SAVITRIBAI PHULE PUNE UNIVERSITY

(FORMERLY UNIVERSITY OF PUNE)

SYLLABUS FOR

MASTERS IN ARCHITECTURE
M.ARCH. (COMPUTERAPPLICATIONS)

(To be implemented w.e.f. A.Y. 2019-20)

BOARD OF STUDIES IN ARCHITECTURE

FACULTY OF SCIENCE AND TECHNOLOGY

PREAMBLE-

Digital design is an emerging area in Architecture and the M.Arch Computer Applications program is designed to prepare students to specialize in this area which has a high potential in future architectural career. Concepts from computation and contemporary sciences and their impact in the domain of architecture and urban design are investigated. This course encourages inquiries into methods and representations for design, the development of design tools, applications of digital technologies to design practice, the impacts of these technologies on the built environment and their social and cultural implications. Students enrolled in Computer Applications take subjects and do research in theory and applications of computation and computer technology including computer graphics, digital modeling and rendering, generative design, CAD/CAM and rapid prototyping technologies, remote collaborative design, and the design processes and management systems. It will probe concepts such as behavioural, parametric and generative design, algorithmic logic and key ideas from quantum physics, biology and systems theory as a knowledge resource and means of production. A productive dialogue will be initiated with experts from other fields, including mathematics, computer science and engineering, under the larger collaborative platform of Computational design. Students are exposed to various new concepts like: Digital Tectonics , Digital Morphogenesis, Parametric design , Generative architecture , Performative Design ,Parametric Urbanism , Hypertecture and Evolutionary prototyping. The program has a main digital design studio which runs through three semesters culminating in the thesis. Students undertake professional training during the course too.

Digital Design Studio :-

• Basic concept formulation, non-linear geometry and parametric thinking

• Sustainable design concepts and design based on data streaming

• Parametric Urbanism design projects using information mapping and research paper

• Research paper and Computer Applications project

Supporting Technical Subjects are :-

• Visualization and animation – advance 3D software and programming

• Advance building construction concepts through digital fabrication and automated design

• Building Information Modelling – simulation and analytical methods using software

• Management Information Systems – Management at all stages from design development to execution

• Geographic Information Systems – information Mapping and querying

Skill Development Classes are :- in software training, programming, colloquium, academic writing and research methods.

OBJECTIVES :-

Architecture as a built reality maintains a close relationship to the mode and techniques of representation. The advent of digital software has released a unique potential that can lead to a significant rethinking, re-imaging and reconfiguration of the built environment. This course offers the opportunity to be at the forefront of interrogation in this field.

SCOPE AND OPPORTUNITIES:-

This course offers an opportunity to be at the forefront of the emergent practice of digital architecture. The graduates of this course can be absorbed in the mainstream Architecture or many related fields like Architectural Visualization, Building Management Systems, Software Development, etc.

PROGRAM EDUCATIONAL OBJECTIVES [PEO]

PEO1 - Concepts from computation and contemporary sciences and their impact in the domain of Architecture and urban design are investigated.

PEO2 – Innovative open exchange programs and dialogue between faculty, students, experts of allied field and practicing professionals to encourage the practice in the field of Digital Architecture.

PEO3 – Contribution to the design profession around the globe through modern tools and technologies.

PEO4 – Understanding the impact on environment and crucial role of an architect towards sustainable methods, an integral part of the curriculum.

PEO5 -Crafting well-educated, responsible, sensible and motivated architects equipped with ultra-modern skills, who can contribute towards building a humane society for the future.

PROGRAM OUTCOMES [PO]

PO1 –
Investigating Computational tools for computer modelling, rendering, simulation, analysis and parametric thinking process in Architectural Design.

PO2 –
Broadly understand the established and ongoing developments and research work in the domain of emerging technologies e.g. digital media and computational design.

PO3 –
Understanding of different digital design theories in Architecture and its application in different scales of Design.

PO4 –
Exploring building and its applications with respect to energy efficiency, climate control, light, sound and noise controls.

PO5 –
Exposure to the practical work of digital fabrication and latest technologies in fabrication.

MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES AND PROGRAM OUTCOMES

PEO	PO1	PO2	PO3	PO4	PO5
PE01	√	√	√		
PEO2	√	√			√
PEO3	√				√
PEO4	√			√	
PEO5	√		√	√	

Sr.No.	Program Outcomes	Subjects in curriculum
1	PO1-	Digital tools and techniques, Elective II
2	PO2-	Elective I
3	PO3-	Digital Design theory
4	PO4-	Automated Design
5	PO5-	Digital Fabrication, Digital Practices and Professional Training

Sr.No.	Electives	Tentative Subjects of Electives
01	Elective I [First Year]	Colloquium
02	Elective II [First Year]	Robotics and Embedded Systems
03	Elective III [Second Year]	Open Elective

M-Arch (Computer Applications) **For Semesters I**

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Theory/ week	Studio/ week	Credits	SS	SV	Theory		Marks
									In semester	End semester	
2019CA101	Digital Design Studio I	**C1**	10	2	8	10		400	Nil	Nil	**400**
2019CA102	Elective I	**EL**	3	2	1	3	100	Nil	Nil	Nil	**100**
2019CA103	Digital Tools and Techniques I	**C2**	4	2	2	4	200	Nil	Nil	Nil	**200**
2019CA104	Digital Design Theory I	**SP1**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA105	Automated Design	**SP2**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA106	Digital Fabrication	**L**	2	1	1	2	100	Nil	Nil	Nil	**100**
			25	11	14	25					**1000**

