

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**M.ARCH. (ENVIRONNEMENTAL ARCHITECTURE)**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

- I. To provide students with additional knowledge and skills as an architect/ researcher/ teacher.
- II. To enable students to add value to the process of architectural design by incorporating depth in already existing fields of study relevant to architecture.
- III. To enable students to widen the scope of their professional abilities through additional fields of study that would enhance their knowledge in intellectual, creative, technical, social and environmental realms.
- IV. to enable students to take independent, informed and innovative decisions within the discipline of architecture.
- V. to enable students to contribute to larger society through their future career as architect/ researcher/ teacher.

**PROGRAMME OUTCOMES (POs):**

On successful completion of the programme,

1. Graduates will demonstrate an all round skill in design and research.
2. Graduates will be able to identify additional parameters/ issues within the context of architectural design and resolve them.
3. Graduate will be able to resolve architectural problems with due consideration to urban issues and environmental issues.
4. Graduates will be able to bring technical expertise in analysis and synthesis.
5. Graduates will be able to apply cutting edge methods/ tools/ approaches in the resolution of problems.
6. Graduates will be able to bring critical thinking in the consideration of any aspect of design.
7. Graduates will be able to identify problems or create design solutions in a holistic manner.
8. Graduates will be able to contribute further to society through their design/research/ teaching.

Programme Educational Objectives	Programme Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I	✓	✓	✓	✓	✓	✓	✓	
II	✓	✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓		✓	
IV	✓		✓				✓	✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	
YEAR 1	SEM 1	Energy, Environment and Sustainable Development			✓						
		Sustainable and green buildings				✓					
		Environmental Impact Assessment							✓		
		Smart Materials for Green Buildings		✓			✓				
		Urban Ecology and Environmental Planning									
		Environmental Architecture Design Studio I	✓		✓					✓	✓
	SEM 2	Environmental Disturbances, Pollution and Remedies							✓		
		Research Methodologies in Architecture	✓								
		Sustainable, Energy Efficient Building Materials and Technologies		✓		✓	✓				
		Elective I									
		Elective II									
Environmental Architecture Design Studio II		✓		✓					✓		
YEAR 2	SEM 3	Life Cycle Assessment of Buildings		✓		✓	✓				
		Environmental Laws and Management						✓			
		Elective III									
		Elective IV									
		Project Phase I- Dissertation	✓								
	Environmental Architecture Design Studio III	✓		✓					✓		
	SEM 4	Elective V									
		*Professional Training	✓								✓
		Project Phase II- Thesis	✓		✓					✓	✓

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**CURRICULA AND SYLLABI FOR I TO IV SEMESTERS**

**SEMESTER I**

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
<b>THEORY</b>								
1.	EA5101	Energy, Environment and Sustainable Development	HS	3	3	0	0	3
2.	EA5102	Smart Materials for Green Buildings	ES	3	3	0	0	3
3.	EA5103	Urban Ecology and Environmental Planning	HS	3	3	0	0	3
4.	EA5191	Sustainable and Green buildings	PC	3	3	0	0	3
5.	EA5192	Environmental Impact Assessment	PC	3	3	0	0	3
<b>STUDIO</b>								
6.	EA5111	Environmental Architecture Design Studio I	PC	10	0	0	10	5
<b>TOTAL</b>				<b>25</b>	<b>15</b>	<b>0</b>	<b>10</b>	<b>20</b>

**SEMESTER II**

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
<b>THEORY</b>								
1.	EA5201	Environmental Disturbances, Pollution and Remedies	HS	3	3	0	0	3
2.	EA5202	Sustainable, Energy Efficient Building Materials and Technologies	ES	3	3	0	0	3
3.	MH5251	Research Methodologies in Architecture	PC	3	3	0	0	3
4.		Professional Elective I	PE	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
<b>STUDIO</b>								
6.	EA5211	Environmental Architecture Design Studio II	PC	10	0	0	10	5
<b>TOTAL</b>				<b>25</b>	<b>15</b>	<b>0</b>	<b>10</b>	<b>20</b>

### SEMESTER III

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C	Pre-requisites	
<b>THEORY</b>										
1.	EA5301	Life Cycle Assessment of Buildings	PAEC	3	3	0	0	3	Pass in Environmental Architecture Design Studio I (Sem I)	
2.	EA5302	Environmental Laws and Management	HS	3	3	0	0	3		
3.		Professional Elective III	PE	3	3	0	0	3		
4.		Professional Elective IV	PE	3	3	0	0	3		
<b>STUDIO</b>										
5.	EA5311	Environmental Architecture Design Studio III	PC	10	0	0	10	5		
6.	EA5312	Project Phase I- Dissertation	PC	6	0	0	6	3		
<b>TOTAL</b>				<b>28</b>	<b>12</b>	<b>0</b>	<b>16</b>	<b>20</b>		

