VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

Scheme of Teaching and Examination (2020)

M.Arch in DIGITAL ARCHITECTURE

CBCS Scheme & OBE

Sl. No	Course	Subject Code	Course Title	Teaching hours/week				Examination					Credits
				Theory / Lecture	Practical/ Studio/Seminar	Skill Development Activities (SDA)/ Workshop	Total	Duration in (Hrs.)	CIE	SEE		Total	
										Theory	Viva		
1	Core course	20DAC1.1	Digital design studio -I	2	10	6 *	12	*	40	*	60	100	10
2	Core course	20DAC1.2	Analytical diagramming and architectural representation	2	*	2	4	*	40		60	100	3
3	Core course	20DAC1.3	Digital architecture process theories and history - I	3	*	*	3	3	40	60	-	100	3
4	Core course	20DAC1.4	Application of digital architecture study on real time project		4	*	4	*	40	*	60	100	2
5	Professional Multi-Disciplinary Elective	20DAE1.5A	Digital materiality and tectonics	2	*	*	2	*	100			100	2
		20DAE1.5B	Performative Design										
		20DAE1.5C	Techniques & technologies in Morphogenetic Design	2	*	*	2	*	100			100	0
6	Supporting course	20DAS1.6	Parametric softwares	2	*	2	4	*	40		60	100	3
7	Supporting course	20DAS1.7	Digital Fabrication - I	2	2		4	3	40	60	-	100	3
			Total	**15**	**16**	**10**	**35**	**6**	**340**	**120**	**240**	**700**	**26**

DAC- Digital Architecture Core Course DAS- Digital Architecture support course DAE - Digital Architecture Elective Course

Note:-

1 Lecture Hour - 1 Credit. 2 Studio Hours - 1 Credit. 2 Workshop Hours - 1 Credit.

2. Minimum Marks for passing: Progressive Marks 50%, Theory Marks - 40% and Viva Marks - 50%

3. Choose one elective either 20DAE1.5A or 20DAE1.5B, 20DAE1.5C will additional Non Credit Mandetroy Course (NCMC) achknowledgeed with attendance and reflected in marks card.

5. *SDA Hours for 18DAC11 are dedicated for the students to carry out site visits, library reading, etc. Hence they are not calculated under contact hours but credits are allocated.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

Scheme of Teaching and Examination (2020)

M.Arch in DIGITAL ARCHITECTURE

CBCS Scheme & OBE

Sl. No	Course	Subject Code	Course Title	Teaching hours/week				Examination					Credits
				Theory / Lecture	Practical /Studio/Seminar	Skill Development Activities (SDA)/ Workshop	Total	Duration in (Hrs.)	CIE	SEE		Total	
										Theory	Viva		
1	Core course	20DAC2.1	Digital design studio -II	2	10	6 *	12	*	40	*	60	100	10
2	Core course	20DAC2.2	Research Methodology	2	*	2	4	*	40	60		100	3
3	Core course	20DAC2.3	Digital architecture process theories and history - II	3	*	*	3	3	40	60	-	100	3
4	Core course	20DAC2.4	Application of digital architecture study on real time project- II		4	*	4	*	40	*	60	100	2
5	Professional Multi-Disciplinary Elective -11	20DAE2.5A	Biomimetic Architecture	2	*	*	2	*	100			100	2
		20DAE2.5B	Product Design+ Robotics										
		20DAE2.5C	Optimizing Built Structures	2	*	*	2	*	100			100	0
6	Supporting course	20DAS2.6	Analysis softwares	2	*	2	4	*	40		60	100	3
7	Supporting course	20DAS2.7	Digital Fabrication - II	2	2		4	3	40		60	100	3
Total				**15**	**16**	**10**	**35**	**6**	**340**	**120**	**240**	**700**	**26**

DAC- Digital Architecture Core Course DAS- Digital Architecture support course DAE - Digital Architecture Elective Course

Note:-

1 Lecture Hour - 1 Credit. 2 Studio Hours - 1 Credit. 2 Workshop Hours - 1 Credit.

2. Minimum Marks for passing: Progressive Marks 50%, Theory Marks - 40% and Viva Marks - 50%

3. One Elective is Mandatory(20DAE2.5A or 20DAE2.5B), 20DAE2.5C will be additional Non credit Mandetory Course whose title will be reflected in the marks card

5. *SDA Hours for 18DAC21 are dedicated for the students to carry out site visits, library reading, etc. Hence they are not calculated under contact hours but credits are allocated.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

Scheme of Teaching and Examination(2020)

M.Arch in DIGITAL ARCHITECTURE

CBCS Scheme & OBE

Sl. No	Course	Subject Code	Course Title	Teaching hours/week				Examination					Credits
				Theory / Lecture	Practical /Studio/Seminar	Skill Development Activities (SDA)/ Workshop	Total	Duration in (Hrs.)	CIE	SEE		Total	
										Theory	Viva		
1	Core course	20DAC3.1	Digital design studio -III	2	10	6 *	12	*	40	*	60	100	10
2	Core course	20DAC3.2	Parametric urban mapping	2	*	2	4	*	40		60	100	3
3	Core course	20DAC3.3	Parametric urbanism	3	*	*	3	3	40	60	-	100	3
4	Core course	20DAC3.4	Application of digital architecture study on real time project- III		4	*	4	*	40	*	60	100	2
5	Professional Multi-Disciplinary Elective -III	20DAE3.5A	Parametric Landscape Urbanism	2	*	*	2	*	100			100	2
		20DAE3.5B	Sustainable Urban Design										
		20DAE3.5C	Generative Urban Design	2	*	*	2	*	100			100	0
6	Supporting course	20DAS3.6	Pre- Thesis	2	*	2	4	*	40		60	100	3
7	Supporting course	20DAS3.7	Digital Fabrication - III	2	2		4	3	40		60	100	3
			Total	**15**	**16**	**10**	**35**	**6**	**340**	**60**	**240**	**700**	**26**

DAC- Digital Architecture Core Course DAS- Digital Architecture support course DAE - Digital Architecture Elective Course

Note:-

1 Lecture Hour - 1 Credit. 2 Studio Hours - 1 Credit. 2 Workshop Hours - 1 Credit.

2. Minimum Marks for passing: Progressive Marks 50%, Theory Marks - 40% and Viva Marks - 50%

3. Choose one elective either 20DAE3.5A or 20DAE3.5B, 20DAE3.5C will additional Non Credit Mandetroy Course (NCMC) achknowledgeed with attendance and reflected in marks card.

