Semester- II

	SUSTAINABLE DESIGN STUDIO			
	Course Code	MDAC201	CIE Marks	50
	Teaching Hours/Week (L:P:SDA)	02:06:00	Viva Marks	50
	Total Hours of Pedagogy	8	Total Marks	100
	Credits	9	Exam Hours	-

Course Learning objectives:

This unit of study introduces explorative and creative thinking expressed through the application of digital software to design propositions. Students will develop the ability to use digital software for the development and execution of parametrically designed building typology

Module-1

Decoding the architectural design process as a collaborative, iterative and evolutionary vector framework - collaborative- spatial design & parameters, iterative - to understand the parameters and form a complex system- vector framework . introduction to sustainable aspects of design -**Case Studies** Examples of parametric design projects with sustainable features, Analysis of their environmental impact and design process

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

Module-2

Role of diagramming in analysis, data mapping and their translation to parametric platforms - data mapping to relevant parameters , parametric analysis. computational tools and skills , Produce creative design outcomes in a digital environment with reference to appropriate parametric software use for designing a building typology - Sustainable design principles (energy efficiency, materials, site considerations)

Teaching-Learning Process	***Collaborative and Cooperative learning****: physical case studies* ***ICT and Digital support****: To introduce and understand different parameters and constraints to incorporate into the analysis and study of the project . power presentation for relevant studies and analysis*

Module-3

Identifying and defining the role of parametric platforms as a powerful design tool that augments the design and execution process - Introduction to generative design principles
Optimization techniques for sustainability metrics (e.g., energy consumption, daylighting)

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation , software tools will be taught*

Module-4

sustainable material & performance analysis - Develop and document individual visual communication concepts and outcomes framed by a brief -Identify and use appropriate digital software to execute intended design outcomes ,Using simulation tools (e.g., energy modeling software) for sustainability analysis, Daylighting analysis and thermal performance evaluation

	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of power point presentation ,software tools will be taught*
	Module-5	
	Apply vector oriented design software as design tools to achieve design objectives -Produce creative design outcomes in a digital environment with reference to appropriate parametric software use for designing a building typology - responsive and adaptive Design	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of power point presentation*

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:

CIE marks shall be awarded by a committee comprising of Principal/Dean, PG Course Coordinator/HOD and Guide/Co-guide of the department. The CIE marks awarded for PSC (professional supportive course), shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report

Semester End 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 will be evaluated by external examiners appointed by the University along with PG Course coordinator/ guide/ co-guide or an internal examiner.
- 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.

Suggested Learning Resources:

Books

- Tschumi, Bernard ; Notations: Diagrams and Sequences
- Koolhaas, Rem ; Delirious New York: A Retroactive Manifesto for Manhattan,
- Fenton, Joseph , Pamphlet Architecture 11: Hybrid Buildings
- Woodbury, Robert ; Elements of Parametric Design, Routledge New York
- Oxman, Rivka and Robert ; Theories of the Digital in Architecture, Routledge New York.

Web links and Video Lectures (e-Resources):

https://www.danieldavis.com/a-history-of-parametric/

- https://vdoc.pub/download/scripting-cultures-architectural-design-and-programming-53g6jiss52r0
- https://davidfrico.com/evolutionary-architecture-principles.pdf
- https://www.perlego.com/book/2388244/from-control-to-design-pdf

https://www.youtube.com/watch?v=SY2VUBE6SgA

Skill Development Activities Suggested

Students will work on above mentioned in detail and will submit the work in the form of drawings and/ models and supplementary documentation as found suitable to explain the design process and product judiciously

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Students should be able to synthesize the knowledge they have acquired throughout the year.	L2
CO2	To understand developments in BIM, parametric and generative design and digital fabrication in combination with the morphogenetic architecture framework	L2
CO3	Advanced their knowledge on contemporary architectural discourse in close relation to the design task.	L3
CO4	To understand the comprehensive design , of a design project	L4
CO5	To establish new ways of thinking about design and fabrication, professional practice and its cultural impact.	L4

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	Decoding the architectural design process as a collaborative, iterative and evolutionary vector framework	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	A framework is proposed as a disciplinary bridge to enable the team members to collaboratively identify and employ appropriate processes to implement morphogenetic IBs	PO5

