SAVITRIBAI PHULE PUNE UNIVERSITY

(FORMERLY UNIVERSITY OF PUNE)

SYLLABUS FOR

MASTERS IN ARCHITECTURE

M.ARCH (ENVIRONMENTAL ARCHITECTURE)

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

BOARD OF STUDIES IN ARCHITECTURE

FACULTY OF SCIENCE AND TECHNOLOGY

PREAMBLE

Environment, environment protection and all issues related to environment have gained importance not only for the government but for the common man also.

As architects we are responsible for a large amount of environment pollution right from manufacturing of building materials to the creation of a built environment. We are also one of the largest consumers of energy resources when we add to the built Environment. The effect of the built environment has a considerable impact on the un-built environment. The environment left to our mercy is degrading due to the insensitive approach of the professionals who matter.

This course aims at sensitizing the professionals to the environmental issues, global as well as site specific, focusing on the design approach, technology and economics to address them. The architects can play a major role in influencing the clients and authorities to practice energy conservation and thus contribute to environmental sustainability. For this an in depth knowledge and understanding of the environment we live in is very important.

The aim of the course is to develop the knowledge and skills of the students to enable them to incorporate environmental sensitivity in the built environment thus helping to address the larger challenges of climate change, resilience, resource consumption etc.

MASTERS IN ARCHITECTURE (ENVIRONMENTAL ARCHITECTURE)

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

1. **KNOWLEDGE AND SKILLS -** To enable students to gain practical knowledge in the field of environmental design and interpret this to achieve environmental sustainability. To enable students to integrate traditional knowledge with contemporary practices.

2. **RESEARCH -** To enable students to critically evaluate research and practices in the field to arrive at studied solutions. To inculcate scientific research thinking and critical analysis in the environmental research domain for the students and faculty both.

3. **EMPLOYABILITY-** To enable students to become architectural practitioners with a clear understanding of global issues. To enable students to take informed and independent decisions pertinent to their field with client needs in mind in the context of current policy requirements.

4. **ETHICS & VALUES –** To instil students with the ability to work in context specific domains in an interdisciplinary work culture respecting the values of the various disciplines. To provide students with the ability to integrate knowledge of environment enabling them to work for the larger benefit of society. The students should be able to take design decisions based on ethical considerations in the profession.

5. **THEORETICAL BASE –** To provide students with a technically sound base of theory and practical knowledge from issues ranging from the micro to the macro level of environmental concerns.

PROGRAM OUTCOMES (PO's)

On completion of the program

1. **Design and planning knowledge -** Graduates will be able to identify issues related to sustainability and provide architectural or planning solutions. Graduates will be able to address various environmental problems through design and planning using cutting edge methods and approaches.

2. **Research Skills -** Graduates will be able to demonstrate skills in research and critical thinking

3. **Technical Knowledge -** Graduates will be able to address and resolve issues related to energy and other sustainability concepts in architectural design. Graduates will be able to apply appropriate methods, tools and technologies to achieve integrated environmental designs

4. **Practical Knowledge -** Graduates will be able to identify and resolve issues in the real life context with the goal of achieving environmental sustainability. Ability to imbibe current and contemporary practices enabling them to handle a wide range of projects from rural to urban contexts.

5. **Sensitization and Responsibility -** Graduates will be able to understand the holistic perspective of environment developing a sensitive understanding of the natural environment to ensure the responsibility towards the future generations for the use of these resources.

6. **Communication Skills –** Graduates will be enabled with the ability to effectively communicate their ideas through various mediums like graphic and oral presentation skills to ensure the transfer of knowledge to professionals and common man alike.

7. **Social Responsibility -** Graduates will be able to apply knowledge gained to the greater good of society through design and research.

MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES AND PROGRAM OUTCOMES

PEO	PO1 **DESIGN AND PLANNING**	PO2 **RESEARCH SKILLS**	PO3 **TECHNICAL KNOWLEDGE**	PO4 **PRACTICAL KNOWLEDGE**	PO5 **SENSITIZATION AND RESPONSIBILITY**	PO6 **COMMUNICATION SKILLS**	PO7 **SOCIAL RESPONSIBILITY**
PE01- **KNOWLEDGE AND SKILLS**	√	√	√			√	
PEO2- **RESEARCH**		√				√	√
PEO3- **EMPLOYABILITY**	√		√	√	√	√	√
PEO4 **ETHICS & VALUES**		√			√		√
PEO5 **THEORETICAL BASE**	√		√	√			

Sr.No.	**Program Outcomes**	**Subjects in curriculum**
1	PO1-**DESIGN AND PLANNING**	Environmental Design Studio-I, II, III Sustainable Development and Environmental Management Environmental Architecture Project Lighting Lab
2	PO2- **RESEARCH SKILLS**	Elective-I, II, III Research I and II Environmental Laws and Legislations Environmental Architecture Project

Sr.No.	Program Outcomes	Subjects in curriculum
3	PO3- **TECHNICAL KNOWLEDGE**	Research-II Environmental Architecture Project Building Energy Management I and II Tools for measuring sustainability Software Simulation Building Physics I Lighting Lab Advanced Technology and Design Lab
4	PO4- **PRACTICAL KNOWLEDGE**	Environmental Architecture Project Elective –III (Open Elective) Environmental Professional practice and Training Building Physics I
5	PO5- **SENSITISATION AND RESPONSIBILITY**	Environmental Design Studio II Environmental Architecture Project Natural Resource Management
6	PO6- **COMMUNICATION SKILLS**	Research II Elective I Elective II Elective III Environmental Design Studio-I, II, III Environmental Professional practice and Training
7	PO7- **SOCIAL RESPONSIBILITY**	Environmental Design Studio II Research II

Sr.No.	Electives	Tentative Subjects of Electives
01	Elective I [Sem-1]	1. Efficient Building Materials & Technologies 2. Carbon Footprint and Mapping 3. Global Trends in Sustainability and Outreach
02	Elective II [Sem-2]	1. Environmental Behavior 2. Indoor Environmental Quality 3. Post Occupancy Evaluation and Techniques
03	Elective III [Sem-4]	Open Elective-Choice Based-Interdisciplinary Elective

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 to focus on one or more of the topics as decided by the institute.

COURSE STRUCTURE

Semester I- M. Arch (Environmental Architecture)

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Th/ Week	St/ Week	Credits	SS	SV	Theory		Marks
									In Sem	End Sem	
2019EA101	Environmental Design Studio I	C1	10	2	8	10	-	400	Nil	Nil	**400**
2019EA102	Elective I	EL	3	2	1	3	100	Nil	Nil	Nil	**100**
2019EA103	Building Physics	C2	4	2	2	4	200	Nil	Nil	Nil	**200**
2019EA104	Environmental Law & Legislations	SP1	3	2	1	3	Nil	Nil	30	70	**100**
2019EA105	Natural Resource Management	SP2	3	2	1	3	Nil	Nil	30	70	**100**
2019EA106	Lighting Lab	L	2	1	1	2	100	Nil	Nil	Nil	**100**
			25	11	14	**25**					**1000**

Semester II- M. Arch (Environmental Architecture)

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Th/ Week	St/ Week	Credits	SS	SV	Theory		Marks
									In Sem	End Sem	
2019EA201	Environmental Design Studio II	C1	10	2	8	10	-	400	Nil	Nil	**400**
2019EA202	Elective II	EL	3	2	1	3	100	Nil	Nil	Nil	**100**
2019EA203	Tools for Measuring Sustainability	C2	4	2	2	4	200	Nil	Nil	Nil	**200**
2019EA204	Research I	SP1	3	2	1	3	Nil	Nil	30	70	**100**
2019EA205	Building Energy Management-I	SP2	3	2	1	3	Nil	Nil	30	70	**100**
2019EA206	Software Simulation Lab	L	2	1	1	2	100	Nil	Nil	Nil	**100**
			25	11	14	**25**					**1000**

Semester III - M. Arch (Environmental Architecture)

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Th/ Week	St/ Week	Credits	SS	SV	Theory		Marks
									In Sem	End Sem	
2019EA301	Environmental Design Studio III	C1	10	2	8	10	-	400	Nil	Nil	**400**
2019EA302	Research II	C2	3	2	1	3	100	Nil	Nil	Nil	**100**
2019EA303	Core subject to include credits of Practical Training **	C3	4	2	2	4	-	200	Nil	Nil	**200**
2019EA304	Sustainable Development & Environmental Management	SP1	3	2	1	3	Nil	Nil	30	70	**100**
2019EA305	Building Energy Management-II	SP2	3	2	1	3	Nil	Nil	30	70	**100**
2019EA306	Advanced Technology and Design Lab	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 Semesters, 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.