### SEMESTER IV

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C	Pre-requisites	
<b>THEORY</b>										
1.		Professional Elective V	PE	3	3	0	0	3	Pass in Environmental Architecture Design Studio II & III and Project Phase I: Dissertation	
<b>STUDIO</b>										
2.	EA5411	Professional Training*	PAEC	-	-	-	-	2		
3.	EA5412	Project Phase II- Thesis	PC	20	0	0	20	10		
<b>TOTAL</b>				<b>23</b>	<b>3</b>	<b>0</b>	<b>20</b>	<b>15</b>		

\* Professional Training of duration minimum 4 weeks full time or 8 weeks part time to be done in a firm related to the specialization during semester vacation.

**TOTAL NO. OF CREDITS : 75**

### PROFESSIONAL ELECTIVE ( PE)

#### ELECTIVE – I

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P /S	C
1	EA5001	Sustainability and Energy Conservation in Landscape Architecture	PE	3	3	0	0	3
3	EA5002	Thermal Comfort and Passive design	PE	3	3	0	0	3
2	RE5071	Spatial Information Systems	PE	3	3	0	0	3

**ELECTIVE – II**

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
1	EA5003	Renewable Energy Systems	PE	3	3	0	0	3
2	EA5004	Landscape Ecology and Planning	PE	3	3	0	0	3
3	EA5005	Environmental Management Systems and Auditing	PE	3	3	0	0	3

**ELECTIVE – III**

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
1	EA5006	Environmental Psychology	PE	3	3	0	0	3
2	EA5007	Carbon Foot Print and Measurement	PE	3	3	0	0	3
3	EA5008	Predictive Building Modeling Softwares and Passive Strategies	PE	3	3	0	0	3

**ELECTIVE – IV**

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
1	EA5009	Design of Energy Efficient and Healthy Buildings	PE	3	3	0	0	3
2	EA5010	Water Conservation Practices in Buildings	PE	3	3	0	0	3
3	EA5011	Environment, Development and Disaster Management	PE	3	3	0	0	3

**ELECTIVE – V**

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P/S	C
1	EA5012	Natural Resource Management	PE	3	3	0	0	3
2	EA5013	Energy, Climate Change and Urban Development	PE	3	3	0	0	3
3	EA5014	Theory of Environmental Planning	PE	3	3	0	0	3

### HUMANITIES SCIENCE (HS)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P /S	C
1	EA5101	Energy, Environment and Sustainable Development	HS	3	3	0	0	3
2	EA5103	Urban Ecology and Environmental Planning	HS	3	3	0	0	3
3	EA5201	Environmental Disturbances, Pollution and Remedies	HS	3	3	0	0	3
4	EA5302	Environmental Laws and Management	HS	3	3	0	0	3

### ENGINEERING SCIENCE (ES)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P /S	C
1	EA5102	Smart Materials for Green Buildings	ES	3	3	0	0	3
2	EA5202	Sustainable, Energy Efficient Building Materials and Technologies	ES	3	3	0	0	3

### PROFESSIONAL CORE (PC)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P /S	C
4	EA5111	Environmental Architecture Design Studio I	PC	10	0	0	10	5
1	EA5191	Sustainable and green buildings	PC	3	3	0	0	3
2	EA5192	Environmental Impact Assessment	PC	3	3	0	0	3
5	EA5211	Environmental Architecture Design Studio II	PC	10	0	0	10	5
6	EA5311	Environmental Architecture Design Studio III	PC	10	0	0	10	5
7	EA5312	Project Phase I - Dissertation	PC	6	0	0	6	3
8	EA5412	Project Phase II - Thesis	PC	20	0	0	20	10
3	MH5251	Research Methodologies in Architecture	PC	3	3	0	0	3

### PROFESSIONAL ABILITY ENHANCEABILITY COURSE ( PAEC)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P /S	C
1	EA5301	Life Cycle Assessment of Buildings	PAEC	3	3	0	0	3
2	EA5411	*Professional Training	PAEC	-	-	-	-	2

<b>EA5101</b>	<b>ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To sensitize the students to the linkages/relationship between energy, lifestyle, food chain and sustainability. To facilitate understanding of appropriate technologies aiding sustainability.

**UNIT I ENERGY SOURCES 08**

Introduction to nexus between Energy, Environment and Sustainable Development; Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes; photosynthesis; food chains, classification of energy sources, quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.

**UNIT II ECOLOGICAL PRINCIPLES 08**

Ecological principles, concept of ecosystems, ecosystem theories, energy resources and their inter-linkages, energy flow, the impacts of human activities on energy flow in major man-made ecosystems- agricultural, industrial and urban ecosystems.

