Amrita School of Architecture

Executive Report
PhD in Architecture
(Program Report)

2025

Executive Report: PhD Program in Architecture, Amrita School of Architecture

1. Executive Summary: Purpose, Vision, and Strategic Impact

The newly approved **Doctor of Philosophy (PhD) Program in Architecture at the Amrita School of Architecture (Ref. Minutes of the 49th Academic Council Meeting held on 07.08.2025 & Office Order AMRITA/UO/2025/329)** is strategically positioned to serve as a high-impact hub for advanced research, innovation, and educational excellence within the evolving field of Architecture and the Built Environment. The core purpose of this program is to foster a new generation of scholars capable of addressing complex global and local challenges through rigorous inquiry into three critical, interconnected domains: **Technology, Sustainability, and Traditional Knowledge Systems**.

Interdisciplinary approaches are now favoured in architectural research and education; colleges across the world report a shift towards advanced research degrees and integrated specialisations because complex built-environment problems demand cross-disciplinary perspectives. Traditional Indigenous architectures illustrate how long-standing knowledge systems create healthy relationships between people and their environment, suggesting that contemporary designers can learn from such traditions to design holistic and sustainable habitats.

This program directly supports the University's overarching goal of strengthening academic quality and enhancing its global standing. The research trajectory is designed to reinforce Amrita Vishwa Vidyapeetham's deep commitment to compassionate research with societal impact and the UN Sustainable Development Goals (SDGs), particularly given its demonstrated global leadership in SDG impact, ranking highly worldwide for areas such as Quality Education (SDG 4), Affordable and Clean Energy (SDG 7), and Climate Action (SDG 13). By focusing research on climate adaptation and low-carbon construction, the PhD program functions as a crucial mechanism for quantifying and amplifying these existing institutional strengths.

The expected strategic outputs are translational and measurable: generating high-quality publications, securing research projects and patents, initiating robust industry collaborations, and delivering community-driven innovations. This action-oriented research, focused on societal benefit and improving quality of living, will significantly enrich the university's research ecosystem and reinforce its foundational role as a leader in transformative, value-based education.

2. Program Overview

This section summarizes the fundamental administrative details of the proposed doctoral offering.

Parameter	Detail
Program Name	PhD in Architecture
Department/School Offering the Program	Amrita School of Architecture
Proposed Start Date	December 2025
Target Number of Students (Annually)	6-8
Mode of Study	Full-time & Part-time

The highly constrained annual intake of six-eight students is a deliberate measure to ensure superior mentorship and rigorous quality control. This limited cohort size guarantees that faculty resources are optimized, ensuring deep engagement with each scholar's research journey, a necessary corrective approach against the national trend of potential academic overburdening in doctoral architecture programs.

3. Rationale and Relevance

3.1. Academic and Industrial Relevance

The establishment of this PhD program is necessitated by the rapid technological and environmental changes transforming the built environment sector globally and locally. The construction industry's growth, fueled by government initiatives focusing on infrastructure and smart cities in India, has created an urgent demand for specialized architectural expertise in areas like sustainable and energy-efficient solutions.

Architectural practice is undergoing a dynamic transformation characterized by the integration of technologies like Artificial Intelligence (AI), computational design, and advanced modular and prefabricated construction methods. The program aims to train scholars who can pioneer R&D, generate intellectual property, and effectively integrate these cutting-edge innovations into professional practice. Furthermore, the rising frequency of extreme weather events requires architects to prioritize resilient design—incorporating flood-resistant materials, passive strategies, and circular design principles.

Crucially, the program’s emphasis on Traditional Knowledge Systems (TKS) is essential not merely for cultural awareness but as a critical source of sustainable and resilient design paradigms. Global organizations increasingly acknowledge that TKS offers valuable, localized inputs for addressing challenges ranging from climate change to sustainable agriculture, offering pathways for sustainable development. By actively researching and documenting India’s rich architectural heritage and blending it with modern technology, the program creates a unique research niche that contributes both to cultural preservation and innovative, context-specific sustainability solutions.

3.2. Benchmarking and Competitive Analysis

The thematic focus and structural design of the PhD program are validated through benchmarking against leading national and international doctoral programs in architecture and the built environment.

Top global institutions prioritize highly specialized tracks, such as the "Building Science, Technology, and Sustainability (BSTS)" field at UC Berkeley and the "Building Technology" concentration at MIT, USA. These programs emphasize the fusion of engineering, computational science, and architectural disciplines. The Amrita School of Architecture’s program commitment to Technology and Sustainability as core pillars directly mirrors these international standards for advanced, high-impact research. Furthermore, global programs encourage a high degree of interdisciplinarity, often requiring students to select minor fields outside of architecture, such as engineering, city planning, or social sciences.

Nationally, PhD programs at institutions like the Indian Institute of Technology (IIT) feature focused tracks, including the "Technologies of the Built Environment". The School of Planning and Architecture (SPA) also emphasizes architectural conservation and specialized research into energy-efficient retrofitting. The Amrita School of Architecture program integrates these proven tracks—Technology, Sustainability, and Traditional Knowledge—into a single, holistic framework, ensuring comprehensive coverage of contemporary research needs.