Mapping of COS and POS

	PO1	PO2	PO3	PO4	PO5
CO1	0	M	M	H	H
CO2	L	M	H	M	L
CO3	0	M	M	H	H
CO4	0	M	M	L	H
CO5	L	L	M	M	H

H – High , M – Medium, L - Low

Semester- II

	INTERACTIVE ARCHITECTURE			
	Course Code	MDAC202	CIE Marks	50
	Teaching Hours/Week (L:P:SDA)	02:00:02	Viva Marks	50
	Total Hours of Pedagogy	4	Total Marks	100
	Credits	4	Exam Hours	-
	Course Learning objectives: Gain insight into interactive architecture's principles and evolution, explore technological integration with sensors and digital interfaces, and develop skills to design and critique innovative projects addressing urban challenges			
	Module- 1			
	Overview- Definition and evolution of interactive architecture, Importance of interactivity in architectural design- **Key Concepts -** Principles of interaction design in architecture, Relationship between human behavior and interactive spaces ,**Case Studies** Examples of interactive architecture projects worldwide, Analysis of their design intent and user engagement			
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-2			
	Introduction to sensors, actuators, and responsive technologies used in interactive architecture Overview of IoT (Internet of Things) applications in buildings- **Sensing Technologies-** Types of sensors used in interactive architecture (e.g., motion sensors, light sensors)- Integration of sensor data with building systems			
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-3			
	Actuation and Responsive Systems- Actuators for kinetic architecture and responsive elements, Designing feedback loops for real-time interaction, **Interactive Design Principles-** User-centered design approaches for interactive spaces- Designing for accessibility and inclusivity in interactive environments ,experimenting with basic sensors and actuators to create interactive prototypes			
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-4			
	Digital interfaces & interaction design - **Digital Interfaces in Architecture-** Introduction to interactive displays,Using digital interfaces for user interaction and information display ,**Gesture and Motion-Based Interaction -** Designing interactive environments based on gestures and body movement, Case studies of gesture-controlled architecture			

	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*
	Module-5	
	responsive lighting and sound, interactive urban spaces ,Designing interactive public spaces and urban interventions, Role of interactive architecture in smart cities and urban planning, spatial computing ,Prototyping and testing interactive architectural concepts in a controlled environment	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

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:

CIE marks shall be awarded by a committee comprising of Principal/Dean, PG Course Coordinator/HOD and Guide/Co-guide of the department. The CIE marks awarded for PSC (professional supportive course), shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report

Semester End 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 will be evaluated by external examiners appointed by the University along with PG Course coordinator/ guide/ co-guide or an internal examiner.
- 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.

Suggested Learning Resources:

Books

- Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015
- Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014,
- Make sensors: Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media, 2014.

Web links and Video Lectures (e-Resources):

- https://www.tutorialspoint.com/internet_of_things/internet_of_things_tutorial.pdf
- https://www.youtube.com/watch?v=LlhmzVL5bm8
- https://www.youtube.com/watch?v=Fj02iTrWUx0

Skill Development Activities Suggested

Students will be able to configure basic protocols in sensor networks. Program and configure Arduino boards for various designs.Python programming and interfacing , Design IoT applications in different domains

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Students should be able to synthesize the knowledge they have acquired throughout the year.	L2
CO2	The students will be familiar with associated concepts of basic protocols in sensor networks	L3
CO3	Advanced their knowledge on Program and configure Arduino boards for various designs.	L3
CO4	Python programming and interfacing for Raspberry Pi	L4
CO5	Design Iot applications in different domains	L4

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	Interpret the impact and challenges posed by IoT networks leading to new architectural models	PO1
2	Compare and contrast the deployment of smart objects and the technologies to connect them to network.	PO2
3	Appraise the role of IoT protocols for efficient network communication.	PO3
4	Elaborate the need for Data Analytics and Security in IoT	PO4
5	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.	PO5