**UNIT III ENERGY SYSTEMS AND ENVIRONMENT 09**

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies (both renewable and non renewable); primary and secondary pollutants; consequence of pollution and population growth; air, water, soil, thermal, noise pollution -cause and effect; pollution control methods, sources and impacts; environmental laws on pollution control. Kyoto Protocol; Conference of Parties (COP); Clean Development Mechanism , Reducing Emissions from Deforestation and Degradation.

**UNIT IV GREEN INNOVATION & SUSTAINABILITY 10**

Criteria for choosing appropriate green energy technologies, emerging trends process/product innovation-, technological / environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity, eco-restoration/ phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other appropriate green technologies.

**UNIT V GREEN ENERGY AND SUSTAINABLE DEVELOPMENT 10**

The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development; global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability - United Nations Framework Convention on Climate Change (UNFCCC).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students gain an understanding of the linkages between the ecosystem, food web and sustainability.
- The students are also to understand the renewable and non-renewable sources of energies and its effects on the environment.

**REFERENCES:**

1. E H Thorndike, Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
2. Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waub, Jean-Philippe; Zaccour, Georges (Eds.), 2005, XVIII, 282 p. ISBN: 978-0 387-25351-0
3. Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, 2000.
4. Energy and the Environment, 2nd Edition, John Wiley, 2006, ISBN:9780471172482; Authors: Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., Publisher: Wiley, Location: New York, 2006.
5. R Wilson & W J Jones, Energy, Ecology and the Environment, Academic Press Inc.

<b>EA5102</b>	<b>SMART MATERIALS FOR GREEN BUILDING</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To expose the students to the applications of smart materials and nanotechnology in the building industry to achieve sustainability.

**UNIT I INTRODUCTION 08**

Introduction to Intelligent buildings - Basic concepts – Intelligent building automation - Building automation system - Cost analysis of intelligent buildings – Introduction to smart materials, Sensing systems.

**UNIT II ACTUATOR TECHNIQUES 10**

Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electrorheological Fluids– Electromagnetic actuation – Role of actuators and Actuator Materials.

**UNIT III STUDY OF ADVANCED BUILDING MATERIALS 07**

Aluminum, glass, fabric, various types of finishes & treatments, Construction chemicals – sealants, engineering grouts, mortars , admixtures and adhesives

**UNIT IV BUILDING SYSTEMS 10**

Lighting – day lighting; ventilation – natural ventilation; indoor air quality; heating/cooling - geothermal; passive and active systems for energy production and conservation; water conservation – grey water reuse, water saving plumbing fixtures

**UNIT V NANOMATERIALS AND POLYMERS 10**

Green materials, including biomaterials, biopolymers, bioplastics, and composites Nanotech Materials for Sustainable Construction -Structural Plastics And Composites- Polymer Membranes- Coatings-Adhesives, self healing concrete, bending concrete, Self compacting concrete, Non - Weathering Materials-Flooring And Facade Materials- Glazed Brick, Photo Catalytic Cement, Acid Etched Copper And Composite Fiber. Metals-Metals And Special Alloys Of Steel-Water Jet Cut Stainless Steel, Mill Slab Steel

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students have an understanding of smart materials and new technology in the building industry, which aids sustainability.

**REFERENCES:**

1. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.
2. Srinivasan ,A.V and Michael McFarland . D, “Smart Structures – Analysis and Design, Cambridge University Press, 2001
3. William Mayers, Bio Design, MOMA, New york, 2014

<b>EA5103</b>	<b>URBAN ECOLOGY AND ENVIRONMENTAL PLANNING</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- The aim of this course is to make the students understand the basic concepts of ecology, Urban Ecology, natural systems and environment.
- To make the students understand the importance of Environmental planning for sustainability, resource planning and allocation and protection of natural resources and their use for sustainability. Also to prepare plans considering preservation, rehabilitation and environmental policies.



**UNIT I INTRODUCTION 09**

Introduction to Urban Eco-systems. Basis of environmental science. Ecology, Ecosystems, Habitat, structure of the ecosystem, major ecosystems, productivity of ecosystems adaptation. Flow of energy, food chain, ecological pyramids, predation, regulatory forces. Components of natural and built environment

**UNIT II CONCEPTS AND APPROACHES TO ECOLOGICAL PLANNING 09**

Different types of life supporting services provided by the nature. General concept of urban ecological planning. Impact of urbanization and industrialization on nature. Resiliency and Biodiversity, resources planning and climate resilient urban development.

**UNIT III HUMAN INFLUENCE ON ECO- SYSTEM 09**

Examination of critical issues underlying the current and future environmental problems. Human impact on environment. Modification of natural environment – Current conditions of natural resources like land, water, air. Over exploitation of natural resources, agriculture, fishing, mineral resources, energy resource, forest wealth etc.

