Semester- IV

	DESIGN THESIS PHASE II : ARCHITECTURAL SYNTHESIS AND REALIZATION			
	Course Code	2MDAC401	CIE Marks	50
	Teaching Hours per semester (L:T:S)	00:14:42	Viva Marks	50
	Total Hours of Pedagogy	360 Hours	Total Marks	100
	Credits	12	Exam Hours	-

Course Learning objectives:

- To enable students to synthesize the theoretical framework and computational design methodologies established in Phase-I into a fully realized, highly resolved architectural proposition.
- To foster advanced independent research that bridges algorithmic design workflows with material performance, environmental simulation, structural logic, or robotic fabrication parameters.
- To cultivate a rigorous academic and professional defense mechanism through systematic multi-objective optimization, comprehensive technical documentation, and scientific validation models.

COURSE CONTENT

Research Content:
The design thesis is an independent, deeply specialized research-driven design project that serves as the capstone of the postgraduate program, continuing directly from the previous semester's research formulation. Students are expected to test their previously developed hypotheses against a complex, real-world architectural, urban, or technological challenge.

The proposal must be translated into a highly synthesized architectural manifesto. The design resolution must explicitly answer:

- **What:** The systemic spatial, structural, and environmental solution to the research problem.
- **How:** The rigorous deployment of parametric, generative, or algorithmic workflows to generate, optimize, and evaluate the form.
- **Why:** The socio-ecological, technological, and architectural justification for the selected methodology and its contribution to the field of Digital Architecture.

The final thesis submission must comprehensively justify the structural logic, material lifecycle, building performance, and tectonic reality of the project within an acceptable, discipline-specific framework.

Research and Realization Process
Students are required to validate their generative proposals using experimental design techniques, advanced simulation engines, or physical prototyping. The iterative design realization process includes:

- **Algorithmic Refinement:** Translating abstract spatial parameters into robust computational models (e.g., multi-agent systems, evolutionary algorithms, topological optimization).
- **Environmental and Performance Simulation:** Validating the geometry against rigorous performance metrics using plugins and tools for solar radiation, thermodynamic behavior, structural load paths, and daylighting optimization.
- **Material and Fabrication Constraints Integration:** Embedding material behavior, manufacturing tolerances, structural engineering parameters, and assembly logic directly into the generative scripts.
- **Physical-Digital Synthesis:** Creating physical scale models, robotic fabrication mock-ups, or immersive interactive spatial simulations (XR/VR) to validate spatial quality and assembly sequences.
- **Continuous Peer and Juror Review:** Periodically presenting defensive arguments in a studio environment to refine communication, graphical clarity, and technical mastery.

Area of Advanced Research

The specialization of the study must align with cutting-edge global paradigms in digital architecture, specifically focusing on:

- **Parametric and Generative Urbanism:** Algorithmic master-planning, climate-resilient urban growth modeling, and network analysis.
- **Computational Materiality and Biomimetic Engineering:** Material-informed form-finding, kinetic envelopes, and bio-integrated building systems.
- **Digital Fabrication and Robotic Assembly:** Custom toolpath generation, additive manufacturing (3D printing) at architectural scales, robotic timber/masonry construction, and automated assembly logic.
- **Virtual Realities and Interactive Environments:** Responsive environments, digital twins, mixed-reality spatial interfaces, and human-computer interaction in physical space.

Presentation and Submission Deliverables

The final submission must be presented as an integrated, multi-media scientific design portfolio consisting of:

- **Comprehensive Design Drawings:** Algorithmic logic diagrams, fully annotated plans, high-fidelity sections, construction details reflecting computational assembly, and advanced computational renders.
- **Performance Reports:** Data charts, simulation graphs, structural finite element analysis (FEA) results, and generative optimization logs.
- **Physical Component/Prototype:** High-precision physical models or a 1:1 / 1:10 fabricated prototype component showcasing material and structural joints.
- **Academic Thesis Report:** A publication-grade research book documenting the methodology, code logic, field/simulation analysis, conclusions, and future research directions.