Semester IV - M. Arch (Environmental Architecture)

Course Code	Course Title	Course Type	Contact Periods (60 mins)	Teaching Scheme			Examination Scheme				
				Th/ Week	St/ Week	Credits	SS	SV	Theory		Marks
									In Sem	End Sem	
2019EA401	Environmental Architecture Project (Major)	C1	20	4	16	20	-	800	Nil	Nil	**800**
2019EA402	Elective III*	EL	5	1	4	5	200	Nil	Nil	Nil	**200**
			25	5	20	**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.

Semester I

COURSE TITLE: **ENVIRONMENTAL DESIGN STUDIO–I**				
Course Code **: 2019EA101**				
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**	

OBJECTIVE:
To understand and analyze, climate and its elements at both micro and macro level and design projects of varied scales with passive strategies.

COURSE CONTENTS:

Unit 1: ***Design Project 1: Urban Scale/ Campus Scale:*** Application of ambient level strategies mainly the Sun and Wind to a given design of urban/ campus /macro level. E.g. – Townships, SEZ, Educational campuses etc.

Unit 2: ***Design Project 2: Building Scale:*** Design of a small unit to respond to building level element and strategies like wall, roof, facade design etc.

SESSIONAL /TERM WORK:
Design outcome for both projects will be assessed as per the project briefs and after fulfillment of the required objectives and application of climate and building physics principals.

OUTCOME:
Students at the end of the semester should have learnt / understood
1. How to perceive & analyse climate
2. How to study & analyze elements of climate at micro as well as macro level
3. Understand the process of incorporating climate strategies in design of projects of varied scales
4. Application of elements of passive design in the different kinds of projects

RECOMMENDED READINGS

1. G.K.Brown and Mark DeKay ; *Sun,Wind and Light*, John Wiley and Sons, INC
2. O.H.Koenigsberger; *Manual of Tropical Housing & Building, University Press*
3. Arvind Krishnan: *Climate Responsive Architecture*
4. Bansal. N; *Passive building design,* London
5. Givoni; *Man, Climate and Architecture*

SUBJECT TITLE: **ELECTIVE–I**				
Subject Code **: 2019EA102**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional - SS	100	
Studio Periods per week	1	Viva/Oral - SV	Nil	
Total Contact Periods (60 min period) per week	**3**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**3**	**Total Marks**	**100**	

OBJECTIVE:
To understand theories, concerns and values in the areas with respect to one of the following as per student's inclination and to develop awareness towards the same in reference to Environmental Design.

COURSE CONTENTS:

Unit 1: 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 to focus on one or more of the following topics:

1. Efficient Building Materials & Technologies
2. Carbon Footprint and Mapping
3. Global Trends in Sustainability and Outreach

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

SESSIONAL/TERM WORK:

Assignment will be in the form of individual 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 an audio-visual presentation, report or any other means of presentation as per the subject requirement.

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 of environment.

RECOMMENDED READINGS

All books/ Journals/ Magazines/ unpublished/published research/websites related to the topic selected by the individual student and institute and based on the subject experts.

SUBJECT TITLE: **BUILDING PHYSICS**				
Subject Code **: 2019EA103**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional - SS	200	
Studio Periods per week	2	Viva/Oral - SV	Nil	
Total Contact Periods (60 min period) per week	**4**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**4**	**Total Marks**	**200**	

OBJECTIVE:

1. To study the various climate zones at Global and Indian context along with its various climatic parameters.

2. To understand and learn in depth building physics theory and principal's w.r.t. sun and wind.

3. To study various passive design strategies to be applied at site level, building level and component level.

4. To study thermal comfort principles and its application.

COURSE CONTENTS:

Unit 1: Climate Analysis

Earth-Sun Relationship, Global Climate, Elements of Climate, Climatic Zones in India, Analysis of macro & micro climate. Interpretation of climatic data through various tools like Climate Data, Sunpath, Psychometric Charts, Bioclimatic charts, Radiation Square etc.