**UNIT IV EFFECTS OF GROWING POPULATION ON ECO-SYSTEMS 10**

Population and pollution, Overcrowding, congestions, hygiene and health problems. Sanitation, water supply, solid and fluid waste generation and disposal problem, changing climate of the cities-urban heat island, urban flood, etc. energy and human settlement. Ecological Land Planning: Preservation and protection of ecologically sensitive areas, Rehabilitation of degraded sites, Development of sites/ land in accordance to their environmental properties.

**UNIT V GLOBAL ISSUES ON MODERN CITIES 08**

Global environmental problems : Global Warming, Ozone Layer Depletion, oceans, fresh water, trans boundary air pollution, biological diversity, Carbon Rating. International treaties, Land pollution, Overview of Government of India's policies, United Nations contribution to address these issues.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students are sensitized on the need for natural resource management, and sustainable lifestyles
- Students appreciate the value of ecosystem and the need and methods for conserving the same.
- Students understand how pollution and hazards can be mitigated..

**REFERENCES:**

1. D. D. Khanna, Sustainable development: environmental security, disarmament, and development interface in South Asia, Macmillan India, 1997
2. Francisco A. Comín, Ecological Restoration: A Global Challenge, Cambridge University Press, 2010.
3. John M. Marzluff, Urban Ecology: An International Perspective on the Interaction Between Humans and Nature, Springer, 2008.
4. Marina Alberti, Advances in Urban Ecology: Integrating Humans and Ecological Processes in Urban Ecosystems, Springer, 2007
5. P. D. Sharma, Ecology And Environment, Rastogi Publications, 2009
6. Saligram Bhatt, Environment Protection and Sustainable Development, APH Publishing, 2004
7. Tony Fry, Design Futuring: Sustainability, Ethics and New Practice, Berg, 2009 - Architecture

EA5191

**SUSTAINABLE AND GREEN BUILDINGS**

L	T	P/S	C
3	0	0	3

**OBJECTIVES:**

- To sensitize the students to the various aspects of sustainable and green building design in the context of global warming and climate change and to address the very process and tools of design to enable architecture that is environmentally friendly and sustainable.

**UNIT I INTRODUCTION 06**

Attitudes to architecture: a historical perspective- General premises and strategies for sustainable and green design- objectives and basis- Eco-mimicry as a design tool based on ecosystem analogy- theoretical basis for a sustainable and eco friendly design.

**UNIT II ECO HOUSE 12**

The form of the house: the building as an analogy- design from first principles: conserving energy; working with climate: passive solar design; minimizing new resources; respect for users; respect for site and holism- photovoltaics and solar hot water systems; water usage; small scale wind systems and hydro power; Case studies- design of eco houses: context specific.

**UNIT III ENVIRONMENTAL IMPACT OF BUILDING MATERIALS 09**

Measuring the impact of building materials- calculating embodied energy- recycling and embodied energy- processing and embodied energy- time and embodied energy- embodied energy of different building materials- low energy building and masonry materials- life cycle analysis- Case studies and analysis.

**UNIT IV GREEN CONSTRUCTION AND ENVIRONMENTAL QUALITY 12**

Sustainable architecture and Green Building: definition- Green building Evaluation Systems; LEED Certification and GRIHA; Green Globe Certification; Case studies which look at the environmental approach- renewable energy- controlling the water cycle- impact of materials on the environment – optimizing construction- site management- environmental management of buildings.

**UNIT V SUSTAINABLE AND GREEN BUILDING DESIGN CASE STUDIES 06**

Instrument and natural case studies to investigate and apply various studio exercises on Green Building Design.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students gain an understanding of the various aspects of sustainable and green building design.
- The students are able to comprehend the Green Building rating system.

**REFERENCES:**

1. Brenda and Robert Vale; Green Architecture- Design for a Sustainable Future; Thames and Hudson; 1996
3. Catherine Slessor; Sustainable Architecture and High Technology- Eco Tech; Thames and Hudson; 1997
2. Daniel Vallero and Chris Brasier; Sustainable Design- The science of sustainability and Green Engineering; Wiley; 2008
4. Dominique Gauzin- Muller; Sustainable architecture and Urbanism; Birkhauser; 2002.
5. Ken Yeang; Eco design - A Manual for Ecological design, Wiley- Academy; 2006
6. Sue Roaf et all; Ecohouse: A design Guide; Elsevier Architectural Press; 2007
7. Thomas E Glavinich; Green Building Construction; Wiley; 2008

**OBJECTIVES:**

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.

**UNIT I INTRODUCTION****07**

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.-EIA process- screening – scoping - setting – analysis – mitigation

**UNIT II COMPONENTS AND METHODS****10**

Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation. EIA methods in other countries.