M-Arch (Computer Applications) **For Semesters II**

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Theory/ week	Studio/ week	Credits	SS	SV	Theory		Marks
									Insemester	End semester	
2019CA201	Digital Design Studio II	**C1**	10	2	8	10		400	Nil	Nil	**400**
2019CA202	Elective II	**EL**	3	2	1	3	100	Nil	Nil	Nil	**100**
2019CA203	Digital Tools and Techniques II	**C2**	4	2	2	4	200	Nil	Nil	Nil	**200**
2019CA204	Digital Design Theory II	**SP1**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA205	Research I	**SP2**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA206	Computer Graphics	**L**	2	1	1	2	100	Nil	Nil	Nil	**100**
			25	11	14	25					**1000**

M-Arch (Computer Applications) For Semesters III

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Theory/ week	Studio/ week	Credits	SS	SV	Theory		Marks
									Insemester	End semester	
2019CA301	Digital Design Studio III	**C1**	10	2	8	10		400	Nil	Nil	**400**
2019CA302	Research II	**C2**	3	2	1	3	100	Nil	Nil	Nil	**100**
2019CA303	Digital Practices and Professional Training**	**C3**	4	2	2	4		200	Nil	Nil	**200**
2019CA304	Interaction Design	**SP1**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA305	Smart Materials and Advanced Construction	**SP2**	3	2	1	3	Nil	Nil	30	70	**100**
2019CA306	Computational Design Skills	**L**	2	1	1	2	100	Nil	Nil	Nil	**100**
			25	11	14	25					**1000**

**This includes Professional Training (40 full working days) to be undertaken during intermediate time between II & III Semester, details of which are mentioned in the detailed syllabus. The Oral Assessment of the same will be held at the end of Semester III. The subject is included as core subject and will have both sessional and viva assessment.

M-Arch (Computer Applications) **For Semesters IV**

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Theory/ week	Studio/ week	Credits	SS	SV	Theory		Marks
									In semester	End semester	
2019CA401	Project	**C**	20	4	16	20		800	Nil	Nil	**800**
2019CA402	Elective III*	**EL**	5	1	4	5	200	Nil	Nil	Nil	**200**
			25			25					**1000**

*Elective III can be offered as an open elective. In case it is not possible to offer open elective, colleges should offer any elective from the list of electives which the student has not undertaken in any previous semester.

DETAIL SYLLABUS

SEM - I

SUBJECT TITLE: **DIGITAL DESIGN STUDIO–I**				
Subject Code **: 2019CA101**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	300	
Studio Periods per week	8	Viva/Oral	100	
Total Contact Periods (60 min period) per week	**10**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**10**	**Total Marks**	**400**	

COURSE OBJECTIVES:

Objective of this studio is to introduce the integration of Parametric tools in Architectural Design .To inculcate the parametric thinking process in design and explore the different fabrication techniques.

COURSE CONTENT :

Students will take up two independent design projects during the course of this semester. The project shall be specifically designed and approved by the faculty, to fulfill the objectives. The scope of the project should be limited to a small project. The source of this may be an existing Architectural project, onto which the Visualization and parametric tools could be integrated and redefined in two separate projects. One project shall go on for no longer than 8 weeks.

Unit I: - Introduction of the first project
Unit II: - Using Parametric tools on the given project
Unit III: - Presentation of the project
Unit IV: - Introduction of the second project
Unit V: - Parametric design project
Unit VI: - Presentation of the project

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

Each student shall be judged on individual performance as well as his/her contribution to the group
work. Students are expected to produce complete documentation with all the required content such as design concepts, design process, digital explorations, models, diagrams and drawings, along with text in a presentation format (soft copy) as well as printed format (hard copy).

OUTCOME :

Students will learn the applications of Parametric tools and parametric thinking process in Architectural Design.

RECOMMENDED READINGS :

- Advanced Technologies : Building in the Computer Age (The Information Technology Revolution in Architecture) by Valerio Travi
- Animate Form by Greg Lynn
- Blobitecture: Waveform Architecture and Digital Design by John K. Waters
- CAD Principles of Design, An Analytical Approach to the Computational Representation of Architectural Form by Peter Szalapaj
- Digital Tectonics by Neil Leach (Editor), David Turnbull (Editor), Chris Williams (Editor)
- Gramazio Fabio, Matthias Kohler, Silvan Oesterle, Encoding Material, architectural Design Special Issue: The New Structuralism: Design, Engineering and Architectural
- HyperArchitecture : Spaces in the Electronic Age (The Information Technology Revolution in Architecture) by Luigi Prestinenza Puglisi, L. Byatt (Translator)
- Hyperbodies by Kas Oosterhuis
- Next Generation Architecture : Folds, Blobs, and Boxes by JOSEPH ROSA

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SUBJECT TITLE: **ELECTIVE –I**				
Subject Code **: 2019CA102**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	100	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**3**	**Total Marks**	**100**	

COURSE OBJECTIVES:

Colloquium

Student should be able to do extensive research on the pioneers of this field and present with audio-visual aids. The presentation should be open house and followed by discussion, which will be guided by the faculty member/s. Faculty shall guide the students for the topics, research methods and writing techniques.

COURSE CONTENT :

Unit I: **Paraphrasing**- Introduction to the colloquium format. Research on potential topics through books, magazines, internet and other sources.

Unit II: **Literature review** - Selection of the topic and colloquium on the literature.

Unit III: **Analytical presentation** - Colloquium presentation based on the selected topic with the understanding of analytical reading.

Unit IV: **Drawing inferences** - Reading and analysis of the topic and drawing inferences based on the focus of the study.

Unit V: **Writing** - Writing papers/articles on the presented and discussed topics.Students should be able to write about own understanding and views.

