and Planning B, Vol. 33, No. 5, 2006.

7. Boeing, G., "OSMnx: New Methods for Acquiring, Constructing, Analysing, and Visualising Complex Street Networks", Computers, Environment and Urban Systems, Vol. 65, 2017.

8. Vaughan, L. (Ed.), "Suburban Urbanities: Suburbs and the Life of the High Street", UCL Press, 2015.

9. Sailer, K. and McCulloh, I., "Social Networks and Spatial Configuration — How Office Layouts Drive Social Interaction", Social Networks, Vol. 34, 2012.

Web links and Video Lectures (e-Resources)

1. https://www.spacesyntax.com/ (Space Syntax Limited — free access to Hillier's "Space is the Machine" and research publications)

2. https://www.spacesyntax.net/ (Space Syntax Network — international Symposium proceedings, SSS1–SSS13)

3. https://depthmapx.org/ (DepthmapX — open-source Space Syntax analysis software, UCL Bartlett, with manual and tutorial data)

4. https://pypi.org/project/momepy/ (momepy Python library — urban morphology and segment-map metrics)

5. https://geoffboeing.com/publications/ (Geoff Boeing — OSMnx tutorials and publications for street-network analysis)

6. https://www.ucl.ac.uk/bartlett/architecture/research/space-syntax-laboratory (UCL Space Syntax Laboratory — tools, projects and resources)

7. https://archive.cept.ac.in/ (CEPT University archive — Space Syntax studies on Indian cities)

Skill Development Activities Suggested

1. Justified graph analysis of building typologies (CO1): select two contrasting typologies from the study area, prepare justified access graphs, and interpret how spatial depth, integration and intelligibility shape social interaction.

2. Axial map construction and precinct analysis (CO2): prepare an axial map of a selected precinct, compute integration, choice, connectivity and intelligibility, and relate colour-coded maps to land use and pedestrian activity.

3. Segment analysis and pedestrian movement study (CO2, CO3): run segment analysis (NAIN/NACH) for the study area, conduct pedestrian counts, and compare observed movement with syntactic predictions.

4. Visibility graph and isovist analysis of public space (CO4): conduct VGA and isovist studies for a selected public space to evaluate visual integration, surveillance, enclosure and spatial quality, interpreting findings against user experience.

5. Dissertation spatial configuration study (CO5): prepare a comprehensive configuration analysis for the dissertation area — axial/segment maps, integration and NACH, VGA/isovist studies and annotated diagrams — to support evidence-based design proposals.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the theoretical foundations of Space Syntax — justified graphs, axial representation, permeability, integration and configurational thinking — in relation to urban morphology and Indian settlement forms.	I, II
CO2	Construct and analyse axial maps, segment networks, justified graphs and visibility graphs using space syntax software, and interpret syntactic measures such as integration, choice, intelligibility, NACH and VGA.	III, IV
CO3	Apply advanced spatial analysis techniques — fractal analysis, kernel density estimation, angular segment analysis and morphological profiling — using GIS-based methods for comparative built-environment studies.	III, IV
CO4	Evaluate the relationship between spatial configuration, pedestrian movement, land-use vitality, social interaction and safety, while critically examining the limitations of configurational analysis in diverse habitat contexts.	IV, V
CO5	Develop dissertation-oriented spatial configuration studies, evidence-based design strategies and professional analytical communication outputs using Space Syntax as a design and research tool.	V, VI

Program Outcome of this course

Sl. No.	Description	POs
1	Develop comprehensive theoretical and applied knowledge of Space Syntax and spatial configurational analysis, understanding the relationship between spatial structure, movement patterns and social interaction in built environments.	1, 2, 4
2	Develop analytical and technical skills in syntactic mapping, segment analysis, visibility graph analysis, fractal metrics and spatial modelling for evidence-based assessment of urban environments.	2, 3, 4, 5
3	Apply configurational analysis tools and GIS-based spatial methods to generate original spatial studies and dissertation-oriented design intelligence for habitat design projects.	1, 4, 5, 7
4	Critically evaluate the influence of spatial configuration on movement, economic vitality, social interaction and urban performance, and communicate evidence-based design strategies and spatial proposals effectively.	2, 5, 6, 10

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	-	-	3	2	-	2
CO2	2	3	1	3	2	-	-	1	-	2
CO3	2	3	3	-	-	2	-	1	3	2
CO4	3	3	3	1	2	2	3	3	2	2
CO5	2	2	2	3	3	-	1	1	1	3
Average	**2.4**	**2.6**	**2.2**	**1.6**	**1.4**	**0.8**	**1.4**	**1.6**	**1.2**	**2.2**

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	Low	Medium	High	No
	1	**2**	**3**	**-**

III Semester

ENVIRONMENTAL MODELLING FOR SUSTAINABLE HABITATS			
Course Code	2MAHD303C	CIE Marks	50
Teaching Hours/Week (L:T:S:P)	14:0:0:28	SEE Marks (Viva)	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	-

Course Learning objectives:

To develop a foundation in climate science, environmental data analysis, and microclimatic processes for sustainable habitat design; build skills in thermal comfort, urban heat island, building energy, daylight, and urban water-cycle modelling using simulation, GIS, and satellite-based tools; and develop competency in carbon accounting, life-cycle assessment, and integrated environmental performance evaluation, with reference to sustainability frameworks such as GRIHA, LEED, and EDGE for advanced habitat design and research.