**UNIT III IMPACT ON SOCIO-ECONOMIC SYSTEMS****08**

Definition of social impact assessment. Social impact assessment model and the planning process. Rationale and measurement for SIA variables. Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition - neighborhood and community impacts. Selecting, testing and understanding significant social impacts. Mitigation and enhancement in social assessment. Environmental costing of projects.

**UNIT IV ENVIRONMENTAL MANAGEMENT PLAN****10**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment.

**UNIT V SECTORAL EIA****10**

EIA related to the following sectors - Infrastructure – construction and housing Mining – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power, Hill area Development and CRZ.-EIA for coastal projects.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students gain an understanding about the significance of environmental impact assessment.
- The students can develop the skills to prepare environmental management plan.

**REFERENCES:**

- Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996.
- Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
- Nick Harvey, Beverley Clarke, Environmental Impact Assessment: Procedures and Practices, Oxford University Press, USA, 2012.
- Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.
- World Bank –Source book on EIA.

<b>EA5111</b>	<b>ENVIRONMENTAL ARCHITECTURE DESIGN STUDIO I</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>10</b>	<b>5</b>

**OBJECTIVES:**

Design of small built-up spaces by taking into consideration of various climatic and environmental design principles.

Design focus:

The building shall be designed to minimize energy use and operating costs without affecting the functionality, accommodation standards, occupant health, safety or comfort. Quantification of the results should be based on theoretical and mathematical principles. Manual quantification is essential for the following aspects.

1. Microclimatic analysis - Bio climatic and psychometric analysis of comfort zone (based on eco charts, and graphs)
2. Whole building Analysis for Energy performance, (based on heat gain and heat loss calculations etc.,)
3. Indoor thermal comfort, (Solar Analysis for optimizing Orientation, Shading and shading analysis, TSI, Thermal neutrality, time lag, Decrement factor etc.,)
4. Passive energy conservation measures (performance evaluation of passive strategies like, stack effect, trombe wall, radiant cooling system etc.,) .
5. Indoor lighting levels (based on Day light factor method, lumen method etc.,)
6. Air quality analysis (IAQ )
7. Analysis on Life cycle assessment/ Embodied energy and carbon foot print
8. Site contour analysis, Net perforated area, annual run off calculations.

The project submission should be submitted in the form of Drawings, calculations, models and reports.

**TOTAL: 150 PERIODS**

**OUTCOMES:**

- An ability to design a building with all the due considerations of sustainable planning and design principles.
- Ability to technically quantify the sustainable design concepts

**REFERENCES:**

1. IS:3362-1977, Indian Standard, code of practice For Ventilation Of Residential Building
2. Rea, M., 2000. *The Lighting Handbook*. 9th ed. Illuminating Engineering Society of North America,
3. SP 41 (1987) Handbook On Functional Requirements Of Non-industrial Buildings(Lighting And Ventilation), BIS
4. Steven V szokolay, 2008, Introduction to architectural science. Taylor & Francis group,UK

<b>EA5201</b>	<b>ENVIRONMENTAL DISTURBANCES, POLLUTION AND REMEDIES</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To provide knowledge related to the broad field of environmental disturbances, and tools that can be used in various remedies.

**UNIT I INTRODUCTION 09**  
 Definition and classification of environmental disturbances – physical, chemical, biological, aesthetic, socio economic factors, natural and man-made, Environmental disturbances at local and global level.

**UNIT II UNIT, MEASUREMENTS AND STANDARDS 09**  
 Air, Water, Solid waste, and Noise pollution – Basic parameters, units, sampling, legal standards, measurements and limits. Environmental planning standards.

**UNIT III REMEDIAL TECHNIQUES AND DISTURBANCE- BUILT ENVIRONMENT 09**  
 Reducing the impact of pollution through chemical, biological & physical remediation techniques. Energy & emission generation from building materials throughout its life cycle analysis. Energy balance of human and built environment -Thermal Environment, Aqueous environment. Environmental impact of building materials, Eco friendly materials, their composition, production and recycling, physical properties etc .Embodied energy /Operational energy of materials like steel, fly ash bricks, gypsum, eco-boards etc. Lifecycle assessment of materials.

**UNIT IV POLLUTION AND REMEDIES 09**  
 Structure and composition of Atmosphere –Definition ,Scope and Scales of Air ,Water and Land Pollution –Sources and classification of air pollutants and their effect on human health .Control and preventive measures –Contaminated soil characterization and containment – Sources of water pollution and treatment methods . ICZM and sustainable Development .

**UNIT V ECOLOGICALLY DISTURBED SITES AND RESTORATION 09**  
 Ecologically sensitive areas -Restoration ecology -Disturbances caused by built structures – from ‘cradle to grave’ –Remedial measures applicable-Fragmentation- Landscape Ecology.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students are to understand the factors leading to environmental disturbance and the correctives and preventives to avoid the same.