Unit 2: Principles of Thermal Comfort and Design

Thermal quantities, Heat exchange in buildings, Balance point temperature and Periodic heat flow.

Unit 3: Vernacular and Contemporary Case Studies & Appraisal

Unit 4: Design Strategies (Outdoor and Indoor)

Modifications of Architectural elements for thermal comfort-orientation, Open spaces, built spaces, building envelope, fenestrations, shading devices, roofs, walls etc. Natural ventilation, Cross ventilation, stack ventilation etc.

Unit 5: Use of Environmental Instruments

Introduction to the use of environmental instruments like weather station/thermo-hygrometer / anemometer for weather/ thermal/ wind data recording and carrying out related studies/exercises.

SESSIONAL/TERM WORK:

Multiple individual exercises related with each subtopic as required to understand the concepts and theories taught.

OUTCOME:

Students at the end of the semester should have learnt / understood:

1. Analysis of climate and its application in design
2. Principles related to thermal comfort and technically be able to calculate the same.
3. learn from the traditional knowledge of designing climate responsive architecture and use the insights gained in contemporary contexts
4. Application of the climate strategies in design

RECOMMENDED READINGS

1. G.K.Brown and Mark DeKay ; *Sun,Wind and Light*, John Wiley and Sons, INC
2. O.H.Koenigsberger; *Manual of Tropical Housing & Building, University Press*
3. Arvind Krishnan: *Climate Responsive Architecture*
4. Bansal. N; *Passive building design*, London
5. Givoni; *Man, Climate and Architecture*

SUBJECT TITLE: **ENVIRONMENTAL LAW AND LEGISLATIONS**				
Subject Code **: 2019EA104**				
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**	

OBJECTIVE:
The objective is to introduce the students to various international developments, environmental laws and legislations in India and its current applicability to the society at large.

COURSE CONTENTS:
Unit 1: Public Health & Safety: Remedies under law of torts, law of crimes & other common law remedies.

Unit 2: The Constitution of India: Salient features, Fundamental Rights and Directive Principles of State Policy, Writ petitions, Public Interest Litigations.

Unit 3: Environmental laws and legislations: Water Act, 1974, Air Act, 1981, Environment Protection Act, 1986, Energy Conservation Act, 2001, Public Liability Insurance Act, 1991 and Biodiversity Act 2002.

Unit 4: Environmental Notifications and Rules: Costal Regulation Zones, Dahanu taluka Eco-Fragile Area, Environment Impact Assessment of Development Projects, Matheran Eco-Sensitive Zones, Bio-Medical Waste (M&H) Rules, 1998, Hazardous Waste (M&H) Rules, 1989, Municipal Solid Waste (M&H) Rules, 2000.

SESSIONAL/TERM WORK/ CONTINUOUS ASSESSMENT
Studies taken up by students individually and/or in groups will be presented and submitted along with compilation of study material in the form of reports/ notes/ assignments.

END OF TERM ASSESSMENT
The continuous assessment will be in the form of notes/ assignments, as stipulated above will be assessed internally with weightage of 30 marks. Theory examination based on the aforesaid course outline for this subject will be conducted for 70 marks.

OUTCOME:
Students at the end of the semester should have learnt / understood:
1. The current laws related to environment in the Indian context
2. To understand their application in the context of design and planning

Recommended Readings

1. Leela Krishnan; *Environmental Law in India*
2. Mehta M ; *Commentary on water and air pollution with environmental protection law*
3. Sarkar S; *Legal aspects of regulations in South Asia*
4. Chalifour N; *Land use law for sustainable development*
5. Birnie PW and Boyle; *International law and the Environment*
6. Saksena K.D ; *Environmental policies and programs in India*

SUBJECT TITLE: **NATURAL RESOURCE MANAGEMENT**				
Subject Code **: 2019EA105**				
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**	

OBJECTIVE:
The primary objective is to introduce the basics of Ecological and Environmental systems, its importance and interdependence on each other. The students should be able to understand the importance of environmental systems and its relation with human development. The course gives an overview of environmental sciences and the natural resources available for sustainable human life.