Unit VI: **Concluding** - Student should be able to write own conclusions, generate research questions
and study further based on those research questions. Students should be able to write with technical understanding of 'writing'

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

The sessional work shall be assessed by the internal faculty member on the basis of A/V presentation
and report/paper/article etc. A/V presentation should be made by individual student.
The assessment shall be based on the following factors:
i. Student's understanding of the topic
ii. Presentation techniques
iii. Technical Writing

OUTCOME :

Emerging technologies e.g. digital media and computational design, students will gain the global perspective of the current research and developments. This format of the coursework helps to broadly understand the established and ongoing developments and research work in this domain.

RECOMMENDED READINGS :

- Hartkopf, Volk, [et al], (1993), Designing the office for the future: the Japanese approach to tomorrows workplace, John Wiley & sons
- Ruck, Nancy, C. 1989, Building Design and Human performance, Van Nostrand Rheingold

SUBJECT TITLE: **DIGITAL TOOLS AND TECHNIQUES –I**				
Subject Code **: 2019CA103**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	200	
Studio Periods per week	2	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**4**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**4**	**Total Marks**	**200**	

COURSE OBJECTIVES:

The focus of this subject would be on various digital tools and their applications in Architectural projects. Opening up new horizons of technological advancements in the field of computational technology through the use of computer modeling, rendering, Parametric modeling, Simulation, analysis, BIM software etc. The focus would be on the exploration of space and place making through use of various computer modelling tools.

COURSE CONTENT :

Each of the below mentioned topics shall be introduced in lecture periods and is to be dealt with subsequently in the design studios in detail. The focus of teaching in this subject shall be as following:

Unit I **- Architectural geometry:** Introduction to basic Architectural 2D & 3D geometry.

Unit II **- Visualization:** Introduction to Visualization tools in Architecture such as 3D software, Nurbs
modeling, Parametric modeling, BIM.

Unit III **- Rendering:** Introduction to rendering techniques including Material mapping, Lighting,
Perspective.

Unit IV **- Presentation:** Introduction to presentation tools & techniques for print and digital medium.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

The assessment will be done on the progressive work in the studios and a final seminar presentation by
the student for the various tools. Submission should be in form of a report and presentation of the progressive work done in the studios throughout the semester.

OUTCOME :

Students will learn different Computational tools for computer modelling, rendering, simulation, analysis
etc.

RECOMMENDED READINGS :

- Alexander, C. (1964). Goodness of fit. In *Notes on the Synthesis* (pp. 15-28).Cambridge: Harvard University Press.
- Cecil Balmond, Geometry, Algorithm, Pattern: The Serpentine Pavillion 2002, *Digital Tectonics*, ed Neil Leach, London ,Wiley-Academy, 2004. 132 Print
- Helmut Pottmann, Michael Hofer and Axel Kilian (eds), *Advances in Architectural Geometry*, Vienna,2008
- TerzidisKostas ,*Algorithmic Architecture*, Architectural Press , Oxford , 2006

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SUBJECT TITLE: **DIGITAL DESIGN THEORY –I**				
Subject Code **: 2019CA104**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional	Nil	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	
		End-semester Examination	70	150min
Total Credits	**3**	**Total Marks**	**100**	

COURSE OBJECTIVES:

The objective of this class is to develop an understanding and a theoretical underpinning for digital
mediation in architecture.

COURSE CONTENT :

Unit I: - Introduction

Unit II: - Concepts in Critical Theory

Unit III: - Digital culture

Unit IV: - Curvilinearity in architecture

Unit V: - Architecture and science

Unit VI: - Architecture and cybernetics

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

This being an individual project, each student shall be judged on their individual performance, through
essays and presentations on readings in the class.

OUTCOME :

Students will develop an understanding for different digital design theories in Architecture.

RECOMMENDED READINGS :

- Architecture and Disjunction by Bernard Tschumi
- Architecture's Appeal, How Theory Informs Architectural Praxis Edited by Marc J. Neveu, NeginDjavaherian
- Architectural Theory Edited by Harry Francis Mallgrave
- Architectural Theories of the Environment, Posthuman Territory Edited by Ariane Lourie Harrison
- G Lynn (ed) Folding in architecture, AD pp 8-15 Profile no. 102
- Hensel, M. and Menges, A (2008): 'Morpho-Ecologies', London: Architectural Association.

- Intersections, Architectural Histories and Critical Theories Edited by Iain Borden, Jane Rendell
- Kotnik Toni, *Digital Architectural Design as Exploration of Computable Functions,* international journal of architectural computing issue 01, (2006) volume 08,(3)
- Lina Bo Bardi, The Theory of Architectural Practice ByCathrineVeikos
- Rethinking Technology, A Reader in Architectural Theory Edited by William W. Braham, Jonathan A.Hale
- The Production of Space by Henri Lefebvre
- Theories of the Digital in Architecture Edited by Rivka Oxman, Robert Oxman
- Thinking Architecture by Peter Zumthor

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SUBJECT TITLE: **AUTOMATED DESIGN**				
Subject Code **: 2019CA105**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional	Nil	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	
		End-semester Examination	70	150 min
Total Credits	**3**	**Total Marks**	**100**	

COURSE OBJECTIVES:

The objective of this class is to study in detail Building automation for various building typologies.

COURSE CONTENT :

Study of the systems and their applicability in the following areas:

Unit I :**Introduction -** Theory of automation design

Unit II :**Theory -** Theory of automation for energy efficiency

Unit III :**Project work -** Simulation for climate control

Unit IV :**Project work -** Simulation for light and noise control

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

Student should be able to generate designs and models based on the building automation technique.