Mapping of COS and POS

	PO1	PO2	PO3	PO4	PO5
CO1	0	M	M	M	H
CO2	L	M	M	M	M
CO3	0	L	M	M	H
CO4	L	0	L	L	M
CO5	0	L	L	M	H

H – High , M – Medium, L - Low

Semester- II

	DIGITAL ARCHITECTURE PROCESS THEORIES AND HISTORY -II			
	Course Code	MDAC203	CIE Marks	50
	Teaching Hours/Week (L:P:SDA)	03:02:00	SEE Marks	50
	Total Hours of Pedagogy	5	Total Marks	100
	Credits	3	Exam Hours	3
	Course Learning objectives: To develop a focused inquiry into a specific area of algorithmic dynamics through formal content and theories with regards to emergent behaviours those exhibit a dynamic interaction of diverse forces.			
	Module-1			
	The subject focuses on the concepts and convergent interdisciplinary effects of evolutionary design processes on design and production technologies in architecture, the focus is on developing these as creative inputs to new architectural design processes.			
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-2			
	The Subject Course is designed to familiarise students with these instruments, their associated conceptual fields and with their application to architectural design research.			
	Teaching-Learning Process	***ICT and Digital support**: To introduce and understand different parameters and constraints to incorporate into the analysis and study of the project . power presentation for relevant studies and analysis*		
	Module-3			
	Course content includes theories of Generative algorithms within the realm of Emergence (swarm Behaviour, Fractals, L systems, cellular Automata, genetic algorithms). The concept ,various tools, building egs should be analysed and studied			
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-4			
	The course is meant to develop vocabulary and critical understanding of a wide array of algorithms, thus developing a critical stance towards algorithmic tooling. '			
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of power point presentation*		

	Module-5	
	Research based theoretical investigations will also include works of architects who recursively use algorithmic tooling in their structural form finding and generative design processes.	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of power point presentation*

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 Assignments, Tests and Term Paper submission.

Semester End Examination:

Theory Examination shall be held for 3-hour duration, students are expected to answer FIVE full questions, one question from each module

Suggested Learning Resources:

Books

- Tschumi, Bernard ; Notations: Diagrams and Sequences
  Koolhaas, Rem ; Delirious New York: A Retroactive Manifesto for Manhattan, Fenton, Joseph , Pamphlet Architecture 11: Hybrid Buildings
- Woodbury, Robert ; Elements of Parametric Design, Routledge New York
- T schumi, Bernard ; Event Cities

Web links and Video Lectures (e-Resources):

- https://www.researchgate.net/publication/282813761_Emergence_in_Architectu
- https://www.youtube.com/watch?v=f6ra024-ASY
- https://www.techtarget.com/searchenterprisedesktop/definition/cellular-automaton#:~:text=A%20cellular%20automaton%20(CA)%20is,the%20states%20of%20neighboring%20cells.
- https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a7137-fractal-geometry-in-architecture/
- https://www.sciencedirect.com/topics/engineering/swarm-intelligence#:~:text=Swarm%20intelligence%20(SI)%20is%20a,movement%20of%20birds%20and%20fish.

Skill Development Activities Suggested

The sessional work will be in the form of exercises that are based on generative processes using algorithmic tools available in grasshopper plugins and to understand its use in architectural design. The submission will also include research reports and theoretical presentations to explore the systematic investigation in design processes using algorithmic tools.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Students should be able to synthesize the knowledge they have acquired throughout the year.	L2
CO2	The students will be familiar with associated concepts of algorithmic architecture and its application to architectural design research	L3
CO3	Advanced their knowledge on contemporary architectural discourse in close relation to the design task.	L3
CO4	To understand the comprehensive design , of a design project	L4
CO5	To establish new ways of thinking about design and fabrication, professional practice and its cultural impact.	L4

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	Decoding the architectural design process as a collaborative, iterative and evolutionary vector framework	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	A framework is proposed as a disciplinary bridge to enable the team members to collaboratively identify and employ appropriate processes to implement morphogenetic IBs	PO5

Mapping of COS and POS

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

H – High , M – Medium, L - Low

Semester- II

	DIGITAL FABRICATION & CONSTRUCTION II			
	Course Code	MDAC204	CIE Marks	50
	Teaching Hours/Week (L:P:SDA)	02:00:02	Term work	50
	Total Hours of Pedagogy	4	Total Marks	100
	Credits	3	Exam Hours	-

Course Learning objectives:

To augment the Contemporary developments in the building & construction domain which display capacities to facilitate experimentation & investigation in material informed design. The focus is to explore several intrinsic properties of materials, which can prove beneficial for iterative morphological design developments.

Module- 1

Experimentation & investigation into a chosen building material wherein in-depth study of the material & its intrinsic properties are studied and recorded

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-2

These documented material properties and its behavior are extracted into numerical parameters which are later used to perform iterative digital operations.

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-3

A feed-back loop thus established between the digital & analogue experiments is further used to augment design developments based on specific properties & behaviors of the materials that are investigated during the course of the studio.