COURSE CONTENTS:

Unit 1: Ecology:
1.1 Concept of Ecosystem, Type of Ecosystems, Components of an ecosystem,
1.2 Earth Biomes & Climate Zones, linkages and the cyclic flow of materials and energy.
1.3 Biotic and abiotic components of an Ecosystem, Introduction to the concepts of Biodiversity
1.4 Introduction to the Natural resources such as soil, water, air and material flows (Carbon cycle, Oxygen cycle, Water Cycle etc).

Unit 2: Environment:
2.1 Overview of Environmental Sciences pertaining to the above, including assessments, mapping tools and methods etc. Human interventions and ecosystem disturbances, Impacts of human activities on natural resources and biodiversity, changing of the ecosystem cycles etc.
2.2 Local, regional and global impacts on the Environment. Introduction to Air, water, land pollution; introduction to wasteland creation & barren land formation, soil erosion at regional level; Introduction to global environmental issues like Climate Change, Desertification, Global Warming, Ozone Depletion, Acid Rain etc.

Unit 3: Impacts of Urbanization on Ecology and Environment.
3.1 Water management, waste and land management systems

SESSIONAL/TERM WORK/ CONTINUOUS ASSESSMENT

Assignment will be in the form of notes/ assignments covering all the topics mentioned above with suitable examples, sketches and supportive material.

END OF TERM ASSESSMENT
The continuous assessment will be in the form of notes/ assignments, as stipulated above will be assessed internally with weightage of 30 marks. Theory examination based on the aforesaid course outline for this subject will be conducted for 70 marks.

OUTCOME:
Students at the end of the semester should have learnt / understood
1. The concepts of ecology and the importance of ecosystem in context of environment
2. To understand the impact created on land, water and waste due to environmental degradation.

RECOMMENDED READINGS

1. Freeland ; *Changing Environment*,
2. Barbara Murck; *Environmental Science*
3. Benny Joseph, Dick Morris & Joanna; *Environmental Studies*
4. D.B.Murthy; *Environmental Awareness and Protection*
5. Frank Press; *EARTH*
6. Edward Kurmondy; *Concepts of ecology*
7. Cuggingham; *Environmental Science*

SUBJECT TITLE: **LIGHTING LAB**				
Subject Code **: 2019EA106**				
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**	

OBJECTIVE:

1. To introduce the students to the theories and principals of daylight and artificial lighting.
2. To study its impact on a built space and to design spaces for adequate lighting.
3. Teaching the testing and performance of lighting.

COURSE CONTENTS

Unit 1: Day lighting and Architecture

1.1 Principles of daylight, Photometric quantities, various daylight metrics, glare metrics, prediction techniques, measurement and analysis of daylight, design strategies.

1.2. Application and testing of daylight performance through simulation software and lab instruments like illumination meter, luminance camera etc.

Unit 2: Artificial Lighting

2.1 Need, Light sources and ballast systems, Luminaries and light distribution, lighting controls, building level controls and integration with daylight, energy conservation strategies etc.

2.2. Use of instruments to measure lighting levels and performance testing through simulation software.

Unit 3: Lighting Policies, Codes and Standards

3.1 Lighting and its impacts on health and environment.

3.2 Post Occupancy Evaluation and Audit Practices w.r.t. lighting.

3.3. Various standards and codes like National Building Codes, Energy Conservation Building Codes and Green Building Certification standards and systems.

SESSIONAL/TERM WORK

Studies taken up by students individually and/or in groups will be presented and submitted along with compilation of study material in the form of reports and assignments. Lab/field based studies are required to be done as part of the project assessment.

OUTCOME:

Students at the end of the semester should have learnt / understood

1. The principles of lighting and lighting design.
2. Understand the various codes, standards associated with lighting and its application in design.