OUTCOME :

Students will learn building automation and its applications in the project with respect to energy efficiency, climate control, light, sound and noise controls.

RECOMMENDED READINGS :

- Applied Illumination Engineering by L.Lindsey. FIES
- Building Control Systems by Vaughn Bradshaw
- Dr.M.K.Murlidhara, luminous environments.Heat and Mass Transfer
- Fry et al. Noise control in building services. Pergammon Press 1988
- Home Automation and wiring – James Gerhart
- L. Cremer and H. Muller (trnsschults). Principles and applications of room acoustics (vol 1) applied science 1982
- Lighting Design + Applicatiob Published by IESNA (Illumination Engineering Society)
- Ronald N.Helms and M.Clay Belcher, lighting for energy efficient

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SUBJECT TITLE: **DIGITAL FABRICATION**				
Subject Code **: 2019CA106**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	1	Sessional	100	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**2**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**2**	**Total Marks**	**100**	

COURSE OBJECTIVES:

This studio will explore fabrication process in architecture with non-linear geometries and the material
techniques which is useful to bring the software models into reality. It gives hands on experience of working with the machines.

COURSE CONTENT :

Architectural and material techniques in architecturally innovative projects realize through digital design
and constructive process. It has become possible because of the collaboration of software and machines.
Introduction to various tools and different techniques of digital fabrication will be taught in this subject. Introduction about digital fabrication, different methods of digital fabrication and their advantages, various fabrication machines.

Unit I: Introduction to various fabrication techniques like sectioning, tessellating, folding, its use.

Unit II: Introduction to various fabrication techniques like of contouring, forming, its use.

Unit III: introduction to various advanced technologies and latest trends like robotics etc.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

Students will be introduced to the types of digital fabrication and machines. The student will take individual project of architectural design and workout the joinery, select the material and technique to be used for individual model.

OUTCOME :

Students will be exposed to the practical work of digital fabrication on machines.

RECOMMENDED READINGS :

- Biosensor principles and Application – by LoicJ.Blum, Pierre R.Coulet
- Digital Fabrications architectural and material techniques – by Lisa Iwamoto

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DETAIL SYLLABUS

SEM - II

SUBJECT TITLE: **DIGITAL DESIGN STUDIO–II**				
Subject Code **: 2019CA201**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	300	
Studio Periods per week	8	Viva/Oral	100	
Total Contact Periods (60 min period) per week	**10**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**10**	**Total Marks**	**400**	

COURSE OBJECTIVES:

Objective of this studio is towards learning digital design processes and their application in Design
studio in architectural projects. Another focus will be on sustainability through Automated design and
construction.

COURSE CONTENT :

Students will take up two independent design projects. One in a group of four, specifically designed to
fulfill the requirement for integration of above-mentioned specializations. The scope of the project should be limited to a medium sized project. The source of this may be an existing Architectural project, onto which the automation tools could be integrated and redefined. The second project shall be an individual one based on parametric design processes.

Unit I: - Introduction of the first project
Unit II: - Using Parametric tools on the given project
Unit III: - Presentation of the project
Unit IV: - Introduction of the second project
Unit V:- Parametric design project
Unit VI: - Presentation of the project

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

This shall be a group-work, distributing specific duties to each of the member. Each student shall be
judged on individual performance as well as his/her contribution to the group work. Students are expected to produce complete documentation with all the required content such as design concepts, design process, digital explorations, models, diagrams and drawings, along with text in a presentation format (soft copy) as well as printed format (hard copy).

OUTCOME :

Students will learn digital design processes and their application in Design studio in architectural projects with focus on sustainability through Automated design and construction.

RECOMMENDED READINGS :

- Atkin, Brian, 1993, Intelligent Buildings: Applications of IT and building automation to high
  technology construction projects, Aldershot: Avebury Technical
- Berry John, 1995, Integrated design-building Services
- Building Control Systems by Vaughn Bradshaw
- DBMS by Date
- Fundamentals of Database Systems by Remez Elmasri, Shamkant B. Navathe
- George B. Korte, " The GIS Book ", Onword Press (Thomson learning), 5th Edition.
- M Anji Reddi, " Remote sensing & Geographical Information Systems ",BS Publication, Second
  Edition.
- Modern Control Engineering by Katsuhilo Ogata, University of Minnesota
- Peter A. Burrough and McDonell, "Principles of Geographical Information Systems", Oxford
  University Press, 1998.

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SUBJECT TITLE: **ELECTIVE –II**				
Subject Code **: 2019CA202**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	100	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**3**	**Total Marks**	**100**	

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COURSE OBJECTIVES:

Robotics and Embedded systems

The course will facilitate understanding of various methods of automation into construction with respect torobotics.

COURSE CONTENT :

Unit I: **Embedded systems -** Embedded systems for intelligent buildings
Unit II: **Self assembly-** Self-assembly systems
Unit III: **Robotics-** manufacturing Introduction to robotics in manufacturing and assembly
Unit IV: **Robotics -** construction Robotics in construction
Unit V: **Mass Customisation -** Concepts in mass customisation

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

Student / group of students should be able to generate 3D models based on the technique of mass customisation/robotics/ automated construction.

OUTCOME :

The students shall be able to execute small scale components of design with the help of emerging technology of automation into construction. This course shall facilitate the practical implementation of mass customisation.