3.3. Demand Assessment

The demand for high-caliber architectural doctoral graduates exists across two main sectors: academia and specialized industry R&D.

In the academic sector, while many Indian universities now offer PhDs in architecture, concerns persist regarding consistent quality, often stemming from overburdened faculty. By maintaining a rigorous selection process and a targeted annual intake of 6-8 students only, the program strategically guarantees high-quality, individualized mentorship. This approach elevates the stature of school’s graduates, positioning them as premium candidates for specialized teaching and research roles in institutions across the nation.

In the industry, graduates with specialized domain expertise will be highly sought after for complex roles in specialized consultancy, particularly in rapidly growing areas such as ESG (Environmental, Social, and Governance) compliance, climate change adaptation strategies, computational design services, and advanced heritage management. The research in Traditional Knowledge Systems provides a necessary contribution to addressing the global issue of vanishing indigenous knowledge, linking locally grounded expertise to globally significant research output.

4. Objectives and Learning Outcomes

4.1. Program Objectives (PO)

The PhD in Architecture program is designed around four primary objectives:

1. **PO 1: Methodological Mastery and Ethical Rigor:** To develop advanced competence in research design, encompassing qualitative, quantitative, and interdisciplinary mixed-methods. This objective includes instilling a rigorous understanding of research ethics, specifically focusing on data veracity, client and data confidentiality, informed consent, and applications of social and environmental justice in built environment research.
2. **PO 2: Translational Innovation:** To foster original research that yields deployable and scalable innovations, such as new computational tools, advanced materials, or energy systems. The goal is to generate patents and technology transfers that demonstrably address societal and environmental needs, thereby fulfilling the University's mission for pioneering innovations.
3. **PO 3: Climate and Energy Solutions:** To contribute fundamental and applied research aimed at achieving global energy transition goals, focusing on net-zero buildings, climate resilience, life-cycle assessment, and the development of low-carbon construction systems.
4. **PO 4: Value-Based Scholarship:** To cultivate critical thinking and intellectual curiosity, ensuring that all research is underpinned by a strong ethical and value-based foundation, leading to architectural solutions that promote community upliftment and mindful, equitable development.

4.2. Key Learning Outcomes (KLO)

Upon successful completion of the program, scholars will be able to demonstrate:

1. **KLO 1: Conceptual Framing:** The ability to rigorously identify significant research gaps within the domain, synthesize complex literature,

and formulate original, theoretically sound hypotheses at the confluence of technology, sustainability, and traditional knowledge.

2. **KLO 2: Interdisciplinary Synthesis:** Proficiency in integrating and applying knowledge from diverse allied fields, including engineering, data science, social policy, and material sciences, to develop comprehensive and holistic built environment solutions.
3. **KLO 3: Pedagogical Competence:** Acquisition of essential teaching, mentoring, and research guidance skills, achieved through the compulsory assignment of teaching load, preparing them effectively for academic careers.
4. **KLO 4: Dissemination and Policy Translation:** The capacity to produce high-impact academic outputs for peer-reviewed journals and to translate complex research findings into actionable advice for professional practice, industry partners, and government policy formulation.

5. Program Structure and Curriculum

The PhD program emphasizes a structure that balances foundational methodological rigor with specialized, cutting-edge disciplinary knowledge.

5.1. Coursework Requirements

As per institutional regulations, all PhD candidates are required to successfully complete specified coursework:

1. **Mandatory Core:** All candidates shall successfully complete the mandatory 'Research Methodology' course.
2. **Optional Specialization:** Candidates must complete at least one optional course prescribed for the programme, or two courses if recommended by the institutional Research Committee.
3. **Performance Standard:** Scholars must maintain a minimum grade of B+ in each coursework subject to satisfy the requirements for continuation.

5.2. Proposed Doctoral Course Offerings

The five proposed courses are designed to provide the necessary methodological expertise and disciplinary depth, directly addressing the program's focus on Technology, Sustainability, and Traditional Knowledge Systems.

Proposed Doctoral Coursework and Thematic Alignment

Course Name	Thematic Focus	Content and Doctoral Rationale
Course Code: **Climate Resilience and Sustainable Building Science**	Sustainability, Technology	Advanced study of net-zero energy standards, climate change adaptation in design, life-cycle assessment of building components, embodied carbon analysis, and resilient materials development.
Course Code: **Traditional Knowledge Systems and Vernacular Heritage**	Traditional Knowledge Systems, Built Environment Issues	Critical investigation of indigenous building practices, conservation principles, traditional material science, cultural landscape management, and the practical application of TKS for modern sustainability challenges.
Course Code: **Digital Technologies, Computation, and Generative Design**	Technology, Built Environment	Hands-on specialization in high-level computational tools, including AI/ML applications in design optimization, parametric modeling, digital fabrication techniques, and simulating complex architectural systems.
Course Code: **Critical Issues in Urbanization and Built Environment**	Built Environment Issues, Policy, Governance	High-level seminar analyzing the complex interplay of financing, regulatory frameworks, policy instruments, infrastructure planning, and social equity challenges in 21st-century urban development.