**REFERENCES:**

1. David Lee Smith, Environmental Issues for Architecture, Wiley; 1 edition, 2011.
2. Larry W Canter, Environmental Impact Assessment (Hard cover), McGraw-Hill Education, 1996
3. Mritunjoy Sengupta, Environmental Impacts of Mining Monitoring, Restoration, and Control, CRC Press; 1 edition, 1993
4. P.K. Gupta , Methods in Environmental Analysis, Agro bios, 2011
5. Scott Drake, The Elements of Architecture - Principles of Environmental Performance in Buildings, 2009, Routledge, 2009.

<b>EA5202</b>	<b>SUSTAINABLE, ENERGY EFFICIENT BUILDING MATERIALS AND TECHNOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To Understand the concept of Energy efficiency
- An insight into various Energy Efficient Materials and Sustainable Construction Technology

**UNIT I INTRODUCTION ON ENERGY EFFICIENCY 09**  
 Energy Efficiency – Energy Conservation – Recourse Consumption – Introduction – Distribution of Energy use in India – Factors affecting the Energy use in Buildings – Pre Building Stage, Construction Stage & Post Occupancy stages – Concept of Embodied Energy – Energy needs in Production of Materials – Transportation Energy – Concept of light footprint on Environment

**UNIT II RECYCLABLE AND RENEWABLE MATERIALS 09**

Concept of Recyclable materials – Sustainable Building Materials – Life Cycle Design of Materials – Biodegradable & Non-Biodegradable Materials – Green rating and Building Materials – LEED and other Green rating Systems – Concept of Resource rescue, Recycled content, Regional materials, Rapidly renewable materials – Fly ash bricks, Cement – Recycled Steel, Bamboo based products

**UNIT III PASSIVE DESIGN IN MATERIALS 09**

Passive Design and Material Choice – Traditional Building Materials – Importance of envelope material in internal temperature control – Specification for walls and roofs in different climate – Material and Humidity Control

**UNIT IV SUSTAINABLE CONSTRUCTION 09**

Design issues relating to sustainable development including site and ecology, community and culture, health, materials, energy, and water- Domestic and Community buildings using self help techniques of construction; adaptation, repair and management - portable architecture.

**UNIT V ENERGY EFFICIENT TECHNOLOGIES 09**

Energy Efficient Construction Technology – Filler Slab – Rat trap Bond – Technologies developed by CBRI – Traditional Building Construction Technologies – Introduction to other Technological interventions to save Energy – Intelligent Buildings – Energy Conservation through Technological intervention – Saving Energy used for lighting by design innovation – Case studies

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- An understanding on sustainability as applicable to architecture and planning.
- Ability to critically analyse buildings with respect to sustainability.

**REFERENCES:**

1. Bansal Naveendra K., Hauser Gerd and Minke Gernot, "Passive Buildings Designs : Handbook of Natural Climatic Control", Elsevier Science, Amsterdam 1997
2. Givonji B., "Man, Climate and Architecture", Elsevier, Amsterdam, 1986
3. Koenigsberger O.H, T.G. Inger Soll, "Manual of tropical Housing and Building" Longman Group United Kingdom, 2012
4. Watson Donald, 'Climatic Design: Energy Efficient Building Principles & Practices", Mc Graw Hill Book company, New York, 1993

<b>MH5251</b>	<b>RESEARCH METHODOLOGIES IN ARCHITECTURE</b>	<b>L T P/S C</b>
		<b>3 0 0 3</b>

**OBJECTIVES**

- To introduce the students to the importance of critical inquiry as a way of gaining knowledge and adding to it through research.
- To expose the students to the various forms of research and research methodologies/ processes.
- To engage this understanding in the specific field of architectural research.

**UNIT I INTRODUCTION 9**

Basic research issues and concepts- orientation to research process- types of research: historical, qualitative, co-relational, experimental, simulation and modeling, logical argumentation, case study and mixed methods- illustration using research samples

- UNIT II RESEARCH PROCESS 9**  
 Elements of Research process: finding a topic- writing an introduction- stating a purpose of study identifying key research questions and hypotheses- reviewing literature- using theory- defining, delimiting and stating the significance of the study, advanced methods and procedures for data collection and analysis- illustration using research samples
- UNIT III RESEARCHING AND DATA COLLECTION 9**  
 Library and archives- Internet: New information and the role of internet; finding and evaluating sources- misuse- test for reliability- ethics  
 Methods of data collection- From primary sources: observation and recording, interviews structured and unstructured, questionnaire, open ended and close ended questions and the advantages, sampling- Problems encountered in collecting data from secondary sources.
- UNIT IV REPORT WRITING 6**  
 Research writing in general- Components: referencing- writing the bibliography - developing the outline - presentation; etc.
- UNIT V CASE STUDIES 12**  
 Case studies in the relevant discipline illustrating how good research can be used from project inception to completion- review of research publications.