RECOMMENDED READINGS :

- Date P. P., "Introduction to Manufacturing Technology, Principles and Practices", , Jayco Publishers, Mumbai
- G. Boothroyd , C. Poli, L. Murch, "Automatic Assembly", Marcel Dekker Inc. 1982.
- Histand B.H., Alciatore D.G., "Introduction to Mechatronics and Measurement Systems", ISBN 0-07-052910-8

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SUBJECT TITLE: **DIGITAL TOOLS AND TECHNIQUES –II**				
Subject Code **: 2019CA203**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	200	
Studio Periods per week	2	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**4**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**4**	**Total Marks**	**200**	

COURSE OBJECTIVES:

The focus of this subject would be on various digital tools and their applications in Architecturalprojects. Opening up new horizons of technological advancements in the field of computational technologythrough the use of computer modeling, rendering, Parametric modeling, Simulation, analysis, BIM software etc. The focus would be on the exploration of space and place making through use of variouscomputermodellingtools.

COURSE CONTENT :

Each of the below mentioned topics shall be introduced in lecture periods and is to be dealt with subsequently in the design studios in detail. The focus of teaching in this subject shall be as following:

Unit I **- Relational geometry:** Introduction to Relational geometry and its applications in Architecture.

Unit II **- NurbsModeling:** Introduction to Nurbsmodeling and its application in Architecture.

Unit III **- Parametric modeling:** Introduction to Parametric modeling& its application in Architecture.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

The assessment will be done on the progressive work in the studios and a final seminar presentation by
the student for the various tools. Submission should be in form of a report and presentation of the progressive work done in the studios throughout the semester.

OUTCOME :

Students will learn different Computational tools for computer modelling, rendering, simulation, analysis
and its application in architectural geometries and architectural design.

RECOMMENDED READINGS :

- Architectural Geometry by Helmut Pottmann
- Architectural Representation Handbook: Traditional and Digital Techniques for Graphic Communication by Paul Laseau
- Helmut Pottmann, Michael Hofer and Axel Kilian (eds), *Advances in Architectural Geometry*, Vienna,2008
- TerzidisKostas ,*Algorithmic Architecture*, Architectural Press , Oxford , 2006

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SUBJECT TITLE: **DIGITAL DESIGN THEORY –II**				
Subject Code **: 2019CA204**				
Teaching Scheme		**Examination Scheme**	**Marks**	Duration
Theory Periods per week	2	Sessional	Nil	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	
		End-semester Examination	70	150 min
Total Credits	**3**	**Total Marks**	**100**	

COURSE OBJECTIVES:

Specific theoretical issues dealing with form generation using the generative potential of software's
unique ability to deploy geometric entities. Introduction of Shape grammars and its potential uses for the
Architectural Design and analysis.

COURSE CONTENT :

The focus of teaching shall be on:

Unit I- Digital Architecture design processes and diagrams

Unit II- Morphogenetic design processes, etc

Unit III-Shape grammar

Unit IV-Other similar theoretical issues

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

The sessional work shall be in form of the experiments with above mentioned topics and research papers
based on those experiments.

OUTCOME :

Students will develop an understanding for different digital design theories in Architecture.

RECOMMENDED READINGS :

- Defining Digital Architecture: 2001 FEIDAD Award by Yu Tung Liu (Editor)
- Demonstrating Digital Architecture: 2004 Feidad Award by Yu-Tung Liu (Editor)
- Developing Digital Architecture by Yu-Tung Liu (Editor), Yu Tung Liu
- Digital Architecture by M. Saleh Uddin
- Digital Eisenman (The Information Technology Revolution in Architecture) by Luca Galofaro, Luca Galofaro (Translator)
- Hybrid Space : Generative Form and Digital Architecture by PETER ZELLNER
- Mathematics of Space by George Legendre
- MORPHOGENESIS OF FLUX STRUCTURE. by Mutsuro; Ito, Toyoo; Isozaki, Arata Sasaki
- Narrative Architecture by Nigel Coates
- New Flatness : Surface Tension in Digital Architecture by Alicia Imperiale
- Patterns of Architecture: No 6 by Mark Garcia
- Programming Cultures: Architecture, Art and Science in the Age of Software Development
  (Architectural Design) by Mike Silver
- The Autopoiesis of Architecture by Patrik Schumacher
- The Function of Ornament by Farshid Moussavi

SUBJECT TITLE: **RESEARCH I**				
Subject Code **: 2019CA205**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional	Nil	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	
		End-semester Examination	70	150 min
Total Credits	**3**	**Total Marks**	**100**	

COURSE OBJECTIVES:

To develop an ability to research on any chosen topic, with systematic methodologies.

COURSE CONTENT :

The lectures will include presentations and discussions on the below mentioned topics.

Unit I: Introduction to research methods and methodology and types of Research Methods

Unit II: Research design and Literature review

Unit III: Data documentation and analysis

Unit IV:Components of the research paper

Unit V:Presentation of data and report

Unit VI:Theoretical research and Applied research

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

For this subject students will be assessed based on their process/es of documentation, methods of analysis and the judicious understanding of the research methods along with the content and research
design.

Minimum Assignment/s submissions towards Sessional Work shall include:
a. A report on understanding of various research methods
b. Comprehensive report of appropriate research design of their own paper on the chosen topic

OUTCOME :

Students will developability to research on any chosen topic, with systematic methodologies.

RECOMMENDED READINGS :

- Research Methodology: Methods and Techniques by C. R. Kothari
- Research Methodology: A Step-By-Step Guide for Beginners by Ranjit Kumar
- Research Methodology: A Handbook by R. P. Misra
- Research Methodology: Theory & Techniques by Jagadish R. Raiyani

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SUBJECT TITLE: **COMPUTER GRAPHICS**				
Subject Code **: 2019CA206**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	1	Sessional	100	
Studio Periods per week	1	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**2**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**2**	**Total Marks**	**100**	

COURSE OBJECTIVES:

This course aims at giving emphasis on the fundamentals of Graphics, scripts & programming related to architectural geometry.