These courses ensure that candidates understand the intellectual and cultural context within which the built environment is produced. These courses ensures that research moves beyond purely theoretical or technical study to address the economic, regulatory, and socio-cultural dimensions of real-world projects, mirroring curriculum structures found in advanced doctoral programs internationally.

Annexure I – Syllabus Outlines

Detailed syllabi for each Course, including module structures, learning objectives, suggested readings, and assessment schemes, are provided separately to support the full program proposal.

6. Faculty and Research Capacity

The program is supported by experienced core and adjunct faculty with Ph.D. qualifications and robust research profiles, ensuring expert guidance aligned with the program's core thematic areas.

6.1. Core and Adjunct Faculty Profiles

The academic team is anchored by expertise in both climate adaptation technology and traditional building science, providing a comprehensive mentorship foundation.

Key Faculty and Research Alignment

Faculty Member	Role	Qualification & Position	Key Research Areas	Thematic Alignment
Dr. Pratheek Sudhakaran	Guide	Ph. D. (Associate Professor)	Climate Change Adaptation, Sustainable Construction, Urban Sustainability, Built Environment	Sustainability, Technology, Climate Resilience
Dr. Harimohan Pillai	Co-Guide	Ph. D. (Professor Emeritus)	Traditional Architecture, Building Science (Materials), Research Frameworks, Architectural Education.	Traditional Knowledge Systems, Building Science, Research Methodology

The combined expertise of Dr. Sudhakaran, focusing on the future challenges of climate change adaptation and technology, and Dr. Pillai, providing foundational knowledge in traditional architectural forms and the scientific properties of building materials, guarantees that scholars receive comprehensive guidance across the entire research spectrum—from vernacular resilience to computational optimization. Furthermore, the program has access to Amrita's multi-disciplinary faculty across Engineering and Artificial Intelligence, reinforcing its commitment to interdisciplinary research.

6.2. Supervision Capacity

The institutional regulation specifies an average supervision capacity of **6-8 scholars per faculty member**. The decision to target an annual intake of 6 students is directly harmonized with this capacity. This strategic alignment ensures that every doctoral candidate receives intensive, high-quality, one-on-one mentorship, thereby guaranteeing the rigor and originality of the dissertation research.

6.3. Research Facilities

Scholars benefit from access to state-of-the-art infrastructure, including a **high-tech computer lab** essential for advanced computational design and data modelling, and a **well-equipped library** with specialized literature on architecture and design. Beyond the school level, the program leverages the extensive research ecosystem of Amrita Vishwa Vidyapeetham, which includes specialized research centres and cutting-edge facilities critical for pioneering action-oriented research and translating technological innovations for societal benefit.

7. Admission Requirements and Process

7.1. Eligibility

To ensure the high standard of incoming scholars, applicants for the PhD program must possess the following qualifications:

- A Bachelor's Degree in Architecture or equivalent with minimum 55%.
- A Master's degree in architecture or an allied specialization (e.g., Urban Planning, Building Technology, Conservation) or equivalent from a recognized institution with minimum 55%
- **Entrance examination and interview:** Candidates will be shortlisted through a written research aptitude test or based on national eligibility examinations and must attend an interview to present their research proposal. Weightage may be assigned to academic record, professional experience and research potential.
- **Research proposal:** Applicants shall submit a preliminary research statement aligning with the programme's thrust areas (technology, sustainability, traditional knowledge systems, heritage conservation).
- **Teaching load:** Full-time scholars receiving assistantship will undertake **four hours of teaching or lab assistance per week** in undergraduate or postgraduate courses, as per the institutional guidelines.
- **Thesis submission:** On completion of the research work and successful defence, scholars must submit multiple copies of the thesis in the prescribed format, including **one hard copy to the Council of Architecture** and a digital copy. This submission must occur **within three months** of thesis examination result.

7.2. Assignment of Teaching Load

To prepare future scholars for academic careers and fulfill institutional requirements, each full-time Ph.D. scholar receiving a government, university, or institutional assistantship will be assigned a minimum of **four hours of teaching load** per week, determined in consultation with their internal guide. This measure serves as a crucial component of pedagogical training, integrating service requirements with professional development.

7.3. Submission of Thesis and Regulatory Compliance

The thesis submission process is characterized by dual compliance, adhering to both the university's rigorous academic regulations and the professional mandates of the national accreditation body. Candidates must successfully complete non-coursework requirements, including Open Seminar I and II, before submitting their synopsis.

Upon completion and declaration of the result of the thesis examination, the candidate is required, in addition to the necessary copies submitted to the university, to submit a **hard copy and a CD to the Council of Architecture (CoA)** within three months. This specific professional requirement confirms that the program maintains the highest standards of academic excellence and professional accountability mandated by the national architectural governing body.

8. Expected Outcomes and Impact

The PhD in Architecture program is expected to generate significant, tangible impacts across research, industry, and society, reinforcing the university's mission of compassionate service and transformative education.