5. *SDA Hours for 20DAC31 are dedicated for the students to carry out site visits, library reading, etc. Hence they are not calculated under contact hours but credits are allocated.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

Scheme of Teaching and Examination (2020)

M.Arch in DIGITAL ARCHITECTURE

CBCS Scheme & OBE

Sl. No	Course	Subject Code	Course Title	Teaching hours/week				Examination					Credits
				Theory / Lecture	Practical/Studio/Seminar	Skill Development Activities (SDA)/ Workshop	Total	Duration in (Hrs.)	CIE	SEE		Total	
										Theory	Viva		
1	Core course	20DAC 4.1	Digital Architectural Project	12	6	10	28	*	40	*	60	100	20
2	Core course	20DAS 4.2	Research Methodology -II	2	*	*	2	*	100			100	2
			Total	**14**	**6**	**10**	**30**		**140**	*	**60**	**200**	**22**

DAC- Digital Architecture Core Course DAS- Digital Architecture support course DAE - Digital Architecture Elective Course

Note:-

1 Lecture Hour - 1 Credit. 2 Studio Hours - 1 Credit. 2 Workshop Hours - 1 Credit.

2. Minimum Marks for passing: Progressive Marks 50%, Theory Marks - 40% and Viva Marks - 50%

3. One Elective is Mandatory.

5. *SDA Hours for 18DAC41 are dedicated for the students to carry out site visits, library reading, etc. Hence they are not calculated under contact hours

20 DAC 1.1 – DIGITAL DESIGN STUDIO-I

CONTACT PERIODS : 12 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 10

OBJECTIVES:
To explore the inter-relationships between the contemporary mediums of digital design to digital production

COURSE CONTENT:

The studio will focus on parametric design process and will demonstrate link between the employment of advanced Digital design tools and the realm of digital fabrication through a product design within an Architectural domain that will augment the character of a specific built environment.

- Investigation into the inter-dependencies amongst definite factors like human ergonomics, explicit site information, specific programmatic data and the immediate environment and their analysis and synthesis.

- Detailed digitized resultants of this analysis to be used as input parameters whose permutations and combinations that will facilitate the generation of different iterations for Product morphologies.

- Advanced digital fabrication tools would be engaged to test the performative capabilities of one specific selection generated through the iterative process.

- The methodologies engaged in the program will necessarily explore the inter-relationships between performative designs, solid modelling and computer numerically controlled fabrication.

SESSIONAL WORK:
Students will work on analytical and design projects of product design scale and produce the work in the following form:-

- Complete documentation with all necessary design abstracts, process trajectory, digital models, diagrams, drawings, illustrations & text in a printed format as well as a soft digital.
- Scaled model of the complete project.

NOTE:
The portfolio cov*ering all the assignments shall be presented for term work.*

REFERENCES:
1. Mark Burry; Scripting Cultures
2. Casey Reas and Chandler McWilliams; Form+Code in Design, Art, and Architecture
3. Kostas Terzidis ; Algorithmic Architecture
4. D-Arcy Wentworth; On growth and form
1. John Frazer; Evolutionary architecture
2. Philip Ball ; Shapes: Nature's Patterns; A Tapestry in Three Parts
3. Tomoko Sakomato ; From control to Design

20 DAC 1.2 – ANALYTICAL DIAGRAMMING AND ARCHITECTURAL REPRESENTATION

CONTACT PERIODS : 4(Studio) per week
PROGRESSIVE MARKS : 40
TERM WORK MARKS : 60
TOTAL MARKS : 100
CREDIT : 3

OBJECTIVE:

To understand the potential of diagramming as an analytical as well as a representational tool inherent to parametric design process

COURSE CONTENTS:

- Understanding diagramming as an analytical and representational tool
- The history and evolution of diagramming in architecture
- Developing the ability to sieve information and build effective and meaningful information diagrams
- Exploring the usage of diagramming in professional international practices
- Use of program diagrams in the design process
- Introduction to Architectural representation platforms
- Post-production techniques and tools
- Understanding architectural representation techniques

SESSIONAL WORK :
Assignment will be in the form of notes/ assignments covering all the topics mentioned above with suitable examples, sketches and supportive material. Students will work on at least one project taken up in the design studio- I and work on conceptual evolution of design strategy through diagramming. Details of the project relating to all the above mentioned topics will be submitted in the form of sheets and /or report and /or presentation.

REFERENCES:

1.Lankow, Jason (2012), Inforgraphics: The Power of Visual Stroytelling, Wiley & Sons Hoboken
2. McCandless; David (2014), Knowledge is Beautiful
3. Mau, Bruce and Koolhaas; Rem (1998), S,M,L,XL, The Monacelli Press
4. MVRDV (1999); Metacity/Datatown
5.Koolhaas, Rem (1999);Content
6.Tschumi, Bernard (2014); Notations: Diagrams and Sequences
7.Ingells, Bjarke (2009); Yes Is More

8. Steele J; Architecture And Computers : Action And Reaction In The Digital Design Revolution

20 DAC 1.3 – DIGITAL ARCHITECTURE PROCESS THEORIES AND HISTORY-I

CONTACT PERIODS : 3 (Studio) per week
PROGRESSIVE MARKS : 40
TERM WORK MARKS : 60
TOTAL MARKS : 100
CREDIT : 3
DURATION OF EXAM: 3 Hrs.