COURSE CONTENT :

Unit I: Basic concepts: Introduction to computer graphics
Line, circle and polygon generation:
Unit II: Basics of Programming & scripting
Unit III: Generation of 2D, 3D geometry

Unit IV: All transformation rules for 2D, 3D geometry

Unit V: Curves and fractals: Curve generation, Interpolation, Interpolating, B-splines, Bezier curves,Fractals, Fractal surfaces and lines

Unit VI: Light, colour and shading: Diffused illumination, Point source illumination, Colour models RGB,HVS, CYM etc., Transparency, Reflection and shadows.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

For this subject students will be assessed based on their small project which has scripts &itsgraphical output.

OUTCOME :

Students will be enabled to deal with varying site-based natural and ecological systems with reference to urban design projects and the city at large.

RECOMMENDED READINGS :

- Architectural Representation Handbook: Traditional and Digital Techniques for Graphic Communication by Paul Laseau
- Computer Graphics, Principles and Practice: Foley, Vandam, Feiner, Hughes, Addison Wesley
- Computer Graphics- A programming approach: McGraw Hill International Editions
- Demonstrating Digital Architecture: 2004 Feidad Award by Yu-Tung Liu (Editor)
- Procedural Elements for Computer Graphics: David F. Rogers, McGraw Hill International Editions

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DETAIL SYLLABUS

SEM - III

SUBJECT TITLE: **DIGITAL DESIGN STUDIO–III**				
Subject Code **: 2019CA301**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional – Internal	150	NA
Studio Periods per week	8	Sessional – External	150	NA
Total Contact Periods (60 min period) per week	**10**	Viva/Oral - Internal	50	NA
		Viva/Oral - External	50	NA
		In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**10**	**Total Marks**	**400**	**NA**

COURSE OBJECTIVES:

Introduction to various digital tools and their applications in Architectural projects. Opening up new horizons of technological advancements in the field of computational technology through the use of computer modelling, rendering, parametric modelling, simulation, analysis, BIM software etc. The focus would be on the exploration of space and place making, structural stability with advanced construction technology through use of various computer modelling tools.

COURSE CONTENT :

Each of the below mentioned topics shall be introduced in lecture periods and is to be dealt with subsequently in the design studios in detail. The focus of teaching in this subject shall be as following:

Unit 1 - Simulation software: Introduction to various simulation software and its applications in Architecture.

Unit 2 - Analysis software: Introduction to various Analysis software and its applications in Architecture.

Unit 3 - Building information modelling: Introduction to Building Information modelling and it's application in Architecture, through various computational software.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK:

Part of sessional work shall be a group-work, distributing specific duties to each of the member. Each student shall be judged on individual performance as well as his/her contribution to the group work. For individual project the assessment shall be on individual work, output.

OUTCOME:

Students will learn digital design processes and their application in Design studio in Urban Design projects with focus on sustainability/energy efficiency.

RECOMMENDED READINGS:

- Advanced Technologies : Building in the Computer Age (The Information Technology Revolution in Architecture) by Valerio Travi Architecture) by Luigi Prestinenza Puglisi, L. Byatt (Translator)
- Blobitecture: Waveform Architecture and Digital Design by John K. Waters
- Digital Tectonics by Neil Leach (Editor), David Turnbull (Editor), Chris Williams (Editor)
- Hybrid Space : Generative Form and Digital Architecture by Peter Zellner
- Hyper Architecture : Spaces in the Electronic Age (The Information Technology Revolution in
- Hyperbodies by Kas Oosterhuis
- Mass Customisation and Personalisation in Architecture and Construction Edited by Poorang A.E.
- Master Planning the Adaptive City, Computational Urbanism in the Twenty-First Century Edited by Tom Verebes
- Next Generation Architecture : Folds, Blobs, and Boxes by Joseph Rosa Pasquero
- Piroozfar, Frank T. Piller
- Systemic Architecture, Operating Manual for the Self-Organizing City By Marco Poletto, Claudia

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SUBJECT TITLE: **RESEARCH–II**				
Subject Code **: 2019CA302**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional - Internal	50	NA
Studio Periods per week	1	Sessional - External	50	NA
Total Contact Periods (60 min period) per week	**3**	Viva/Oral - SV	Nil	NA
		In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**3**	**Total Marks**	**100**	**NA**

OBJECTIVE

1. To explore and study central issues related to digital architecture from past, to the present day and future.
2. To enable the student to undertake a methodical research on a topic in digital architecture and to communicate it through technical writing

COURSE CONTENTS

Unit I: The subject deals with selecting an appropriate topic from the field of Digital architecture or allied disciplines, for the theoretical exploration related and supportive to the selected dissertation topic.

The topic of the research paper could be selected in a such way that it could help to develop an appropriate methodology and research approach (but not restricted to) related to the Digital Design Project taken up in semester-IV.

SESSIONAL/TERM WORK:
Research paper shall be prepared by each student based upon the topic approved by the institute in around 5000 words, in the format specified by the university. The paper has to adhere to the plagiarism norms as given by UGC and a plagiarism report will be attached as a part of the submission. A research seminar to be conducted internally as the end of the term which shall be mandatory for internal evaluation.

ASSESSMENT
The sessional work as stipulated above will be assessed internally and externally with equal weightage of 50 marks each for sessional work.

OUTCOME:
Students at the end of the semester should be able to undertake independent research in the field of Digital Architecture and present it in the appropriate technical formats as required.