Research and Innovation: The program anticipates a sustained output of impactful publications in globally indexed, peer-reviewed journals, substantially elevating the research productivity of the Amrita School of Architecture. A core measure of success will be the development of new patents and Intellectual Property (IP) disclosures related to sustainable materials, climate-resilient construction, and computational design methodologies, directly contributing to Amrita's recognized success in translating technological innovations.

Industry and Policy Translation: Graduates are expected to lead crucial industry collaborations, transferring academic findings into practical, scalable applications. Their research will influence regional and national policy, particularly concerning sustainable urbanization, climate risk assessment, and the integration of traditional knowledge into modern building codes.

Societal Upliftment: In alignment with the university's value-based approach, the program will produce action-oriented research focused on solutions that drive positive change at the community level. This includes creating accessible, scalable, and sustainable architectural models for community-driven projects, contributing directly to societal upliftment and supporting the goals of developing self-reliant, resilient communities.

9. Contact Information:

Primary Contact for PhD Program Inquiries:

Primary Contact	Detail
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Prof Dr Harimohan Pillai, Professor Emeritus, Amrita School of Architecture

Conclusion and Strategic Outlook

The PhD Program in Architecture at the Amrita School of Architecture represents a crucial strategic investment designed to meet the growing national and global demand for high-level domain expertise in Technology, Sustainability, and Traditional Knowledge Systems. By adopting a rigorous, quality-controlled structure (targeting 6-8 students annually) and leveraging the University's proven capacity for action-oriented, interdisciplinary research, the program is optimally designed to cultivate scholars who are not only academically proficient but also ethically grounded and professionally prepared for leadership roles.

The commitment to integrating foundational research in traditional knowledge with cutting-edge digital technologies provides a unique platform for innovation, particularly in the critical area of climate resilience. This alignment ensures that the PhD graduates will serve as key contributors to the University's ongoing ascent in global impact rankings and its mission to deliver transformative, socially responsible education and research.

Annexure 1

Core Courses

(Detailed Syllabus)

Doctoral programs in Architecture are structured to transcend professional practice and cultivate independent scholars capable of rigorously advancing the boundaries of knowledge within the built environment. This endeavor requires mastery of theoretical depth and methodological sophistication. The four advanced seminars detailed within this report represent crucial, interdisciplinary research clusters that address the most pressing global challenges facing contemporary architecture: mitigating environmental collapse (Climate Resilience), ensuring cultural survival (Traditional Knowledge Systems), managing technological transformation (Digital Technologies), and addressing socio-spatial equity (Critical Issues in Urbanization). These seminars are thus designed not merely for foundational knowledge transmission but specifically for developing the highest cognitive capacities required for original scholarly creation.

The prescribed evaluation model for these doctoral seminars ensures a comprehensive and balanced assessment of both foundational theoretical comprehension and continuous scholarly engagement. The split between Internal and External grading reinforces the institutional requirement for rigorous assessment and accountability in doctoral education.

Table 1: Standardized Doctoral Course Evaluation Pattern

Evaluation Component	**Type**	**Weightage (%)**	**Rationale/Focus**
Internals (Total 50%)	Mid Semester Theory Examination	40%	In-depth evaluation of theoretical frameworks and modular content mastery (Modules 1-3).
	Assignment and Continuous Evaluation	10%	Assessment of short research papers, seminar presentations, literature reviews, and practical computational exercises. Focuses on ongoing scholarly engagement and methodological development.
Externals (Total 50%)	End Semester Theory Examination	50%	Comprehensive, summative assessment of all course content (Modules 1-5), requiring synthesis, critical argument construction, and methodological application.

The Mid Semester Theory Examination focuses on internal content mastery early in the semester, while the Assignment and Continuous Evaluation component ensures students engage in ongoing scholarly production—a hallmark of PhD training. The final End Semester Theory Examination is a summative test, requiring candidates to synthesize arguments across all five modules.

Course 1: Climate Resilience and Sustainable Building Science (CRSBS)

Course Overview

This advanced seminar offers an intensive exploration into the physical phenomena and interdisciplinary research governing the performance and adaptive capacity of the built environment amidst accelerating climate change. The course moves decisively past introductory green building concepts to concentrate on high-performance design, advanced computational analysis, integrated design optimization, material science, and the development of strategies aimed at net-zero carbon operations and multi-scalar resilience. The core objective is to utilize physics-based and data-driven approaches to provide comprehensive understanding of building energy usage and occupant comfort, thereby informing designers and engineers on the actual performance realities of their designs.

Course Outcomes (COs)

The doctoral candidate upon completion of this course will be able to:

CO1: Analyze the complex, coupled human-environment-energy systems and physics-based phenomena influencing building performance and failure mechanisms.

CO2: Evaluate the efficacy and limitations of advanced computational environmental modeling software and data-driven approaches in predicting building performance metrics.

CO3: Create novel, climate-responsive design strategies by integrating advanced building technologies with localized, traditional vernacular knowledge systems.

CO4: Analyze the embodied and operational carbon impacts across a building's lifecycle and formulate comprehensive net-zero emissions strategies.

CO5: Evaluate policy instruments and design interventions necessary for enhancing the adaptive capacity and resilience of vulnerable populations and urban scales.