OBJECTIVE/PREAMBLE :

To develop a conceptual orientation for the historic trajectory and trace current process influences impact of digital technologies in architectural design.

SUBJECT CONTENT :

The focus of the content will be on Readings and discussions that trace the sociocultural and technological ferment of Post modernism and DE constructivist movement, along with advancement in technical capabilities brought about a radical departure from traditional planning in architecture. The trajectory will trace the background of past 20 years that was crucial for the formation of Digital Culture in architecture.

The subject will also include Process based theoretical investigations through works of practitioners to understand their radical processes and parametric process trajectories which enabled architects to design and construct innovative buildings with more exacting qualitative and quantitative conditions.

SESSIONAL WORK :

Submission will be in the form of reports, discussions and debates. The outcome will also be in the form of individual perceptions on process theories through documentation and critical appraisals.

REFERENCES:

1. Antoine Picon ; Digital Culture in Architecture
2. Ali Rahim; Contemporary Processes in Architecture
3. BrankoKolarevic; Architecture in the Digital Age: Design and Manufacturing
4. Rivka Oxman, Robert Oxman; Theories of the Digital in Architecture
5. Lise Anne Couture , Hani Rashid; Asymptote: Flux Hardcover
6. Lise Anne Couture , Hani Rashid; Asymptote Architecture: Actualizations
7. Ban Van Berkel and Caroline Bos; UNStudio UN Fold

20 DAC 1.4 –APPLICATION OF DIGITAL ARCHITECTURE ON REAL TIME PROJECT- I

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 2

OBJECTIVE:

To give an opportunity for learning and for development of skills related to practical aspects of the discipline of Digital Architecture, by working in a professional firm.

COURSE CONTENT:

- Building information modeling as a design agency towards bringing in common design language in collaborative digital practices
- Specifically engages in practices that incorporate digital tools. The student can also volunteer to work as an apprentice in the consultancy cell of the college and or engage in any research work done by a professional within the premise of digital architecture research.
- The Oral Assessment of the same will be held at the end of Semester I.

SESSIONAL/TERM WORK:

Final submission will include compilation of the work done during the training in the form of A3 report. All hard copies need to be submitted with the signature of the head and the stamp of the firm, at the time of appearing for the viva-voce.

READINGS:
Websites of various professional organization associated with the profession of Landscape Architecture.

20 DAE 1.5 – ELECTIVE-I

CONTACT PERIODS : 2 (Studio) per week
PROGRESSIVE MARKS: 100
TOTAL MARKS: 100
CREDIT: 2

OBJECTIVE:

The objective of this elective course is to allow the students to cover a varied spectrum of domains of investigation within the premise of digital architecture. This course seeks to posit the role of different experimental threads within the broader context of digital practice.

COURSE CONTENT:

With the aim of imparting core theoretical literacy in different experimental leanings of digital architecture electives are offered in the disciplines of Digital Materiality and Tectonics, Performative design and Techniques and Technologies in Morphogenetic Design

The choice of the electives to be offered to the students will depend upon each individual College and the availability of resource persons. In such a case detailed syllabus for all other Elective Topics will be finalized by individual College in consultation with expert Faculty, considering the time and marks allotted to the subject.

I. DIGITAL MATERIALITY AND TECTONICS:

The subject elective investigates the emerging new synthesis of material in design which is resulting in the formulation of conceptual principles of digital architecture. This emphasizes the need for integration of design with fabrication and production. Through the comparative analysis of selected case studies of material-based design in research and practice, conceptual models processes and principles will be identified and documented.

II. PERFORMATIVE DESIGN:

This elective course will investigate the theoretical basis for understanding the current shift in performance-based, termed performative design. In the theoretical introduction the terms performative design and performative architecture will be defined and discussed. Topics related to the current movement towards performance-based design in architecture, such as the role of parametric design, associative geometry, and generative processes will be discussed and documented through case studies presented, and their implications for, and influence upon, performative design will be discussed.

III. TECHNIQUES AND TECHNOLOGIES IN MORPHOGENETIC DESIGN:

Digital morphogenesis as a process of shape development enabled by computation is investigated through formal theoretical research and all the genres of morphogenetic design are explored within this premise.

Investigations of group of methods that employ digital media for form-making and adaptation rather than for representation, often to respond to contextual processes will be studied through case studies.

SESSIONAL WORK :

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.

REFERENCES:

1. BrankoKolarevic; Performative Architecture: Beyond Instrumentality
2. AchimMenges; Emergence: Morphogenetic Design Strategies
3. AD Wiley publications; Material Computation
4. Robert Corser ; Fabricating Architecture: Selected Readings in Digital Design and Manufacturing
5. Toshiko Mori; Textile/Tectonic: Architecture, Material, and Fabrication
6. NeriOxman ; Towards a Material Ecology

20 DAS 1.6 – PARAMETRIC SOFTWARE

CONTACT PERIODS : 6 (Studio) per week
PROGRESSIVE MARKS : 40
TERM WORK MARKS : 60
TOTAL MARKS : 100
CREDIT : 3

OBJECTIVE :

The subject aims to introduce students to associative parametric design software, both as an aid to an iterative design process, a method of design exploration through the introduction of parametric modeling softwares.