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-4

Fundamental concepts of geometric modeling: Spatial coordinates, projections, Boolean operations, formal transformations, freeform surface creation, surface development and deformations aimed at architecture applications, discretization and meshing, digital prototyping and geometry reconstruction.

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-5

	Parametric modeling techniques and tools: Tools that are available to model design parametrically will be introduced in this class to illustrate the construction of geometrical relationships among complex shapes. The lectures will focus on hands-on techniques that can be applied to the design process, to extend the efficiency and productivity of work during the process.	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

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 Assignments, Tests and Term Paper submission.

Semester End Examination:

Theory Examination shall be held for 3-hour duration, students are expected to answer FIVE full questions, one question from each module

Suggested Learning Resources:

Books

- Peter Brandon; Emerging Paradigms and Models in Digital Design – Performance-Based Architectural Design
- Michael Hensel ; Performance-Oriented Architecture: Rethinking Architectural Design and the Built Environment
- Stanney K M ; Handbook Of Virtual Environments : Design Implementation And Applications
- Braun ; Masterpieces: Performance Architecture + Design
- IncPadt; Introduction to the Ansys Parametric Design Language : A Guide to the Ansys Parametric Design Language

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=6meHDZMJp-I**
- **https://www.youtube.com/watch?v=WgvGv8OceLA**
- **https://www.youtube.com/watch?v=if8verABo2g**

Skill Development Activities Suggested

The sessional work will include in-depth documentation of material experimentation that will specifically include intrinsic material properties documentation through demonstrative results, conversion of material properties into the digital medium and iterative digital explorations with reductive material parameters. The documentation will have material experimentation and prototypical models.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To characterize central technology in fabrication	L2
CO2	Interpret the different concepts and transfer to models	L3
CO3	To Critically review and assess the introduction and shift to digital fabrication in manufacturing organizations.	L3
CO4	To demonstrate the use of fabrication in computational design	L4
CO5	students will be able to better understand the concepts , for tool aided design	L4

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	Assess what type or combinations of types of digital fabrication technologies that are appropriate for the task at hand.	PO1
2	Encompass the ability to work in collaboration with interdisciplinary teams.	PO2
3	Critically review and assess the introduction and shift to digital fabrication	PO3
4	Analyze organizational implications of digital fabrication.	PO4
5	Assess what type or combinations of types of digital fabrication technologies that are appropriate for the task at hand.	PO5

Mapping of COS and POS

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

H – High , M – Medium, L - Low

Semester- II

	ADVANCED COMPUTATIONAL METHODS			
	Course Code	MDAC206	CIE Marks	50
	Teaching Hours/Week (L:P:SDA)	00:02:01	Viva Marks	50
	Total Hours of Pedagogy	3	Total Marks	100
	Credits	3	Exam Hours	-

Course Learning objectives:

To establish performance analysis as a major driver to architectural design decisions. Emphasis is to achieve a feed-back loop between the design ambitions and the physical simulations within the domain of performance based digital architecture.

Module- 1

Introduction of contemporary software that are capable of inducing physical parameters into the digitally generated model to evaluate its performance for various factors necessary for the performance of the buildings.

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

Module-2

This is done through testing the digitally generated models for their structural, environmental, thermal and material properties.

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

Module-3

To facilitate this students are introduced to contemporary softwares that are capable of inducing physical parameters into the digitally generated model to evaluate its performance for various factors. These software's aid the students to perform structural stability checks, computational fluid dynamics (CFD) analysis, thermal analysis, etc.

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

Module-4

These softwares are taught to them as short seminars and relevant industrial expertise from different faculties, practices or establishments are invited to delve deeper into specifics of any particular software : ladybug, firefly, butterfly , puffer fish, mosquito, dragon fly, termite nest, honeybee , space

Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

	Module-5	
	Application of the gained knowledge to design problems- to find the optimized solution / understanding of the parameters- using the different tools/ plugins to drive an optimized solution/ to understand the core structure - workflow of parametric modelling	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

CIE marks shall be awarded by a committee comprising of Principal/Dean, PG Course Coordinator/HOD and Guide/Co-guide of the department. The CIE marks awarded for PSC (professional supportive course), shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report

Semester End 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 will be evaluated by external examiners appointed by the University along with PG Course coordinator/ guide/ co-guide or an internal examiner.
- 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.