**TOTAL: 45 PERIODS**

#### **OUTCOMES**

- The student will develop the skill to identify, decipher and interpret issues relating to architecture based on research enquiry methods.
- The student will gain knowledge of different methods of conducting research and research writing.

#### **REFERENCES**

1. Iain Borden and Kaaterina Ruedi Ray ; The Dissertation: An Architecture Student's Handbook; Architectural Press; 2006
2. JA Smith, P Flowers, M Larkin -Interpretative Phenomenological Analysis: Theory, Method and Research (English) FIR Edition- Sage Publication -2009.
3. John W Creswell; Research design: Qualitative, Quantitative and Mixed Methods Approaches; Sage Publications; 2011.
4. Linda Groat and David Wang; Architectural Research Methods – 2<sup>nd</sup> edition ‘,John Wiley & Sons Inc,Hoboken,New Jersey, US , 2013.
5. Ranjith Kumar; Research Methodology- A step by step guide for beginners-3<sup>rd</sup> Edition ; Sage Publications;2011
6. Wayne C Booth; Joseph M Williams; Gregory G. Colomb; ‘The Craft of Research’ , 3<sup>rd</sup> Edition; Chicago guides to writing, editing and publishing;2008

**OBJECTIVES:**

- Detailed theoretical study of Global, Macro and Micro level Climate – Elements of climate and its qualification – Earth energy balance – Climatic data and its interpretation – Energy balance of human and built Environment – Thermal Environment – Adaptive model of thermal comfort and its application to sustainable design of building – Design of any type of building – hotel / commercial buildings, etc. – with the above principles.

**The detailed scope of the design project is not limited to the following****Whole building Analysis for Energy performance, Climatic Comfort & ECBC Compliance**

1. Solar Analysis for optimizing Orientation, Shading and glazing areas
2. Detailed whole building thermal / Energy Simulation to achieve thermal comfort indoors through detailed analysis.
3. GRIHA/LEED related analysis and further bio climatic considerations:

**Building Analysis for Day lighting and artificial Lighting**

1. Day lighting simulation for optimizing natural lighting
2. Luminance Analysis

**Natural ventilation and Indoor air quality**

1. CFD analysis for exterior and interior wind movements (Comparison with bio-climatic chart)
2. Indoor air quality and air change analysis

**Site Planning & Water Management**

1. Design and recommendation for Erosion control & sedimentation control on site.
2. Assist on Low water Usage, Rainwater Harvesting, wastewater recycling and construction waste usage and other waste management strategies
3. Transportation Management Strategies
4. Embodied energy calculations using online simulation tools
5. Carbon foot print analysis using online simulation tools

The project submission should be in the form of drawings, models and reports.

**TOTAL: 150 PERIODS**

**OUTCOMES:**

- An ability to design a building or a group of buildings with all the due considerations of sustainable planning and design principles.
- Ability to use energy simulation tools and its result analysis
- To balance human needs with environmental concerns in architectural design.

**REFERENCES:**

1. Givoni Baruch, "Passive and Low Energy Cooling of Buildings", Van Nostrand Reinhold, New York, 1994
2. **Steven V szokolay**, 2008, *Introduction to architectural science*. Taylor & Francis group, UK
3. <https://www.designbuilder.co.uk>
4. <https://www.iesve.com/>



**OBJECTIVES:**

- To enable an understanding of life-cycle analysis as a means to achieving sustainable buildings and the various tools to assess the same

**UNIT I INTRODUCTION AND TERMINOLOGY 08**

History of LCA, Aspects of LCA, variants of LCA, Life cycle stages, end of life, Functional unit, System boundary, Life Cycle Inventory (LCI) data base, Life Cycle Management (LCM), Life Cycle Energy Analysis (LCEA), Carbon Accounting.

**UNIT II LIFE CYCLE ASSESSMENT IN BUILDING INDUSTRY 07**

Material level, Product Level, Building level, Industry level, LCA and Design process, Pre-design, Schematic Design and Design Development Stage. LCA process and impact categories: Inventory Analysis, Impact assessment, interpretation, Different impact categories like Global Warming Potential (GWP), Acidification Potential (AP), Eutrophication Potential (EP), Smog Formation Potential, Fossil fuel and Ozone Depletion Potential.