Recommended Readings

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

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SUBJECT TITLE: **DIGITAL PRACTICES AND PROFESSIONAL TRAINING**				
Subject Code **: 2019CA303**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional - Internal	75	NA
Studio Periods per week	2	Sessional - External	75	NA
Total Contact Periods (60 min period) per week	**4**	Viva/Oral - External	25	NA
		Viva/Oral - Internal	25	NA
		In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**4**	**Total Marks**	**200**	**NA**

OBJECTIVE

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

COURSE CONTENTS

• Introduction to Professional Practice – Ethics, code of conduct and liabilities as an architect, contracts and tenders. Professional fees, Role of various bodies and organizations like COA, IIA etc., professional procedures, office management, project development,

• Approval processes, planning mechanisms and working structure associated with governmental organizations (Municipal Corporations etc.)

• The Professional Training (40 full working days) is to be undertaken during intermediate time between II & III Semester. The Oral Assessment of the same will be held at the end of Semester III. The subject is included as core subject and will have both sessional and viva assessment. It involves working in a firm engaged in architectural or planning related work with futuristic approach in India or abroad. 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 and in the form of notes/journals/assignments done during the studio in Semester III. 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.

ASSESSMENT

The sessional work as stipulated above will be assessed internally and externally with equal weightage of 75 marks each for sessional work along with equal weightage of 25 marks each for Viva – voce.

RECOMMENDED READINGS

1. Websites of various professional organization associated with the profession of Architecture

2. COA Handbook

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SUBJECT TITLE: **INTERACTION DESIGN**				
Subject Code **: 2019CA304**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional - SS	Nil	NA
Studio Periods per week	1	Viva/Oral – SV	Nil	NA
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	NA
		End-semester Examination	70	150 min.
Total Credits	**3**	**Total Marks**	**100**	**NA**

COURSE OBJECTIVES:
Issues dealing with Information Systems and Human Psychology, similarities and differences, importance of human factor and paradigms of interaction.

COURSE CONTENT :
Unit I : Introduction: The Human- I/P, O/P channels, Human memory, Thinking, Emotion, Individual differences (diversity), Human psychology.

Unit II : Theory & Principles of models and guidelines

- Principle 1: Recognize diversity
- Principle 2: 8 golden rules of id
- Principle 3: Prevent errors
    1. Guidelines for data display, Guidelines for data entry, Study of HCI patterns
    2. Models: Types of models, cognitive models, GOMS and keystroke level model, stages of action models, linguistic models, BNF and task action grammar, object action interface model.

Unit III: Design Process: The process of design, user focus, and aims of user entered design process, three pillars of design, participatory design, scenarios, navigation design, screen design, development methodology. s/w tools: design tools, and s/w engineering tools.

Unit IV : Audio: Use of audio in computer applications, basic concepts, capture, digital representation of sound and processing music, speech, file formats for sound, streaming.

Unit V : Text and Animation: Text in multimedia, hypertext, hypermedia, Principle of animation, 2D, 3Danimation

Unit VI : Introduction to tools & techniques of intelligent & embedded design, multimedia devices.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :
Students will be assessed based on assignments, Interface designs for different gadgets.

OUTCOME :
Students will develop an understanding with regards to interrelation between Information Systems and Human Psychology

RECOMMENDED READINGS :

- "Designing the User Interface", by Ben Shneiderman, Pearson Education, 2001
- "Human Computer factors: A study of users and Information Systems", by Andy Smith, McGraw Hill, 1997
- "Human Computer Interaction", by Alan J. Dix, Janet Finlay, Russell Beale, Pearson Education, 3rd Edition 2004
- "The essentials of Interaction Design", by Alan Cooper, John Wiley, 2003

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SUBJECT TITLE: **SMART MATERIALS AND ADVANCED CONSTRUCTION**				
Subject Code **: 2019CA305**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	2	Sessional - SS	Nil	NA
Studio Periods per week	1	Viva/Oral - SV	Nil	NA
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	30	NA
		End-semester Examination	70	150 min
Total Credits	**3**	**Total Marks**	**100**	**NA**

COURSE OBJECTIVES:

This course aims at giving opportunity of learning more about different material families, their abilities to perceive climatic, acoustic and light conditions and the way they adapt to them; user detection and modification of the space in relation to users' bodies, their movements; their possibilities for capturing wind and solar energy; or even their ability to generate electrical and thermal energy. The course will also introduce students to materials that are untested but hold promise for future usage.

COURSE CONTENT :

Unit 1 :

Material properties: - Intrinsic Mechanical, physical, Thermal, Optical decorative.
- Extrinsic Economic, Environmental, Societal, Cultural.

Metals - Light alloys, gels & foams, coatings, Adaptive / Responsive Surfaces

Polymers - High-performance polymers, Biopolymers Ceramics, Nano materials, Smart materials

Unit 2 :

Natural - Eco-efficient materials, Smart Biodegradable, shape-memory materials, Composites - Advanced composites, Ceramics

Unit 3 :

Complex process: extraction, refining, processing, manufacturing, construction, Inception, life cycle

Unit 4 :

Complex system: materials components, assemblies, devices, building systems

SUBMISSION REQUIREMENT FOR SESSIONAL WORK :

The group works with digital content, information and fabrication for the generation of new techniques generating the production of non-rigid, responsive and multi-functional material and construction systems.

OUTCOME :

The course will challenge students to refine their understanding of responsible or sustainable design practice by looking at the evolution of those ideas within the field of architecture.