Suggested Learning Resources:

Books

- Peter Brandon; Emerging Paradigms and Models in Digital Design – Performance-Based Architectural Design
- Michael Hensel ; Performance-Oriented Architecture: Rethinking Architectural Design and the Built Environment
- Stanney K M ; Handbook Of Virtual Environments : Design Implementation And Applications
- Braun ; Masterpieces: Performance Architecture + Design
- IncPadt; Introduction to the Ansys Parametric Design Language : A Guide to the Ansys Parametric Design Language

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=6meHDZMJp-I
- https://www.youtube.com/watch?v=WgvGv8OceLA
- **https://www.youtube.com/watch?v=if8verABo2g**

Skill Development Activities Suggested

The students will be asked to make presentations about the role of performance based design using a specific simulation tool that they have learnt in the due course introduced to them. Through small exercises the students will apply their parametric knowledge and performance assessment to a building typology. Students are expected to submit detailed reports of the tutorials they undertook with appropriate analysis of the results.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Students should be able to synthesize the knowledge they have acquired throughout the year.	L2
CO2	The students will be familiar with associated concepts of basic protocols in sensor networks	L3
CO3	Understand the core structures and workflows of parametric modeling	L3
CO4	Manipulate complex data flows toward desired design outcomes	L4
CO5	Become familiar with program flow and geometry manipulation in Rhino	L4

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	Possess the critical skills necessary to question the limits and biases of a software interface.	PO1
2	Encompass the ability to work in collaboration with interdisciplinary teams.	PO2
3	Critically review and assess the software interface and apply to design	PO3
4	To develop a sensibility for generative modeling uniquely	PO4
5	To able the students in the better understanding of tools that aid in computational design	PO5

Mapping of COS and POS

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

H – High , M – Medium, L - Low

Semester- II

	BIOMIMETIC ARCHITECTURE			
	Course Code	MDAE215A	CIE Marks	100
	Teaching Hours/Week (L:P:SDA)	02:00:02	Term work	-
	Total Hours of Pedagogy	4	Total Marks	100
	Credits	3	Exam Hours	-

Course Learning objectives:

This course examines how biomimicry and parametric design can address environmental challenges. to understand the concepts and analysis of bio- mimicry - applications using, computational tools

	Module- 1	
	This class will examine how natural organisms can be models for architectural design using Biomimicry principles and morphogenetic parametric design. Starting from the beauty of nature as inspiration, students will study ways that architects and designers are examining nature's forms, mechanisms and systems to discover principles for approaching design problems.	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-2	
	Design approaches will include processes of observation, description, analysis, metaphor and abstraction.Biomimicry and systems thinking provide a framework for looking at skins, bones and growth as paradigms for designing static structures and dynamic systems.	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-3	
	Students will study how designers have used natural models to generate building designs, architectural systems and kinetic constructions. Examples will span scales from landscapes, architecture and product design.	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-4	
	Students will study and analyse in detail, different buildings that have been modelled under bio mimicry egs- Beijing National Stadium, National Aquatic Centre, Council House2 , Milwaukee Art Muesem , The Gherkin , Eastgate Centre .	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-5	
	Students can observe and document natural patterns, 3d patterns ,solar adjustable module , solar responsive surface etc . This will familiarise the students to analyse and document buildings within these parameters .	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

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:

CIE marks shall be awarded by a committee comprising of Principal/Dean, PG Course Coordinator/HOD and Guide/Co-guide of the department. The CIE marks awarded for PSC (professional supportive course), shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report

Semester End 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 will be evaluated by external examiners appointed by the University along with PG Course coordinator/ guide/ co-guide or an internal examiner.
- 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.

Suggested Learning Resources:

Books

- Biomimetics: Biologically Inspired Technologies Ed. Yoseph Bar-Cohen,2005
- Biomimicry and Architecture Michael Pawlyn, 2011
- Bionics in Action: The Design Work of Franco Lodato, Motorola Jens Bernsen, 2004
- Cat's Paws and Catapults: Mechanical Worlds of Nature and People
  Steven Vogel, 1998
- The Gecko's Foot: Bio-inspiration, Engineering New Materials and Devices from Nature.
  Peter Forbes, 2005

Web links and Video Lectures (e-Resources):

- **https://www.greenbiz.com/vid**
- **https://www.youtube.com/wat**
- **https://cei.ece.cornell.edu/new**
- **http://algorithmicbotany.org/**