STUDIO CONTENT :

The new modelling technique called as Associative modelling will be taught as one of the approach for design development. Demonstrating the significantly associative role of the software as against its assumed role as a representative tool. The subject will become the base to develop digital concepts through parametric skill sets. Students will be introduced to different exercises to familiarize thoroughly with the parametric software fundamentals which help them in precision modelling and to create and edit free-form 3d models.

This studio aims to cover all the essentials needed

• Basic Interface – of 3D modelling and its parametric interface • Capacity determination of the designing agency
• Geometry types - Points, Vectors, Lines,
• Curves, Surfaces and Meshes.
• Organizing data
• Decoding geometrical logic
•Extracting information for fabrication
• Common pitfalls and how to avoid them • An introduction to physical simulation
• Tips, tricks and shortcuts

SESSIONAL WORK :

Specific software submissions in the form of process tutorial output will be submitted individually by every student. Students will develop their parametric understanding through different exercises and also students will work on at least one project taken up in the design studio- I and work on digital details of the project relating to all the above mentioned topics in the form of sheets and /or report. The merit of submissions will be assessed on the basis of digital concept development, variations and specific design negotiations through parameters

REFERENCES:

1. Robert Woodbury Parametric; Design for Architecture
2. Arturo Tedeschi ; Algorithmic aided design
3. Andy Payne; The Grasshopper Primer_Second Edition.
4. Zubin khabazi; Generative Algorithms series with grasshopper.
5. RajaaIssa; Essentid modelling and mathematics.
6. FreyerC ; Digital By Design : Crafting Technology For Products And Environments.
7. Burry J ; New Mathematics Of Architecture.
8. Sakamoto T ; From Control To Design : Parametric Algorithmic Architecture.
9. Schulitz H C ; Form Follows Performance.

20 DAS 1.7 – DIGITAL FABRICATION - I

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
DURATION OF EXAM: 3Hrs.
CREDIT: 3

OBJECTIVE:

The primary learning objective of this subject is systems application of existing modes of production using digital fabrication. The subject aims towards the development of new thinking that results from invented systems wherein design is constrained and informed by CAD/CAM manufacturing and real materials

COURSE CONTENT:

Different manufacturing processes like Additive, Subtractive &Consolidatory processes will be introduced to the students as under

- CNC cutting
- CNC milling
- Laser Cutting
- 3D Printing (SLS & FDM) • 3D Scanning
- 3 Axis CNC cutting & milling on non-planar surfaces

Data conversion for design production will be emphasised upon details for file Conversions, Meshing, etc. that is required for realising the proto-types from digital files of the models will be emphasized upon. Students will be exposed to emerging theories pertaining to smart materials and alloys.

SESSIONAL WORK:

Students will demonstrate their proficiency through Model making Students will submit reports related to their process of fabrication and research in the related domain will be presented through documentation.

REFERENCES:

1. Lisa Iwamoto ; Digital Fabrications: Architectural and Material Techniques
2. Luca Caneparo; Digital Fabrication in Architecture, Engineering and Construction
3. Christopher Breorkram ; Material Strategies in Digital Fabrication
4. Sophia Vyozviti; Soft Shells: Porous and Deployable Architectural Screens
5. Sophia V yozviti; Folding Architecture
6. Mark Burry Jordi BonetiArmengol, Jos Tomlow, Antoni Gaudi ; Gaudi: Unseen

20 DAC 2.1 – DIGITAL DESIGN STUDIO-II

CONTACT PERIODS : 12 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT:10

OBJECTIVE:

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

COURSE CONTENT:

1. Decoding the architectural design process as a collaborative, iterative and evolutionary vector framework

2. Role of diagramming in analysis, data mapping and their translation to parametric platforms

3. Identifying and defining the role of parametric platforms as a powerful design tool that augments the design and execution process

4. Develop and document individual visual communication concepts and outcomes framed by a project brief

5. Identify and use appropriate digital software to execute intended design outcomes

6. Apply vector oriented design software as design tools to achieve design objectives

7. Produce creative design outcomes in a digital environment with reference to appropriate parametric software use for designing a building typology

SESSIONAL WORK:

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.

REFERENCES:

1. Tschumi, Bernard ; Notations: Diagrams and Sequences
2. Koolhaas, Rem ; Delirious New York: A Retroactive Manifesto for Manhattan,
3. Fenton, Joseph , Pamphlet Architecture 11: Hybrid Buildings
4. Woodbury, Robert ; Elements of Parametric Design, Routledge New York
5. T schumi, Bernard ; Event Cities
1. Di Mari, Anthiny&Yoo, Nora ; Operative Design: A catalogue of spatial verbs Barios, Carlos ; Parametric Design in Architecture: Fundamentals, Methods, Applications.
1. Oxman, Rivka and Robert ; Theories of the Digital in Architecture, Routledge New York.

20 DAC 2.2 – RESEARCH METHODOLOGY

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 3

OBJECTIVE:

To introduce the methods and the process of research within the realm of Digital architecture and to understand the significance of the same in contemporary architectural practice.

COURSE CONTENT:

1. Introduction to the types of research and the process of formulating a research project. 2. Introduction to various methods of research, their relative advantages and disadvantages and their applications. 3. Introduction to technical writing and presenting a research paper. 4. Development of skills.

SESSIONAL WORK:

To undertake a focused study based upon a research question and to present it in the form of a research paper, compilation of study material, along with brief assignments demonstrating the steps in the research process.

REFERENCES:

1. Creswell, J. W; Research Design: Qualitative, quantitative and mixed methods approaches, 2nd Ed., Thousand Oaks: Sage. 2003.