Detailed Syllabus: Climate Resilience and Sustainable Building Science

Module 1: Foundational Building Physics and Performance Metrics

This module establishes the scientific basis for building performance research, reviewing foundational thermodynamic principles, heat transfer dynamics, moisture transport, and psychrometrics. The central theme is the transition from passive design theory to quantitative analysis. Doctoral students must master the application of physics models—specifically physics-based and data-driven approaches—for detailed investigation into building energy usage and occupant comfort. This mastery is essential for informing design decision-making and optimization processes, laying a crucial groundwork for advanced computational work in subsequent modules.

Module 2: Advanced Environmental Modeling and Simulation Techniques

The focus shifts to methodology, demanding mastery of Computer Environmental Modelling Software (e.g., EnergyPlus, OpenStudio) and advanced simulation techniques. Topics include detailed climate analysis, daylighting simulation, thermal bridging calculation, and Computational Fluid Dynamics (CFD). The module develops practical skills in comprehensive Environmental Assessment Techniques (EAT). The requirement for proficiency in EAT supports the ability to evaluate the efficacy of design parameters against predicted performance, a critical scholarly skill that enables the appraisal of design viability prior to execution.

Module 3: Net Zero Carbon Design and Embodied Energy Analysis

This section clarifies the distinctions between Net Zero Energy (NZE), Net Zero Emissions (NZE), and Net Zero Cost buildings. It addresses advanced decarbonization strategies across the entire construction lifecycle. A thorough study of advanced life-cycle assessment (LCA) methodologies is required for accurately calculating embodied energy and assessing material sourcing impacts. The emphasis is placed on energy efficiency and passive/low-energy design as non-negotiable foundations for high-performance architecture. Furthermore, moving beyond the simple NZE energy balance to focusing on NZE emissions or cost introduces significant policy and economic challenges. Research in this area must focus on innovative ways to couple financial and design strategies to offset complex charges like utility taxes, distribution fees, and peak demand charges, which is vital for analyzing holistic carbon reduction strategies.

Module 4: Material Resilience and Climate Adaptation

Module 4 integrates material science with climate vulnerability research. It examines the impact of climate change and pollution on the resilience and degradation of traditional building materials, analyzing examples like stone, wood, concrete, and ceramic. Strategies for adaptive re-use and the critical contribution of traditional and alternative materials to reducing negative environmental impact are discussed. The curriculum addresses climate projections, vulnerability assessment, and design interventions needed for handling extreme conditions, such as those in floodplains. The relationship between material lifespan and local adaptation defines resilience, making explicit the need to analyze the "vulnerability" and "adaptive capacity" of the physical built environment.

Module 5: Integrated Optimization and Climate-Resilient Futures

The final module synthesizes knowledge from previous sections to address future architectural strategies. It focuses on combining Indigenous and vernacular knowledge systems with advanced green building technologies to construct demonstrably climate-resilient buildings. Case studies examine multi-scalar resilience, ranging from individual structures to comprehensive urban planning. The module mandates the use of parametric optimization techniques to integrate rigorous environmental analysis with structural and material constraints, providing comprehensive data to inform designers, engineers, and building managers. This synthesis aims to move beyond mere documentation of traditional practices by requiring students to quantify the resilience achieved when traditional and modern methods are scientifically combined.

Detailed References

Text Books (Required Foundational Reading for Doctoral Seminar):

1. Saylor, B., et al. (Eds.). (2024). *Climate Adaptation and Resilience Across Scales*. CRC Press.
2. Janković, L. (2020). *Sustainable and Resilient Building Design: Approaches, Methods, and Tools*. Woodhead Publishing.
3. Goulding, J. R., Lewis, J. O., & Steemers, K. (2013). *Energy Conscious Design: A Primer for Architects*. Routledge.
4. Gagnon, S., & Bédard, C. (2018). *Integrated Sustainable Design of Buildings*. John Wiley & Sons.

Reference Books (Advanced Research and Specialized Topics):

1. Heschong, L. (2002). *Thermal Delight in Architecture*. MIT Press.
2. Torcellini, P., et al. (2006). *The Definition of Net Zero Energy Buildings*. NREL/TP-550-39833.
3. Crawley, D. B. (2008). *Building Energy Modeling: A Primer*. ASHRAE.
4. Luo, Z., & Chen, G. (Eds.). (2020). *Data-Driven Building Performance Analysis*. Elsevier.

Course 2: Traditional Knowledge Systems and Vernacular Heritage

Course Overview

This seminar is dedicated to a theoretical and material analysis of traditional knowledge systems as applied to vernacular heritage. The research focus extends beyond conventional architectural history to include a rigorous analysis of the material properties, structural systems, and ecological efficiency inherent in indigenous building practices. The course critically evaluates these systems, which are often characterized by their perfection in serving purpose and relative immutability across fashion cycles, to determine how they can inform contemporary conservation methodologies, sustainable development, and advanced climate adaptation research.

Course Outcomes (COs)

The doctoral candidate upon completion of this course will be able to:

CO1: Analyze the historical, socio-cultural, and ecological contexts underpinning the development of diverse global vernacular traditions.