RECOMMENDED READINGS :

- Architecture in the Digital Age: Design and Manufacturing by Branko Kolarevic
- Intelligent Skins _ By Michael Wiggington
- Material Connexion _ By George Beyleron
- Space Reader: Heterogeneous Space in Architecture, Hensel, M., Hight, C., Menges, A. (eds.): 2009, John Wiley and Sons, London. (ISBN 978-0470519424)

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SUBJECT TITLE: **COMPUTATIONAL DESIGN SKILLS**				
Subject Code **: 2019CA306**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	1	Sessional - Internal	50	NA
Studio Periods per week	1	Sessional - External	50	NA
		Viva/Oral - SV	Nil	NA
Total Contact Periods (60 min period) per week	**2**	In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**2**	**Total Marks**	**100**	**NA**

COURSE OBJECTIVES:

GIS – Geographic Information System

The main objective of this elective is obtaining the basic knowledge of Geographic Information System (GIS) and its relevance to Architectural design and development.

COURSE CONTENT :

The lectures to be arranged by the faculty followed by the discussions and written work.

Unit 1: **Map Language**:

Map as a model, classification of maps, spatial referencing system, map projections, commonly used map projections, grid systems, computer map production

• digital database in a GIS.

Unit 2: Visual image interpretation:

Types of pictorial data products, Image interpretation strategy, Image interpretation process, overview of image interpretation equipment.

• Digital image processing: Basic chapter of digital images, processing, registration, enhancement, spatial filtering, transformation, classification, image classification and GIS.

Unit 3: Fundamentals of GIS:

Roots of GIS, Overview of information system, the four Ms, GIS definition and terminology, GIS queries, GIS architecture, Models of GIS, Framework for GIS, GIS categories, levels/scales of measurement.

• Spatial data modelling: Stages of GIS data modelling, Graphic representation of spatial data, raster GIS models, vector GIS models.

Unit 4: GIS data management: Database management system, database models, storage of GIS data object based data models, temporal topology and organizational strategy of DBMS in GIS.

• Data input and editing: The data stream, data input models, data input methods, GPS for GIS data capture, data editing.

• Data quality issues: Components of data quality, accuracy, precision and resolution, consistency, completeness, source of error in GIS, GIS output, modelling errors and error evaluation.

• Data analysis and modelling: Format conversion, Data medium conversion, Spatial measurement methods, buffering techniques, overlay analysis, modelling surfaces, modelling networks.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK:

An individual project may be taken for individual studies. Various possible aspects to be accommodated and managed by the student. The scope of the project may be relatively small and pre-approved by the faculty member.

OUTCOME:

To expose student for integrating GIS as system to be the part of Architectural design and development.

RECOMMENDED READINGS :

- George B. Korte, " The GIS Book ", Onword Press (Thomson learning), 5th Edition.
- M Anji Reddi, " Remote sensing & Geographical Information Systems ",BS Publication, Second Edition.
- Peter A. Burrough and McDonell, "Principles of Geographical Information Systems ", Oxford University Press, 1998.

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SUBJECT TITLE: **DIGITAL DESIGN PROJECT**				
Subject Code **: 2019CA401**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	04	Sessional	600	NA
Studio Periods per week	16	Viva/Oral	200	NA
Total Contact Periods (60 min period) per week	**20**	In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**20**	**Total Marks**	**800**	**NA**

COURSE OBJECTIVES:

Students work on the detailed design and presentation of an approved thesis subject that shall be in form of a real or virtual project based on a topic of individual preference. This project should be able to demonstrate a reasonable amount of interesting ideas and execution techniques.

COURSE CONTENT:

The topic for this project shall be pre-approved by the guiding faculty member/members. The scope of this project shall be carefully considered. A student may take one internal and another external guide as subject expert. Dissertation will have a final product in the form of report (of words not less than 10,000 words) on the chosen subject, supported with images, drawings, etc. The students shall work in the studios on self-study guided by the faculty members.

SUBMISSION REQUIREMENT FOR SESSIONAL WORK:

The final project shall be assessed based on the predefined criteria, such as ingenuity of ideas, their execution, presentation, level of complexity, etc. Viva may be taken based on the methodology and content of the final project. The sessional work as stipulated above will be assessed internally and externally with equal weightage as specified.

OUTCOME:

The students will produce detailed design and presentation of their respective thesis project.

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SUBJECT TITLE: **ELECTIVE III**				
Subject Code **: 2019CA402**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
Theory Periods per week	1	Sessional	200	NA
Studio Periods per week	4	Viva/Oral - SV	NIL	NA
Total Contact Periods (60 min period) per week	**5**	In-semester Examination	Nil	NA
		End-semester Examination	Nil	NA
Total Credits	**5**	**Total Marks**	**200**	**NA**

OBJECTIVE:

To expose the students in interdisciplinary area of their interest and impart them with theoretical knowledge and practical understanding of the subject offered in the elective.

COURSE CONTENTS:

Individual college may offer the students one or more topics, depending upon the availability of experts and resource material. The colleges will have the opportunity and choice to focus on one or more of the topics. Being an open interdisciplinary elective the topics offered for the elective shall be outside the core knowledge domain of architecture. The open elective would be offered by departments/schools other than architecture.

In case the topics offered cannot be conducted the students can take any one of the topics offered in either elective I or elective II but not opted for by the students earlier.

Detailed syllabus for the topics will be finalized by individual college in consultation with expert faculty, considering the time and marks allotted to the subject.

SESSIONAL/TERM WORK:

The mode of teaching learning shall be decided by the experts and the department where the elective is offered. The final outcome and submission shall be in form of report / journal/ model/ or any other form suitable for the topic studied.

OUTCOME:
Students at the end of the semester should have learnt / understood the broad idea and concept inherent in the subject as well as its application and importance in the field.

RECOMMENDED READINGS:
As per the topic offered.