2. De Vaus, D. A; Surveys in Social Research, Jaipur :Rawat Publications. 2003.

3. Groat, L. & Wang; D. Architectural Research Methods, NY: John Wiley and Sons Inc. 2002.

4. Kothari, C.R; Research Methodology: Methods and Techniques, New Delhi: WishwaPrakashan. 2005.
5. Sanoff, H; Methods of Architectural Programming, Dowden Hutchinson and Ross, Inc. Vol. 29, Community Development Series. 1977.

6. Sanoff, H; Visual research methods in design, USA: Van Nostrand Reinhold. 1991.udio.

20 DAC 2.3 – DIGITAL ARCHITECTURE PROCESS THEORIES AND HISTORY-II

CONTACT PERIODS : 3 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT : 3
DURATION OF EXAM: 3 Hrs.

OBJECTIVE:

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.

COURSE CONTENT:

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.

2. The Subject Course is designed to familiarise students with these instruments, their associated conceptual fields and with their application to architectural design research.

3. Course content includes theories of Generative algorithms within the realm of Emergence (swarm Behaviour, Fractals, L systems, cellular Automata, genetic algorithms).

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. '

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.

SESSIONAL WORK:

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.

Theory examination based on the aforesaid course outline for this subject will be conducted for 100 marks

REFERENCES:

1. Casey Reas and Chandler McWilliams; Form+Code in Design, Art, and Architecture
2. Kostas Terzidis ; Algorithmic architecture
3. D-Arcy Wentworth ; On growth and form
4. John Frazer; Evolutionary architecture
5. Philip Ball; Shapes: Nature's Patterns: A Tapestry in Three Parts
1. Tomoko sakomato ; From control to Design Mark Burry and Jane Burry ; New Mathematics of Architecture
6. Clegg C J ; Advanced Biology Principles And Applications
7. Ball P ; Flow : Nature's Patterns A Tapestry In Three Parts

20 DAC 2.4 – APPLICATION OF DIGITAL ARCHITECTURE STUDY ON REAL TIME PROJECT - II

CONTACT PERIODS : 4 (Studio) per week
TERM WORK MARKS: 40
TOTAL MARKS: 60
CREDIT: 2

OBJECTIVE:

To give an opportunity for learning and for development of skills related to practical aspects of the discipline of Digital Architecture, by working in a professional firm.

COURSE CONTENT:

- Debates in the digital architecture practice – Ethics, code of conduct and liabilities in collaborative practices
- Building information modeling as a design agency towards bringing in common design language in collaborative digital practices
- The students shall undergo professional Training (40 full working days) to be undertaken during intermediate time between II & III Semester. It involves working in a Architect's Firm in India or abroad that specifically engages in practices that incorporate digital tools. The student can also volunteer to work as an apprentice in the consultancy cell of the college and or engage in any research work done by a professional within the premise of digital architecture research.
- The Oral Assessment of the same will be held at the end of Semester III.

SESSIONAL/TERM WORK:

Final submission will include compilation of the work done during the training in the form of A3 report. All hard copies need to be submitted with the signature of the head and the stamp of the firm, at the time of appearing for the viva-voce.
Readings
Websites of various professional organization associated with the profession of Landscape Architecture.

20 DAE 2.5 – ELECTIVE-II

CONTACT PERIODS : 2 (Studio) per week
PROGRESSIVE MARKS: 100
TOTAL MARKS: 100
CREDIT: 2

OBJECTIVE:

To introduce the students to parametric developments in allied fields and to observe adjacencies specifically in the use of parametric tools.

COURSE CONTENT:

1.BIOMIMETIC ARCHITECTURE

Biomimetic architecture deals with the development of innovations on the basis of investigation of chemical & biological structures, functions, methods, processes and systems. An emergent behavior or emergent property can appear when a number of simple entities (agents) operate in an environment, forming more complex behaviors as a collective.

When we study the behavior of a certain organism we can derive basic principles of the same which are its inherent properties. These can be converted into algorithms which can be implemented for design solutions in different scales. The idea is to study these characteristics and use them to generate different morphologies or units according to the design goals of the studio.

The studio will have an integral mix of use of digital techniques and physical models to explore the forms to its optimum. Physical models will explore the integration of material behavior and fabrication processes.

2) PRODUCT DESIGN + ROBOTICS

It will focus on the understanding of the basics behind programming and robotics. These topics will be explored by designing an interactive product according to the studio design intent. Dedicated time for working with programmes like Python for grasshopper, Arduino etc will be allotted since the students have to learn the underworking of any adaptive design.

The studio concludes with the design of a product and its iterations as per the variations in its movement or use, and the detailed design of the mechanisms within it, with digital and fully fabricated models.

3) OPTIMIZING BUILT STRUCTURES

The Studio is divided into two major parts, one being the study of building typologies and its optimization techniques using Grasshopper for Rhino. The second half consists of mapping study of an Indian city for system intervention in the next part of the semester. 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. Optimization techniques play a major role in practice since these methods can help generate different iterations of fixed area or other conditions and the exploration of many such options can become an integral part of a design exercise. These techniques can also mimic the 'Survival of the fittest' criteria in nature and streamline the process of natural selection in a design context'

SESSIONAL WORK:

The students will be asked to make presentations about the role of parametric tool in the particular field of design introduced to them. Through small exercises the students will apply their parametric knowledge to the design process specific to the chosen field through which a final design will be achieved.

REFERENCES:

1. Robert Woodbury; Elements of Parametric Design
8. Rhino 3d .com ; Simply Rhino Generative Design for Jewellers
9. ElîaniaRosetti ; Designing Jewelry with Rhinoceros
2. Issey Miyake; Making Things Midori Kitamura; Issey Miyake Pleats Please
10. KanHu,Chi Di; Addendum Surface Design Based on the Parametric Method
11. Jackson P; Folding Techniques For Designers : From Sheet to Form

20 DAS 2.6 – ANALYSIS SOFTWARE

CONTACT PERIODS : 6 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT:3

OBJECTIVE:

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.