CO2: Evaluate the performance, durability, and production methods of traditional building materials against contemporary sustainable standards.

CO3: Create systematic methodologies for the documentation, protection, and conservation of endangered vernacular heritage and associated intangible knowledge systems.

CO4: Analyze the principles of climate-responsive design embedded in indigenous architecture, especially concerning passive energy systems and localized resource management.

CO5: Evaluate the feasibility and ethical application of integrating vernacular knowledge systems into modern construction for achieving current sustainability and resilience goals.

Detailed Syllabus: Traditional Knowledge Systems and Vernacular Heritage

Module 1: Theories and Historiography of Vernacular Architecture

This foundational module introduces the canonical debates defining vernacular architecture. Key works, such as Bernard Rudofsky's discussion of building as a universal, non-pedigreed phenomenon, and Henry Glassie's seminal argument prioritizing floor plans, context, use, and materials over mere decorative features , are essential readings. The module analyzes the concept of architecture that is "nearly immutable" and serves its original purpose to perfection. The focus on deep structural and ecological analysis—rather than surface aesthetics—justifies the need for high-level scholarly investigation into these systems (CO1).

Module 2: Traditional Materials Science and Construction Ecology

An in-depth technical study of traditional materials is undertaken, focusing on their structure, inherent properties, and production methods (e.g., earth, wood, stone). The module emphasizes the ecological aspects of these systems, specifically their low embodied energy, renewability, and potential for recycling. This provides a necessary technical connection to sustainable building science. Analyzing the ecological performance and recycling potential of these materials is crucial for evaluating their viability within modern net-zero strategies (CO2, CO5).

Module 3: Climate-Responsive Design: Indigenous Strategies and Passive Systems

This section focuses on the sophisticated climate-responsive strategies inherent in indigenous building traditions, such as the use of wind catchers, thermal mass, and solar orientation. Specific regional examples, including Hassan Fathy's principles for hot arid climates, are studied. Crucially, the module also examines how the efficiency of traditional architectural styles has been observed to reduce over time in communities highly dependent on land and ecosystems, a consequence of rapidly changing climate conditions. This observation underscores the need to analyze the mechanisms of this performance shift, moving beyond mere celebration to rigorous assessment (CO4).

Module 4: Conservation, Documentation, and Heritage Protection Procedures

This module concentrates on the methodological framework necessary for scholarly intervention. It covers advanced methodologies for documenting intangible heritage and construction techniques. The curriculum includes a detailed review of legal and policy frameworks for heritage protection and focuses on the specific procedures for protecting vernacular architecture. The requirement for students to create systematic documentation methodologies (CO3) is supported by the mastery of these essential technical procedures.

Module 5: Application of Vernacular Principles in Modern Sustainable Development

The final module requires synthesis, focusing on advanced case studies that successfully integrate vernacular principles into contemporary architectural and urban designs. Research involves methods for combining Indigenous cultural practices with advanced green building technologies, such as those suggested for climate resilience projects in vulnerable regions. This section necessitates evaluating the economic, social, and cultural challenges inherent in technology transfer. This synthesis—justifying the utility of traditional knowledge systems in modern, quantified contexts—represents the highest level of scholarly creation for this course (CO5).

Detailed References

Text Books (Required Foundational Reading for Doctoral Seminar):

1. Rudofsky, B. (1964). *Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture*. MoMA.
2. Glassie, H. (1975). *Folk Housing in Middle Virginia: A Structural Analysis of Historic Artifacts*. University of Tennessee Press.
3. Fathy, H. (1986). *Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates*. University of Chicago Press.
4. Oliver, P. (2003). *Dwellings: The Vernacular House World Wide*. Phaidon Press.

Reference Books (Advanced Research and Specialized Topics):

1. Asquith, L., & Vellinga, M. (Eds.). (2006). *Vernacular Architecture in the Twenty-First Century: Theory, Education and Practice*. Routledge.
2. Moffat, I. (2020). *The Resilience of Historic Buildings and Vernacular Materials*. Springer.
3. Cajete, G. (2000). *Native Science: Natural Laws of Interdependence*. Clear Light Publishers.
4. Research papers discussing the integration of traditional materials and procedures for sustainability.

Course 3: Digital Technologies, Computation, and Generative Design

Course Overview

This seminar offers an in-depth study of the theoretical frameworks and practical applications of advanced computational methods in architecture, with a primary focus on Generative Design (GD). The program examines computation as an essential "intermediary agent" for the seamless integration of analysis, material constraints, and advanced fabrication into complex architectural processes. Students are required to develop mastery in algorithmic foundations, parametric systems, evolutionary solvers, and the emerging, transformative role of Machine Learning (ML) and Artificial Intelligence (AI) in augmenting or automating architectural creativity.