Skill Development Activities Suggested

Assignment will be in the form of in depth documentation subsequent to the study of a topic related to any one of the subject based on availability of experts, which will be presented by the student in the form of a documented report , and a presentation on the same.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Ability to address an environmental design problem by using a natural analogy, natural processes, or natural material properties.	L2
CO2	Understanding of bio-inspired methods for sustainable design	L3
CO3	Ability to use parametric design software to generate form variants	L3
CO4	Understanding of emergent possibilities in digital design, analysis and fabrication	L4
CO5	students will be able to better understand the concepts , for tool aided design	L4

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 biomimetic design	PO5

Mapping of COS and POS

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

H – High , M – Medium, L - Low

Semester- II

	DIGITAL HERITAGE PRESERVATION			
	Course Code	MDAE215B	CIE Marks	100
	Teaching Hours/Week (L:P:SDA)	02:00:02	Term work	-
	Total Hours of Pedagogy	4	Total Marks	100
	Credits	3	Exam Hours	-
	Course Learning objectives: Digital heritage preservation involves the use of advanced technologies to document, conserve, and promote cultural heritage in digital formats. It encompasses techniques like 3D scanning, photogrammetry, and digital imaging to create accurate representations of artifacts, sites, and monuments. This digital data not only preserves cultural significance but also facilitates wider accessibility, education, and research opportunities. Key considerations include data integrity, long-term preservation strategies, ethical practices, and the integration of digital archives with global heritage conservation efforts			
	Module- 1			
	Overview- Definition and significance of digital heritage preservation ,Historical context and evolution of digital technologies in heritage conservation,**Key Concepts-** Principles of cultural heritage conservation and documentation ,Role of digital technologies (e.g., 3D scanning, GIS) in preservation efforts **Case Studies -** Examples of successful digital heritage preservation projects worldwide, Challenges and ethical considerations in digital conservation			
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-2			
	Digital documentation techniques - **Photogrammetry and 3D Scanning-** Principles and methods of photogrammetry for heritage documentation , Use of laser scanning and structured light scanning technologies,mage-based modeling and texture mapping -**Data Processing and Management-** Processing and organizing digital data for preservation , Standards for metadata and data interoperability in heritage contexts case studies of the same			
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*		
	Module-3			
	Digital reconstruction and visualization - **Virtual Reconstruction-** Techniques for reconstructing heritage sites and artifacts digitally -**Interactive Platforms-** Development of interactive digital exhibits and online platforms/ Creating immersive experiences for public engagement -**Case Study** Analysis of a digital reconstruction project, focusing on its accuracy and educational impact			

	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*
	Module-4	
	Digital Preservation Strategies- Long-term preservation strategies for digital heritage data , Risk management and disaster recovery planning ,**Access and Ethics** Providing access to digital archives while respecting cultural sensitivities , Intellectual property rights and ethical considerations in digital heritage. Evaluating the effectiveness of a digital archive in preserving and disseminating heritage information	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*
	Module-5	
	Emerging Technologies- Role of artificial intelligence (AI) and machine learning in heritage preservation , Use of blockchain for provenance and authentication of digital artifacts - sustainability and adaptablity Strategies for maintaining and updating digital preservation initiatives, Adapting to technological advancements and changing preservation needs	
	Teaching-Learning Process	***ICT and Digital support****: Lecture will be conducted , through the use of powerpoint presentation*

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:

CIE marks shall be awarded by a committee comprising of Principal/Dean, PG Course Coordinator/HOD and Guide/Co-guide of the department. The CIE marks awarded for PSC (professional supportive course), shall be based on the progress of the student throughout the semester, presentation skills in seminars and submission of the report

Semester End 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 will be evaluated by external examiners appointed by the University along with PG Course coordinator/ guide/ co-guide or an internal examiner.
- 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.

Suggested Learning Resources:
Books

- **https://www.researchgate.net/publication/337361090_Digital_Heritage**
- **https://unesdoc.unesco.org/ark:/48223/pf0000130071**
- **https://www.isprs.org/proceedings/xxxvi/5-c53/papers/FP104.pdf**

Web links and Video Lectures (e-Resources):

- Applying Digital Documentation for Sustainable Heritage Preservation and Management
- 3D digital documentation in conservation, preservation, & promotion of Ireland's cultural heritage

Skill Development Activities Suggested

Assignment will be in the form of in depth documentation subsequent to the study of a topic related to any one of the subject based on availability of experts, which will be presented by the student in the form of a documented report , and a presentation on the same.