COURSE CONTENT:

- Introduction of contemporary software's those 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.
- This is done through testing the digitally generated models for their structural, environmental, thermal and material properties.
- 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.
- 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.

SESSIONAL WORK:
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.

`REFERENCES:

1. Peter Brandon; Emerging Paradigms and Models in Digital Design – Performance-Based Architectural Design
2. Michael Hensel ; Performance-Oriented Architecture: Rethinking Architectural Design and the Built Environment
3. Braun ; Masterpieces: Performance Architecture + Design
4. BrankoKolarevic; Performative Architecture: Beyond Instrumentality
   M. Hensel, A. Menges; Performance in Morpho-Ecological Design
5. IncPadt; Introduction to the Ansys Parametric Design Language : A Guide to the Ansys Parametric Design Language
6. Stanney K M ; Handbook Of Virtual Environments : Design Implementation And Applications
7. Castle H ;New Structuralism : Desing Engineering And Architectural Technologies

20 DAS 2.7 – DIGITAL FABRICATION- II

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
DURATION OF EXAM: 3Hrs.
CREDIT: 3

OBJECTIVE:

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.

COURSE CONTENT:

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

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

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.

SESSIONAL WORK:

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.

REFERENCES:

1. Lisa Iwamoto; Digital Fabrications: Architectural and Material Techniques
2. Luca Caneparo; Digital Fabrication in Architecture, Engineering and Construction
3. Christopher Breorkram; Material Strategies in Digital Fabrication
4. Sophia Vyozviti; Soft Shells: Porous and Deployable Architectural Screens

20 DAC 3.1 – DIGITAL DESIGN STUDIO-III

CONTACT PERIODS : 12 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT:10

OBJECTIVE:

To explore new limits and possibilities of urban interventions that are assisted by parametric design principles. The aim is to hone and utilize parametric capacities and use them as a powerful tool that augments the multi-layered and collaborative urban design process and helps produce design solutions of greater resilience.

COURSE CONTENT:

1. Introduction to analytical diagramming/information graphics post mapping for analysis and data representation tool acting at local and urban scale

2. Stakeholder analysis, demographic study, climate studies, socio-economic analysis and related analysis of a wide range of urban forces

3. Inferences from analysis in terms of Variables, Constraints & Opportunities followed by 'problematization'(identification of key urban issues that need resolution wrt to design brief)

4. Development of design agenda and an urban concept that addresses the macro issues followed by a more specific strategy for the site that addresses micro issues/opportunities

5. Introduction of parametric platform as a vector field for site formulation

6. Design evolution and refinement through selection and iteration within the parametric platform

7. Refinement and detailing in 3d and Detailing in 2d digital environment modelling environment and Post production and design representation techniques

SESSIONAL WORK:
Students will work on above mentioned in detail and will submit the work in the form of drawings and/ models that will elaborately explain the complex layering of information post strategizing and the design resolution.

REFERENCES:

1. Jacobs, Jane (1961), The Death and Life of Great American Cities, Random House
2. Maas, Winy (2013), MVRDV: Agenda for Urbanism, O10 Publishers
3. Mau, Bruce and Koolhaas, Rem (1998), S,M,L,XL, The Monacelli Press
4. Schumacher, Patrick (2011), Total Fluidity, University of Applied Arts Vienna
5. Maas, Winy (2010), Visionary Cities
1. Farley, Lorraine (2011); Drawing for Urban Design, Lawrence King Publishing
London Lynch, Kevin (1960); Image of the City, MIT press
1. Tschumi, Bernard (2005); Event Cities, MIT Press

20 DAC 3.2 – PARAMETRIC URBAN MAPPING

CONTACT PERIODS : 4 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT:3

OBJECTIVE :

To define the role of information in parametric urban design.This studio focuses on imparting skillset through different mapping techniques of parametric urban mapping where the emphasis is placed on data collection, pattern analysis, visualization, parametric spatial modelling, and physical representation.

STUDIO CONTENT:

The studio explores spatial diagramming, through digital modelling and documentation, showcases how the urban phenomenon and its geospatial pattern can be interpolated into parametrically controlled forms which can later be translated into design solutions. The students will investigate programmatic and formal precedents through readings, discussions, field trips which will be in support of the subject research. The goal will be to understand current urban conditions and practices, and reveal underlying patterns of the fields of research within the domain of parametric designing. The research conducted by students will cover mapping of different aspects of urban phenomena and their relation with physical city scape. The course syllabus assumes preparing students to best practice the urban planner profession in the conditions of information society. Another objective is to provide them with the tools for influencing the dominant discourses.

SESSIONAL WORK:

The studio includes group work; Students will map the site (design premises) documenting and visualizing the data then translating it to design strategies.

REFERENCES:

1. MVRDV: Agendas on Urbanism
2. JernejVidmar University of Ljubljana, Faculty of Architecture, SloveniaA lateral method for 3D urban design
3. José Beirão, NunoMontenegro, PedroArrobas; City Information Modelling: parametric urban models including design Support data Campus and the City
4. Kerstin Hoeger and KeesChristianse ; Urban Design for the Knowledge Society

20 DAC 3.3 – PARAMETRIC URBANISM

CONTACT PERIODS : 3 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 3
DURATION OF EXAM: 3 Hrs.

OBJECTIVE:

To trace the theoretical developments in use of parametric techniques in the urban design process and investigate formal design approaches to the parametric urban morphology. The subject intends to trace the development concerned with the deliberation on the genesis and the development of parametric urban models through theoretical research.