RECOMMENDED READINGS

1. C Robbins; *Daylighting: Design and Analysis*
2. Christoph Reinhart*; Daylight Handbook 1 and 2*,
3. Helmut Koster; *Dynamic daylight Architecture*
4. Benjamin Evans; *Daylight in Architecture*
5. G.K.Brown and Mark DeKay; *Sun, Wind and Light*
6. Arvind Krishnan*; Climate Responsive Architecture*

Semester II

SUBJECT TITLE: **ENVIRONMENTAL DESIGN STUDIO–II**				
Subject Code **: 2019EA201**				
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**	

OBJECTIVE:
To develop creative skills, abilities and judgment in the design of built environment. The student should be able to have a whole building design approach with a clear focus on energy efficiency.

COURSE CONTENTS:
Unit 1: Design/Retrofitting of buildings/campuses for energy efficiency. Focus should be on buildings/campuses which are conventionally energy guzzlers.

SESSIONAL/TERM WORK / CONTINUOUS ASSESSMENT
Concept presentations, technical drawing portfolio and report to elaborate the design scheme as per the project brief at various stages of the design process.

OUTCOME:
Students at the end of the semester should have learnt / understood:
1. Design a built environment considering aspects of environment.
2. Understand strategies to be applied to design a built environment that has energy efficiency and energy conservation as a focus.
3. Understand issues related to retrofitting and provide solutions that fulfill holistic environmental design.

Recommended Readings
Case Studies and Other recommended reading based on the topic selected for the year and the project brief.

SUBJECT TITLE: **ELECTIVE - II**				
Subject Code **: 2019EA202**				
Teaching Scheme		**Examination Scheme**	**Marks**	
Theory Periods per week	2	Sessional	100	
Studio Periods per week	8	Viva/Oral	Nil	
Total Contact Periods (60 min period) per week	**10**	In-semester Examination	Nil	
		End-semester Examination	Nil	
Total Credits	**10**	**Total Marks**	**100**	

OBJECTIVE:
To understand theories, concerns and values in the areas with respect to one of the following as per student's inclination and to develop awareness towards the same in reference to Environmental Architecture.

COURSE CONTENTS:

Unit 1: 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 to focus on one or more of the following topics:

1. Environmental Behavior
2. Indoor Environmental Quality
3. Post Occupancy Evaluation and Techniques

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

SESSIONAL/TERM WORK:

Assignment will be in the form of individual 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 an audio-visual presentation and a report on the same.

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 of environment.

RECOMMENDED READINGS

All books/ Journals/ Magazines/ unpublished/published research/websites related to the topic selected by the individual student.

SUBJECT TITLE: **TOOLS FOR MEASURING SUSTAINABILITY**				
Subject Code **: 2019EA203**				
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**	

OBJECTIVE:
1. To introduce various tools and methods associated in practice for environmental architecture and planning.
2. To prepare students for new skills and trends in the field of sustainability and energy conservation.

COURSE CONTENTS:

Unit 1: To understand the various Green Building Rating Systems like LEED, GRIHA, IGBC etc and its allied applications and processes.

Unit 2: To understand the various Energy Conservation Building Codes and its application.

Unit 3: To understand Life Cycle Assessment as a tool and its assessment methods.

Unit 4: Any other tool or topic with deals with sustainability and its measurement/assessment

** This list is not exhaustive and further topics could be added if required over time.*

SESSIONAL/TERM WORK/CONTINUOUS ASSESSMENT

Multiple individual exercises related with each subtopic as taught in the module. Projects should be given to understand the concepts and theories taught and checking for the applicability of the same.

OUTCOME:
Students at the end of the semester should have learnt / understood:
1. Apply the various tools that have been developed for measuring sustainability
2. Prepare reports

RECOMMENDED READINGS

GRIHA; *Griha Manual, Vol 1 to 5*,TERI Publication
IGBC Manuals, CII Publication
LEED Manuals
ECBC Manual
ISO standards

SUBJECT TITLE: **RESEARCH - I**				
Subject Code **: 2019EA204**				
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**	

OBJECTIVE:

To introduce the various methods and process of research in order to understand its significance with emphasis on research in the domain of Environmental Architecture

COURSE CONTENTS:

Unit 1: Introduction to the types of research and the process of formulating a research project

Unit 2: Introduction to research design, sampling types and methods etc.