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 evolution of robotic systems	L2
CO2	Understand robot configuration, structures, basic components, workspace and generations of robots	L2
CO3	Associate the relation between kinematic linkages and robot kinematics	L2
CO4	Understand robot dynamics	L2
CO5	Understand robot characteristics with their control systems /application of robots in the industry	L4

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	**L**	**M**	**M**	**M**	**H**
CO2	**M**	**M**	**L**	**M**	**H**
CO3	**0**	**L**	**M**	**L**	**M**
CO4	**L**	**L**	**M**	**M**	**M**
CO5	**L**	**L**	**M**	**H**	**H**

H – High , M – Medium, L - Low

Semester- II

	OPTIMIZING BUILT STRUCTURES			
	Course Code	MDAE215C	CIE Marks	100
	Teaching Hours/Week (L:P:SDA)	02:00:02	Term work	-
	Total Hours of Pedagogy	4	Total Marks	100
	Credits	3	Exam Hours	-

Course Learning objectives:

This subject focuses on the study of building typologies and its optimization techniques using Grasshopper for Rhino, This project extends the system logics to a larger and more complex piece of the city where parameters like the microclimate, social and typological organizations of an urban context will be studied

Module- 1

Problem Formulation and Setup- System characterization:

1. Identification of objectives, design variables, constraints, subsystems
2. System-level coupling and interactions
3. Examples of MSDO in practice
4. Visualization techniques in design optimization

Subsystem model development

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-2

Optimization and Search Methods- Optimization and exploration techniques:

1. Review of linear and nonlinear programming
2. Heuristic techniques: genetic algorithms simulated annealing, Tabu search
3. Design Space Exploration: Design of Experiments (DOE): Full factorial search, parameter study, Taguchi/orthogonal arrays, latin hypercubes
4. Mixed integer programming (application to hub spoke / network problems)

Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Module-3

Multiobjective and Stochastic Challenges

1. Multiobjective optimization:
    1. Weighted sum optimization
    2. Weak and strong dominance
    3. Pareto front computation
    4. Goal programming and isoperformance
    5. Physical Programming
    6. Multiattribute Utility Theory

	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-4	
	Implementation Issues and Real World Applications System assessment and extensions: 1. What is optimality? 2. Design for value: including lifecycle costing 3. Optimizing product families and platforms	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*
	Module-5	
	Implementation issues: 1. Model reduction 2. Approximation techniques: response surfaces, kriging, neural networks 3. Concurrent design Reference studies of buildings of students choice is encouraged - to better understand the architectural aspect	
	Teaching-Learning Process	***ICT and Digital support**: Lecture will be conducted , through the use of powerpoint presentation*

Assessment Details (both CIE and SEE)

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- 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.

Suggested Learning Resources:

Books

- DNagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003
- Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008
- Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
- Harry Asada &Slottine "Robot Analysis& Control" , Wiley Publications, 2014

Web links and Video Lectures (e-Resources):

- **https://www.researchgate.net/publication/329132291_Product_Design_Process_and_Methods**
- **https://nzifst.org.nz/resources/creatingnewfoods/documents/CreatingNewFoodsCh5.pdf**
- **https://www.researchgate.net/publication/283452773_Introduction_to_Robot_Design**

Skill Development Activities Suggested

Assignment will be in the form of in depth documentation subsequent to the study of a topic related to any one of the subject based on availability of experts, which will be presented by the student in the form of a documented report , and a presentation on the same.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To analyse area of analysis and optimization of multidisciplinary systems during the "conceive" and "design" phases	L2
CO2	Develops and codifies a prescriptive approach to multidisciplinary modeling and quantitative assessment of new or existing system/product architectures	L2
CO3	Rationalize and quantify a system architecture or product design problem by selecting appropriate objective functions, design parameters and constraints	L2
CO4	Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model	L3
CO5	To analyse and study buildings to understand the different generations / survival of the fittest / optimised results	L3

Program Outcome of this program. (CPM)

Sl. No.	Description	POs
1	perform a critical evaluation and interpretation of analysis and optimization results, including sensitivity analysis and exploration of performance, cost and risk tradeoffs	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	be familiar with the basic concepts of multiobjective optimization, including the conditions for optimality	PO5

Mapping of COS and POS

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

H – High , M – Medium, L - Low