COURSE CONTENT:

- The subject will examine architectural vision of the city from emergence of the metropolis to the contemporary city.
- Emphasizing the concepts of form, movement, infrastructure, network, pattern and landscape, the seminar will investigate different agendas, strategies, manipulations that were employed in relation to the city, forcing a new understanding of the urban realm to emerge.
- This course focuses on relationship between urban design ideals, urban design action, and the built environment through readings, discussions, presentations, and papers. It specifically will delve in the theoretical development of use of parametric tools in urban design where their utilization augments the multi-layered and collaborative urban design process. It will analyse the diverse design ideals that influence cities and settlements, and investigates how urban designers use parametric technologies to shape urban form.

SESSIONAL WORK:

Students will examine a contemporary and seminal text in parametric city-building through research in academic proliferations and practice centric theories that are necessarily situated in parametric interventions in urban design. Assignment will be in the form of individual in-depth study of the topics related to above said context.

REFERENCES:

1. Patrick Schumacher; Parametric Urbanism
5. Toni Oosterland; The Digital Design in Sustainable Urbanism – Explorations in computational design strategies
6. Tom Verebes ;Masterplanning the Adaptive City: Parametric Urbanism in the Twenty-first Century
7. Michael Hensel Tom Verebes; Architecture & Urbanism 3 - .urbanisations
1. EVOLO ; Digital and parametric architecture
2. Tomas Michael; Hybrid architecture for future urbanism
3. Michael Weinstock; Architecture of Emergence
4. Aldo Rossi ; Architecture of the city

20 DAC 3.4 – APPLICATION OF DIGITAL ARCHITECTURE STUDY ON REAL TIME - III

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 2

OBJECTIVE:

To give an opportunity for learning and for development of skills related to practical aspects of the discipline of Digital Architecture, by working in a professional firm.

COURSE CONTENT:

- Debates in the digital architecture practice – Ethics, code of conduct and liabilities in collaborative practices
- Building information modeling as a design agency towards bringing in common design language in collaborative digital practices
- The students shall undergo professional Training (40 full working days) to be undertaken during intermediate time between II & III Semester. It involves working in a Architect's Firm in India or abroad that specifically engages in practices that incorporate digital tools. The student can also volunteer to work as an apprentice in the consultancy cell of the college and or engage in any research work done by a professional within the premise of digital architecture research.
- The Oral Assessment of the same will be held at the end of Semester III.

SESSIONAL/TERM WORK:

Final submission will include compilation of the work done during the training in the form of A3 report. All hard copies need to be submitted with the signature of the head and the stamp of the firm, at the time of appearing for the viva-voce.
Readings
Websites of various professional organization associated with the profession of Landscape Architecture.

20 DAE 3.5 – ELECTIVE-III

CONTACT PERIODS : 2 (Studio) per week
PROGRESSIVE MARKS: 100
TOTAL MARKS: 100
CREDIT:2

OBJECTIVE:

The objective of this elective course is to allow students to cover a varied spectrum of domains of investigation within the premise of parametric urbanism. This course seeks to posit the role of different experimental threads within the broader context of parametric urbanism.

COURSE CONTENT:

These electives explore the role of thinking about those processes specific to parametric urbanism and the built environment in a broad range of contexts including history/theory, and necessary processes of parametric intervention in urbanism and new conceptions for the making and display of architecture. The elective begins with the premise that making architecture is governed by a critical perspective and practice of those processes that reflect on-going changes in technology, contemporary urban environment and society. Students should select at least two of the topics listed below as their electives and work on both in depth.

1. PARAMETRIC LANDSCAPE URBANISM:

Parametric Landscape is a forum for the investigation, experimentation, and application of parametric modeling in the field of Landscape Architecture. This elective course will specifically investigate various parametric strategies that are used for digital mediation in Landscape design using parametric software.

2. SUSTAINABLE URBAN DESIGN:

Investigations are directed towards parametric urbanism and correlating it with environmental approach from a quantitative point of view, through deducing the main physical parameters of the urban morphology and how these parameters can be associated with the environmental aspects to create a parametric assessment/generation for supporting design decision making. This course elective integrates the role of digital technologies and performance based parametric strategies to analyze urban data and discover new relationships between the form of the city and its performance.

3. **GENERATIVE URBAN DESIGN**:

This subject delves into the new field of generative design, as applied to urbanism. Its purpose is to formulate a concept of parametric urbanism and data-driven urban design, and how it departs from existing concepts of urban analysis and resulting design methods. It highlights the description of the notion of generative urban design, and its relevance to current practice of architecture and global political, sociological and economic developments. The difference between dogmatic forms of urban design and new parametric research methods will be explored.

SESSIONAL WORK:

Assignment will be in the form of individual study of a topic related to any one of the subjects based on availability of experts, which will be presented by the student in the form of an audio-visual presentation and a report on the same. The submissions should be done separately for both the topics chosen by the student as their elective. I –IV SEM M.ARCH. (DIGITAL ARCHITECTURE) - DETAILED SYLLABUS (CBCS) 2018-19 VISVESVARAYA TECHNOLOGICAL UNIVERSITY - BELAGAVI Page 21

REFERENCES:

1. Patrick Schumacher; Parametric Urbanism
2. Toni Oosterland; The Digital Design in Sustainable Urbanism – Explorations in computational design strategies
3. Tom Verebes ;Masterplanning the Adaptive City: Parametric Urbanism in the Twenty-first Century
4. Michael Hensel Tom Verebes; Architecture & Urbanism 3 - urbanisations
5. EVOLO ; Digital and parametric architecture
6. Tomas Michael; Hybrid architecture for future urbanism
7. Michael Weinstock; Architecture of Emergence
8. Aldo Rossi ; Architecture of the city

18 DAS 3.6 – PRE THESIS

CONTACT PERIODS : 6 (Studio) per week
PROGESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 3

OBJECTIVE:

To enable students to choose a thesis topic and develop a broad thesis proposal.