Unit 3: Introduction to various methods of research, their relative advantages and disadvantages and their applications

Unit 4: Introduction to methods of data collection, analysis and presentation

Unit 5: Introduction to technical writing and presenting a research paper

Unit 6: Development of research writing and presentation skills

SESSIONAL/TERM WORK/ CONTINUOUS ASSESSMENT

Assignment will be in the form of notes/ assignments covering all the topics mentioned above with suitable examples, sketches and supportive material.

End of Term Assessment
The continuous assessment will be in the form of notes/ assignments, as stipulated above will be assessed internally with weightage of 30 marks. Theory examination based on the aforesaid course outline for this subject will be conducted for 70 marks.

OUTCOME:
Students at the end of the semester should have learnt / understood:

RECOMMENDED READINGS

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: Wishwa Prakashan. 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

SUBJECT TITLE: **BUILDING ENERGY MANAGEMENT–I**				
Subject Code **: 2019EA205**				
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**	

OBJECTIVE:

1. To introduce the demand side of energy and its approach in designing of various building services.

2. Catering to the demand side management of these energy systems.

3. Looking at new low cooling technologies and industry ready technologies.

4. Looking at the allied building services through the frame of environmental consciousness and conservation.

COURSE CONTENTS:

Unit 1: Plumbing for Green Buildings
Pump types, factors affecting pump performance, efficient pump operation systems, flow control strategies. Energy conservation opportunities in pumping systems

Unit 2: Advanced and Energy Efficient HVAC Systems and Services
Air Cycle, Refrigerant cycle, Basics of Cooling load estimation. Types of systems to include unitary, central, CAV, VAC, VRF etc. air cooled, water cooled, and ducting design. Energy conservation measures and technologies.

Unit 3: Low Cooling and Heating technologies: Radiant Cooling/Heating systems, Evaporative cooling system, Direct indirect evaporative systems, structure cooling system etc should be introduced and students should be sensitized towards future trends in energy conservation through HVAC.

Unit 4 Energy Efficient Electrical Utilities
Electrical Energy basics, Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit.

Sessional/Term Work/ Continuous Assessment

Assignment will be in the form of notes/ assignments covering all the topics mentioned above with suitable examples, sketches and supportive material.

End of Term Assessment

The continuous assessment will be in the form of notes/ assignments, as stipulated above will be assessed internally with weightage of 30 marks. Theory examination based on the aforesaid course outline for this subject will be conducted for 70 marks.

OUTCOME:
Students at the end of the semester should have learnt / understood:

1. Demand side energy systems and their application in construction

2. Understand efficient plumbing systems
3. Understand energy efficient lighting and electrical systems

RECOMMENDED READINGS

1. Turner and Doty; *Energy Management Handbook.*
2. Martin Greenwald; *Residential energy systems and climate control technology.*
3. Jan Kreider; *Solar heating design*.
4. Hegger and Fuchsen;. *Energy Manual*

SUBJECT TITLE: **SOFTWARE SIMULATION LAB**				
Subject Code **: 2019EA206**				
Teaching Scheme		**Examination Scheme**	**Marks**	**Duration**
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**	

OBJECTIVE:

The objective is to provide hands-on training of various whole building performance modelling and simulation software like eQuest, Design Builder and IES. The software skills shall in turn be used for various whole building analysis and parameters. Also overall internet and cyber security will be introduced to the students as part of the curriculum.

COURSE CONTENTS:

Unit 1: Overview of Energy Simulation Software and Introduction: Hands-on experience of modeling in the software along with introductory parameters and their studies like: Climatic analysis, shadow analysis, material selection etc

Unit 2: Lighting: Calculations and inferences for day lighting and application of artificial lighting along with its analysis

Unit 3: Thermal Comfort: Calculations for thermal comfort of spaces and its associated parameters like heat gains-losses, temperature profiles, fabric gains-losses, ventilation etc

Unit 4: Add-on Software: Introduction and Hands-on with allied and compatible software like Radiance, PMV, Solar Tool etc

SESSIONAL/TERM WORK:
Studies taken up by students individually and/or in groups will be presented and submitted along with compilation of study material in the form of reports and assignments. Lab/field based studies are required to be done as part of the project assessment.

RECOMMENDED READINGS

1. Help Manuals and Tutorials
2. Video Tutorials