Syllabus Outline:

Climate Analysis and Environmental Data Foundations

- Climate variables and Indian climate classifications for passive design.
- Bioclimatic tools: Mahoney Tables, Givoni's chart, psychrometric charts.
- Weather data (EPW, TMY) from standard climate databases; wind, sun-path and radiation analysis.
- Urban microclimate and UHI; satellite-based land surface temperature mapping for vulnerable typologies.

Thermal Comfort and Urban Heat Island Modelling

- Comfort indices — PET, UTCI and adaptive models (ASHRAE 55, EN 15251); comfort assessment tools and survey methods.
- Urban microclimate simulation — inputs, and PET/UTCI outputs.
- Design scenarios — tree planting, reflective surfaces, green roofs, water features.
- UHI mitigation — cool roofs, greening, permeable paving; ΔPET, ΔTa, ΔTmrt as indicators.

Building Energy Simulation and Daylighting Analysis

- Energy modelling parameters — U-value, WWR, SHGC, thermal mass, HVAC demand.
- Building energy simulation — EUI, cooling loads, peak demand.
- Passive strategies (baseline vs intervention); Indian standards (ECBC 2017, BEE Star Rating, NBC).
- Daylighting — DF, UDI, sDA, ASE; daylight simulation methods.

Urban Water Cycle Modelling and Green Infrastructure

- Urban hydrology; rainfall-runoff (Rational Method, SCS Curve Number); flood mapping via DEM/GIS; CPHEEO demand-supply.
- Stormwater simulation with LID controls (permeable paving, rain gardens, bioswales, green roofs).
- Green infrastructure — rainwater harvesting, constructed wetlands, traditional Indian water systems.
- Grey versus green infrastructure — attenuation, recharge, water quality, resilience.

Carbon Accounting, LCA and Integrated Performance Assessment

- Operational and embodied carbon; whole-life assessment; low-carbon material strategies.
- LCA — inventory and impact indicators (GWP, AP, EP, PED); life-cycle assessment tools.
- Benchmarking with GRIHA, LEED India and EDGE.
- Integrated dissertation dashboard; base-vs-intervention comparison; climate justice and equity.

Assessment Details (both CIE and Viva) The weightage of Continuous Internal Evaluation (CIE) is 50% and for the Semester End Exam (SEE) - Viva 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% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE) The assessment shall comprise the following components:

Two Assignments – Total: 25 marks

One Skill Development Activity (SDA) – 25 marks

The total CIE shall be evaluated out of 50 marks. CIE methods are defined topic-wise and may include studio discussions, tutorial exercises, reviews, CIE tests, quizzes, seminar presentations, simulation-based analytical assignments, report writing and dissertation-linked micro-projects in environmental modelling and sustainable habitat analysis. Assessment methods shall be designed to evaluate the attainment of Course Outcomes (COs) and Programme Outcomes (POs) across different levels of Bloom's Taxonomy. Deliverables may be linked to the Habitat Design Dissertation (2MAHD301) so that analytical outputs feed back into the dissertation.

Suggested Learning Resources

Books

1. Givoni, B., "Climate Considerations in Building and Urban Design", Van Nostrand Reinhold, 1998.

2. Oke, T.R., Mills, G., Christen, A. and Voogt, J.A., "Urban Climates", Cambridge University Press, 2017.

3. Bruse, M. and Fleer, H., "Simulating Surface–Plant–Air Interactions inside Urban Environments with a Three Dimensional Numerical Model", Environmental Modelling & Software, Vol. 13, 1998. [ENVI-met theoretical basis]

4. Crawley, D.B. et al., "EnergyPlus: Creating a New-Generation Building Energy Simulation Program", Energy and Buildings, Vol. 33, 2001.

5. Rossman, L.A., "Storm Water Management Model User's Manual, Version 5.1", US EPA, 2015.

6. Rao, M.N. and Rao, H.V.N., "Air Pollution", Tata McGraw-Hill, 2nd Edition, 1996.

7. Roy, S.B. and Avissar, R., "Impact of Land Use/Land Cover Change on Regional Hydrometeorology in Amazonia", Journal of Geophysical Research, 2002.

8. Malmqvist, T. et al., "Holistic and Systemic Perspectives for Future Sustainable Buildings and Neighbourhoods", Energy Procedia, 2018.