Teaching-Learning Process	Critical review with constructive suggestions / feed backs has to be provided by the Guide/ co-guide during the progress of the dissertation.

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:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department one of whom shall be the Guide, or external reviewer whoever takes mid-review on invitation by the department. The CIE marks awarded for the dissertation work shall be based on the evaluation of the dissertation design/project Report, presentation skill, and question and answer session in the periodic reviews. 50% weightage to be given to the design, 25% to the report and presentation, and 25% to question answers.

Viva- Voce Examination:

- The student needs to submit his/her report done throughout the semester, including the data collection for the Viva examination, at least one day prior to the Viva examination to the PG course coordinator/HOD.

- The viva-voce marks list generated is to be signed by both internal and external examiners and submitted to VTU in the sealed cover through the Principal of the institution.
- SEE for Design Thesis work will be conducted by the two independent external examiners appointed by the University alongside the internal panel. The SEE marks awarded for the project work shall be based on the evaluation of the thesis work Report, project presentation skill, and question and answer session in the ratio 50:25:25

Suggested Learning Resources:
Books

- Menges, A., S Ahlquist, S. (2011). Computational Design Thinking. John Wiley S Sons.
- Carpo, M. (2017). The Second Digital Turn: Design Beyond Intelligence. MIT Press.
- Oxman, R., S Oxman, R. (2014). Theories of the Digital in Architecture. Routledge.
- Hensel, M., Menges, A., S Weinstock, M. (2010). Emergent Technologies and Design: Towards a Biological Paradigm for Architecture. Routledge.
- Groat, L. N., S Wang, D. (2013). Architectural Research Methods. John Wiley S Sons.

Web links and Video Lectures (e-Resources):

- ACADIA (Association for Computer Aided Design in Architecture) Research Repository
- eCAADe Open Access Digital Library
- ResearchGate / SADA (International Journal of Architectural Computing)
- Thesis Format | Dissertation Format | Paper, Structure, Sample | Leverage Edu

Skill Development Activities Suggested -

- Advanced technical masterclasses on custom toolpath generation (e.g., KUKA|prc) or complex optimization platforms (e.g., Octopus, Wallacei).
- Scientific peer-review workshops of drafted research papers aimed at international conference tracks.
- Industrial/Laboratory visits to advanced digital fabrication facilities, robotic labs, or smart-city command centers.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	**Synthesize** complex environmental, contextual, and programmatic parameters into a cohesive computational architectural strategy using design research.	L6 (Creating)
CO2	**Deploy** advanced multi-objective optimization, systemic simulation tools, and parametric logic to generate hyper-resolved, data-driven design variants.	L3 (Applying)
CO3	**Evaluate** the structural, thermodynamic, and material performance of a speculative architectural form against scientific engineering benchmarks.	L5 (Evaluating)
CO4	**Formulate** explicit fabrication, robotic construction, or assembly strategies that prove the real-world tectonic viability of a digital model.	L6 (Creating)
CO5	**Defend** complex theoretical and technological frameworks through rigorous graphic mapping, written research manuscripts, and oral academic jury reviews.	L5 (Evaluating)

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	The generation of digital tools makes it possible to use parametric design as a way of evolving new information systems, new ways of producing building components and architecture.	PO1
2	The course/project goal is to increase the student's knowledge in this area/field and skills/knowledge in the field of architecture in general.	PO2
3	The students will enter the project with varying degrees of knowledge/skills and will subsequently end up at different levels at the end of the course/project.	PO3
4	The individual student must show an increase in the particular skills/knowledge offered and in the field of architecture in general.	PO4
5	To critically interpret and understand product design+robotics.	PO5

Mapping of COS and POS

	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	H	L
CO2	H	H	L	M	M
CO3	M	H	M	H	M
CO4	H	M	M	L	H
CO5	L	H	H	M	M

H – High, M – Medium, L – Low

— — — END OF SEMESTER — — —