COURSE CONTENT:

1. To outline the larger focus and relevance of the thesis topic and its architectural implications and project design results in the realm of digital architecture.

2. Alternatively, to conceptually formulate an architectural proposition, explore and articulate ideas through research and critically evaluate the feasibility of the thesis proposal. This includes detailed project context where it shall be explored and its significance to digital architecture.

3. To encourage students to pose relevant questions on the discipline to undertake self-directed study with inquisitiveness, rigor and demonstrate a depth of inquisitiveness in exploring the chosen topics which should lead to writing a research paper and submitting to technical journals.

4. To focus on Innovation, experimentation as some of the learning outcomes and draw inspiration in the various electives/design studios taken through the graduate program.

SESSIONAL/TERM WORK:

Final submission will include compilation of the work done during the training in the form of A3 report. All hard copies need to be submitted with the signature of the head and the stamp of the firm, at the time of appearing for the viva-voce.

REFERENCES:

1. Creswell, J. W; Research Design: Qualitative, quantitative and mixed methods approaches, 2nd Ed., Thousand Oaks: Sage. 2003.
2. De Vaus, D. A; Surveys in Social Research, Jaipur :Rawat Publications. 2003.
3. Groat, L. & Wang; D. Architectural Research Methods, NY: John Wiley and Sons Inc. 2002.
4. Kothari, C.R; Research Methodology: Methods and Techniques, New Delhi: WishwaPrakashan. 2005.
5. Sanoff, H; Methods of Architectural Programming, Dowden Hutchinson and Ross, Inc. Vol. 29, Community Development Series. 1977.
6. Sanoff, H; Visual research methods in design, USA: Van Nostrand Reinhold. 1991.

18 DAS 3.7 – DIGITAL FABRICATION - III

CONTACT PERIODS : 4 (Studio) per week
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100.
CREDIT: 3

OBJECTIVE:

The objective is to delve into the Digital fabrication and robotics via embedded systems explored with respect to the domain of Interactive/Responsive design environments.

STUDIO CONTENT:

This studio explores theoretical and practical potentials of robotic fabrication following a speculative methodology which gets empirically implemented via robotically built scale models.

Studies include a wide range of activities from theoretical discourse and mostly digital explorations of interactivity to hands-on experiments using sensors, actuators, and related scripting environments. Design premise for implementation would be within a palette of augmented spaces on an urban level or a building scale, interactive networks, interactive media towards responsive environments, and interactive components and products that will be explored in the due course of the studio.

This studio we'll be focusing on new hardware and software prototyping techniques; primarily focusing on a wide range of sensing and actuation modalities in order to build novel interactive panel devices, Using remote sensors, microcontrollers (Arduino), and actuators.

SESSIONAL WORK:

Using both Grasshopper and the Firefly plug-in, students will create intelligent control strategies for interactive or responsive facades or environment. Students will build virtual and physical prototypes that can communicate/interact with humans and the world around them.

REFERENCES:

1. Andrew Payne; The firefly premier second edition
1. Rodolphe el-Khoury,ChristosMarcopoulos Carol Moukheiber; The Living, Breathing, Thinking, Responsive Buildings of the Future
2. Wes Mc Gee; Robotic Fabrication in Architecture, Art and Design
3. Gramazio and Kohler; The Robotic Touch – How Robots Change Architecture

18 DAC 4.1 – DIGITAL ARCHITECTURAL PROJECT

CONTACT PERIODS : 30 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT: 20

OBJECTIVE:

To enable a student to independently conceptualize and develop a Digital architectural project with a design level/fabrication feasibility proposal for the same.

COURSE CONTENT:

The studio will emphasize design research that is collectively formulated through relationships among contemporary investigation into Parametric Designing. Different techniques and tools will be used to approach to the projects that engage mixtures of architecture, urbanism and landscape as well as contemporary design techniques and Digital Materiality and fabrication. Students work on the detailed design and presentation of an approved thesis subject that investigates from a theoretical or pragmatic position a subject of sufficient complexity and particular relevance to the thesis candidate's background and career orientation within the premise of Digital Architecture.

1. Each student is required to select an independent study, with reference to a special topic in Digital Architecture, before the end of third semester in consultation with the faculty members.

2. Identification of the project with its significance, scope and limitations

3. Programming research related to the project and evolving the project brief

4. Preparing a project proposal and presenting it in graphical and textual format supported with a model.

SESSIONAL WORK:

Students will work on analytical and design projects of a substantial scale and produce the work in the form of sheets, a report and a model produced with the help of Digital fabrication machinery and techniques.

18 DAS 4.2 – RESEARCH METHODOLOGY II

CONTACT PERIODS : 2 (Studio) per weeks
PROGRESSIVE MARKS: 40
TERM WORK MARKS: 60
TOTAL MARKS: 100
CREDIT:2

OBJECTIVE:

To enable the student to undertake methodical research on a topic in Digital architecture and to communicate it through technical writing.

COURSE CONTENT:

1. Develop on the thesis topic selected during the pre-thesis. The topic should be from the field of digital architecture or allied disciplines for its exploration.
2. Documentation of the process and methodology of digital design being undertaken by the student using the methods introduced to the student during the course of semesters 1,2 and 3.
3. Processing of the data (relevant to the project) collected and data visualization.

SESSIONAL/TERM WORK:

Research dissertation shall be prepared by each student, based upon the topic approved by the institute in around 5000 words, in a format specified by the university.

REFERENCES:

All books/ Journals/ Magazines/ unpublished thesis related to the topic selected by the individual student.