9. GRIHA Council, "GRIHA V.2019: Rating for New Buildings", TERI Press, 2019.

Web links and Video Lectures (e-Resources)

1. https://energyplus.net/ (EnergyPlus — US DOE building energy simulation engine; free, with EPW weather files for Indian cities)

2. https://www.openstudio.net/ (OpenStudio — graphical interface for EnergyPlus; free, with tutorials)

3. https://www.envi-met.com/ (ENVI-met — urban microclimate simulation software; academic licence available)

4. https://comfort.cbe.berkeley.edu/ (CBE Thermal Comfort Tool — free web-based tool, UC Berkeley)

5. https://www.epa.gov/water-research/storm-water-management-model-swmm (EPA SWMM — free stormwater modelling software)

6. https://climate.onebuilding.org/ (Climate.OneBuilding.Org — free EPW weather files for Indian cities)

7. https://www.grihaindia.org/ (GRIHA Council — India's national green building rating system, tools and manuals)

8. https://edgebuildings.com/ (EDGE — IFC green building certification tool; free online calculator)

Skill Development Activities Suggested

1. Climate analysis of the dissertation study city (CO1): analyse the city's weather data — wind rose, sun path, psychrometric and radiation studies — identify passive strategies via Mahoney Tables, map UHI using satellite land surface temperature data, and present an illustrated climate analysis report.

2. Outdoor thermal comfort simulation (CO2): model a selected area of the study site, simulate peak-summer conditions, test mitigation such as tree planting, cool surfaces or green roofs, and compare pre- and post-intervention PET and air temperature with analytical interpretation.

3. Building energy simulation (CO3): build an energy model using local climate data, evaluate passive interventions (insulation, shading, natural ventilation), compare Energy Use Intensity results and assess ECBC 2017 compliance.

4. Stormwater modelling (CO4): prepare a habitat-scale model with subcatchments, drainage networks and rainfall events; evaluate runoff, flooding and the performance of green infrastructure such as rain gardens and permeable paving.

5. Integrated environmental performance portfolio (CO5): compile climate analysis, thermal comfort, energy, stormwater and embodied-carbon outputs into a performance portfolio for the Dissertation (2MAHD301), presenting analytical diagrams, dashboards and an integrated design narrative that identifies the most impactful sustainability decisions.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Interpret climate variables, weather data and bioclimatic frameworks to identify the dominant passive design strategies for the habitat study area's climate zone, and map Urban Heat Island intensity from satellite data.	I, II
CO2	Apply microclimate simulation to model outdoor thermal comfort in the dissertation study area, compare UHI mitigation strategies using PET and UTCI metrics, and generate evidence-based recommendations for cooling interventions.	III, IV
CO3	Conduct building energy simulation and daylighting analysis, compare passive design scenarios using EUI and sDA metrics, and evaluate compliance with ECBC 2017 and GRIHA benchmarks.	III, IV
CO4	Model stormwater runoff and evaluate green infrastructure performance through simulation, size rainwater harvesting and LID controls for monsoon conditions, and quantify peak-flow reduction and water-volume benefits for a habitat catchment.	IV, V
CO5	Produce an integrated multi-criteria environmental performance assessment for the dissertation proposal covering thermal comfort, energy, daylighting, stormwater and carbon, and critically evaluate sustainability trade-offs and climate-justice dimensions.	V, VI

Program Outcome of this course

Sl. No.	Description	POs
1	Develop applied knowledge of environmental modelling principles, climate analysis methods and simulation workflows for assessing and improving the thermal, energy, hydrological and carbon performance of habitat systems.	1, 2, 4, 8
2	Apply computational simulation tools for microclimate, building energy, stormwater and daylighting to quantitatively evaluate and optimise environmental design decisions at building and neighbourhood scales.	2, 4, 5, 8
3	Generate evidence-based passive design strategies, green infrastructure interventions and low-carbon material specifications, supported by modelled performance data, as design intelligence for the Habitat Design Dissertation (2MAHD301).	3, 5, 6, 8
4	Critically evaluate the environmental performance of habitat design proposals against GRIHA, ECBC, EDGE and international benchmarks, and articulate climate-justice and social-equity dimensions of sustainable habitat practice.	6, 7, 8, 10

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	-	-	3	2	-	2
CO2	2	3	1	3	3	-	-	1	-	-
CO3	2	2	3	-	-	2	3	1	2	2
CO4	1	2	2	3	3	2	3	2	2	2
CO5	2	2	3	2	3	-	3	3	1	2
Average	**2.0**	**2.2**	**2.2**	**2.0**	**1.8**	**0.8**	**2.4**	**1.8**	**1.0**	**1.6**

Graduate Attributes

Knowledge	Analytical Skills	Application of Research	Application of latest Technology/ Tools	Generate Designs/ Solutions	Ethics	Societal Concern	Environmental Concern	Collaborative aptitude	Opportunity for Continued Learning
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

Mapping Co- relation	Low	Medium	High	No
	1	**2**	**3**	**-**