Course Outcomes (COs)

The doctoral candidate upon completion of this course will be able to:

1. **Analyze** the historical evolution and theoretical foundations distinguishing parametric, algorithmic, and generative design methodologies.
2. **Evaluate** the capacity of algorithmic frameworks, such as formal grammars, Voronoi, and Delaunay algorithms, to generate complex, performative spatial and structural organizations.
3. **Create** novel computational tools and algorithms that effectively link disparate digital and physical models to incorporate multiple material and environmental constraints into the design process.
4. **Analyze** the operational principles, ethical implications, and practical limitations of using evolutionary computation, machine learning, and neural networks in architectural design loops.
5. **Create** an advanced generative system, potentially utilizing technologies like Generative Adversarial Networks (GANs), to produce and critically evaluate original architectural solutions.

Detailed Syllabus: Digital Technologies, Computation, and Generative Design

Module 1: Computational Thinking and Algorithmic Design History

The module begins with a historical overview of computational design and establishes clear theoretical distinctions between parametric, algorithmic, and generative design. Core concepts include the fundamentals of scripting cultures and formal logic. The essential premise is the recognition of computation as an intermediary agent required for analysis and the incorporation of material constraints. By analyzing the historical movement, students understand that computational research must address the limitations often imposed by an overemphasis on "digital continuity and conformity," prompting the discovery of significant architectural potential through disparate modeling approaches.

Module 2: Parametric Systems and Computational Anatomy

This section focuses on the application of parametric relationships for design generation (Generative Objects). It includes studies in computational anatomy and anthropometry (Generative Fashion), and the use of physical and behavioral simulations to generate optimized spaces. Furthermore, the course expands the scholarly scope by exploring rule-sets from non-architectural generative disciplines, such as music, poetry, narrative, and policy. This expansion reinforces the academic principle that generative design is fundamentally a set of formal logics, thereby strengthening the student's ability to synthesize complex, cross-domain knowledge (CO3).

Module 3: Structural and Spatial Generation

Students engage with advanced algorithms for the generation of structural and spatial systems. Key topics include designing with formal grammars and growth algorithms (Generative Structure) , and utilizing advanced geometry derived from Voronoi, Delaunay triangulation, and routing algorithms (Generative Pattern). Emphasis is placed on implementing optimization criteria—such as structural performance, cost, and daylighting—directly within the generation process. Formal grammars and structural generation demonstrate the potential for self-organizing systems, and the application of optimization criteria ensures that generated forms are technically viable, integrating the constraints of materialization.

Module 4: Evolutionary Computation and Optimization

This module concentrates on advanced optimization techniques, including the design process utilizing evolutionary solvers, genetic algorithms, and life-cycle systems (Generative Evolution). Students analyze multi-objective optimization methods and the creation of data analysis and performance feedback loops to guide computational evolution. Evolutionary computation is the primary technical mechanism for integrating the complex material and performance constraints identified in earlier modules. This necessitates high-level evaluation skills (CO2) for successfully navigating complex optimization landscapes.

Module 5: Generative Inference and Machine Learning in Architecture

The final module addresses cutting-edge research through the study of machine learning and neural networks (Generative Inference). It includes practical and theoretical engagement with Generative Adversarial Networks (GANs) as tools for architectural creativity. Crucial academic discussions cover the ethical, intellectual property, and practical impact considerations of these technologies on the future of design practice. This module demands the highest level of scholarly creation (CO5), as doctoral research here must focus on advancing knowledge by using ML to bridge the theoretical gap between abstract digital models and physical, material practice.

Detailed References

Text Books (Required Foundational Reading for Doctoral Seminar):

1. Meibodi, M. A. (2016). *Generative Design Exploration: Computation and Material Practice*. KTH.
2. Burry, M. (2012). *Scripting Cultures: Architectural Design and Programming*. John Wiley & Sons.
3. Pottmann, H., et al. (2017). *Architectural Geometry*. Applied Mathematics.
4. Frazer, J. H. (2016). *An Engineer Imagines*. Routledge.

Reference Books (Advanced Research and Specialized Topics):

1. Menges, A., & Ahlquist, S. (Eds.). (2011). *AAD Algorithms Aided Design*. Birkhauser.
2. Dehlinger, H., & Zafeiropoulou, M. (2016). *Computational Design Thinking*. Springer.
3. Saggio, A. (2020). *Artificial Intelligence and Architecture: From Research to Practice*. Routledge.
4. Coenen, T. (2018). *Industry 4.0 for the Built Environment*. Routledge.

Course 4: Critical Issues in Urbanization and Built Environment (CIUBE)

Course Overview

This seminar provides the essential critical theoretical foundation for advanced doctoral research in the built environment, emphasizing political economy, spatial justice, and advanced planning theory. The curriculum engages canonical debates concerning urban processes, the formation of the built environment under capitalist regimes, and the resultant conflicts regarding land use, equity, and governance. Students are required to master the theoretical literatures and utilize both quantitative and qualitative methods necessary to produce methodologically rigorous scholarly work.

Course Outcomes (COs)

The doctoral candidate upon completion of this course will be able to:

1. **Analyze** foundational Marxist and post-structuralist theoretical frameworks that explain contemporary processes of urbanization and built environment formation.
2. **Evaluate** the role of finance, land rent, and the "secondary circuit of capital" in shaping urban morphology, development strategies, and systemic economic crises.
3. **Create** theoretically informed research questions and conceptual models addressing normative theories of social justice, equity, and the production of urban space.
4. **Analyze** the complex interaction of human agency, political ecology, and pressing environmental concerns within dynamic urbanization and global city formation.
5. **Evaluate** advanced quantitative and qualitative research methodologies appropriate for conducting rigorous, multidisciplinary critical urban studies.

Detailed Syllabus: Critical Issues in Urbanization and Built Environment

Module 1: Foundational Debates in Critical Urban Theory

This module focuses on achieving mastery of critical theoretical traditions. Key canonical texts include those of Henri Lefebvre on *The Production of Space*, emphasizing concepts like "lived space" and "everyday life". Additionally, students study Manuel Castells' *The Urban Question* regarding urban social movements and Marxist approaches. The curriculum explores advanced planning theory and theories of good city form. Analyzing Lefebvrian concepts, specifically by rereading "lived space" to emphasize its socially transformative character, provides the methodological lens necessary for translating abstract theory into concrete social justice objectives (CO3).

Module 2: Political Economy of Urbanization and Capital

Module 2 centers on the frameworks established by David Harvey, including *Social Justice and the City* , the concept of the spatial fix, and, critically, the role of the "secondary circuit of capital"—investment in housing and the built environment. Theories of economic geography and urban land rent are covered. The required study of the general theory of the laws of motion of capital, including Marxist crisis theory, is necessary to understand how the *financialization* of urban development shapes the built environment and precipitates crises like those observed in 2007-09. This knowledge is essential for evaluating the economic forces that determine urban morphology (CO2).

Module 3: Normative Theories of Social Justice and Equity

This section addresses the ethical imperative in urban planning, focusing on normative theories of social justice and urbanism. Key scholarship includes Susan Fainstein's concept of the Just City. The curriculum analyzes socio-spatial inequality, poverty, and processes of urban exclusion, examining issues such as the housing sector, land use zoning, and transportation policy through a social justice framework. This module serves as the primary bridge, translating abstract economic critiques into actionable, normative goals, requiring students to critique current policy by applying robust justice frameworks.

Module 4: Global Flows, Urban Political Ecology, and the Environment

The module explores the interaction of human agency and the environment within urban contexts. It introduces advanced theories of urban political ecology, including the work of Swyngedouw and Heynen. Debates surrounding the relevance of the 'Urban Age' and the dynamics of global city formation (Sassen) are central. The curriculum links the processes of urbanization to environmental concerns, particularly connecting issues of global warming to built environment formation through a critical, power-focused lens, rather than purely technical analysis (CO4).

Module 5: Critical Research Methodologies and Scholarly Leadership

The final module ensures that candidates develop the methodological depth necessary for independent research. It covers a mastery of diverse research methods, ranging from quantitative and deductive approaches to qualitative and inductive methods. Doctoral candidates must select and master a specific set of methods appropriate for their dissertation research, which often involves required advanced theoretical coursework. This module directly supports the mission of training leading scholars by requiring students to evaluate methodological tools and produce rigorous research comparable to that expected of faculty in high-research activity universities.

Detailed References

Text Books (Required Foundational Reading for Doctoral Seminar):

1. Harvey, D. (1973). *Social Justice and the City*. Johns Hopkins University Press.
2. Lefebvre, H. (1991). *The Production of Space*. Blackwell Publishing.
3. Castells, M. (1977). *The Urban Question: A Marxist Approach*. MIT Press.
4. Fainstein, S. S. (2010). *The Just City*. Cornell University Press.

Reference Books (Advanced Research and Specialized Topics):

1. Harvey, D. (2012). *Rebel Cities: From the Right to the City to the Urban Revolution*. Verso.
2. Brenner, N., & Schmid, C. (2014). “The 'Urban Age' in Question”. *International Journal of Urban and Regional Research*.
3. Sassen, S. (2001). *The Global City: New York, London, Tokyo*. Princeton University Press.
4. Swyngedouw, E., & Heynen, N. (2003). “Urban Political Ecology”. *Antipode*.

Conclusion: Programmatic Synergy and Doctoral Excellence

The detailed structure of these four PhD Courses ensures a rigorous intellectual training environment that prepares candidates for scholarly leadership. The pedagogical framework, which strictly adheres to the highest levels of Bloom's Taxonomy (Analyze, Evaluate, Create), guarantees that students are trained in critical thinking and original knowledge production.

The curriculum design deliberately integrates knowledge across disciplinary boundaries, fostering essential synergy. For example, the need to quantify the resilience achieved by combining traditional knowledge systems with advanced technologies, as explored in TKSVH Module 5, provides crucial localized data that feeds directly into the performance modeling required by CRSBS Module 5. Similarly, the data-driven analysis of urban processes using computational tools (DTCGD Module 2) can provide novel empirical evidence necessary for the critical socio-spatial analysis of inequality required in CIUBE Modules 3 and 4. This integrated approach ensures that doctoral candidates are capable of addressing complex contemporary challenges—from mitigating the material impacts of climate change to critiquing the systemic drivers of urban inequity—with both theoretical depth and methodological rigor.