**UNIT III DIFFERENT TOOLS FOR LCA 12**

Configuration of a tool, Classification of tools, Impact estimator and eco-calculator, Building for Economic and Environmental Sustainability (BEES), International LCA Tools, Related tools, Green footsteps & eco-friendly applications. Guidelines to integrate: LCA with design and evaluation, Different Scenarios of use of LCA, Sustainability targets, Selection of a LCA tools, LCIA

**09****UNIT IV GREEN BUILDING MATERIALS SELECTION**

Figure of Merit (FOM), Parameter selection for FOM, Selection based on FOM, Building into components-three phase building breaking down a materials, Criteria for material selection

**UNIT V LIFE CYCLE COSTING (LCC) TOOL 09**

Component characteristics of an element group, Input for energy Calculation, LCC calculations conduct of LCI and LCC calculations, Slective Assessment, Normalization and Weighing Factors LCA and LCC for different materials. Case studies- Two and Three variants of a house, office building, retrofitting buildings

**TOTAL: 45 PERIODS****OUTCOMES:**

- Understand all aspects of Life Cycle analysis of a building.
- To be able to analyse building Life Cycle with respect to sustainability

**REFERENCES:**

- A. Kapur and T.E. Graedel: Industrial Ecology. Encyclopedia of Energy, Volume 3, 2004
- Environmental life cycle analysis by David Ciambone, CRC-Press 1997
- Life-cycle analysis of energy systems from methodology to applications, by Bent Sorensen, Published by Royal Society of Chemistry, June 2011
- Lifecycle Assessment: Principles and Practice Chapter 1
- R. A. Frosch and N. E. Gallopoulos: Strategies for Manufacturing, Scientific American 261 (3), 144-152 1989

<b>EA5302</b>	<b>ENVIRONMENTAL LAWS AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- An Understanding of various Environmental Laws and Protection
- To expose the students to the concepts of Environmental Ecology, Accounting and Management

**UNIT I ENVIRONMENTAL LAW AND POLICY 09**

Constitutional Provisions for Environmental Protection: Specific Provisions for Environmental Protection in the Constitution of India, Provisions in the Directive Principles of State Policy - Environmental Acts, Rules and Notifications - Water (Prevention & Control of Pollution) Act - Water (Prevention & Control of Pollution) Cess Act - Air (Prevention & Control of Pollution) Act and the corresponding Rules- Environment (Protection) Act and Rule - Hazardous Waste (Management & Handling) Rules - Manufacture, Storage and Import of Hazardous Chemicals Rules - Public Liability Insurance Act and Rule. International Law on Environmental Protection.

**UNIT II INDUSTRIAL ECOLOGY 09**

Definitions- Fundamentals of Ecology- Metaphor - Food Webs and Industrial Eco Parks- Generation and Evaluation of Alternatives-Decision Methods-Life Cycle Assessment (LCA); Components - Goals - Definition and Scope - Industrial Metabolism - Anthropogenic Vs Natural Fluxes of Toxic Heavy Metals-Industrial Law in Environmental Protection- Mitigation and Environmental Management Plan

**UNIT III ENVIRONMENTAL PLANNING AND DECISION MAKING 09**

Environmental Concepts – Sustainability and Environmental Carrying Capacity - Strategies in Land use, Transportation, Infrastructure Planning and Management - Generation and Evaluation of Alternatives -Decision Methods-Mitigation and Environmental Management Plan - Public Participation in the Process of Environmental Decision Making Process

**UNIT IV INTRODUCTION TO ENVIRONMENTAL ACCOUNTING 09**

Defining Environmental Costs - Managing Environmental Costs - Identifying Environmental Costs - Controlling Environmental Costs (Waste and Effluent Disposal- Water Consumption - Energy - Transport and Travel Consumables and Raw Materials)- Accounting for Environmental Costs – Environmental Audit- Input/Outflow Analysis.

**UNIT V ENVIRONMENTAL MANAGEMENT 09**

Environmental Protection Act 1986-Coastal Zone Regulations, Hill Area Conservation, Forest Conservation Act- Components of Environment – Classification of Environmental Resources - Purpose and Objectives in Environmental Protection, and Management – Institutional and Legal Support in management of the Environment-Environmental Policies, and Protocols-Global Environmental Initiatives- Environmental Indicators - Concepts and Measures in Environmental Standards - Environmental Management Options

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand Environmental laws in the Indian Context.
- Understand specific Environmental laws in special areas such a hilly areas, coastal areas etc.

**REFERENCES:**

1. Christian Ndubisi Madu, 'Environmental Planning And Management', Imperial College Press Business & Economics, 2007.
2. John Randolph, 'Environmental Land Use Planning and Management', Island Press, Architecture, 2004.
3. Narasimha Murthy D.B., 'Environmental Planning and Management' Deep and Deep Publications, Environmental policy, 2005.

4. P. Leelakrishnan , Environmental Law in India, Butterworths Wadhwa; 3rd edition, 2008
5. Trivedy R. K- Handbook of Environmental Laws, Guidelines, Compliance & Standards, Vol. 1 & 2 Environ – Media karad, India, 2010.

**EA5311 ENVIRONMENTAL ARCHITECTURE DESIGN STUDIO III**      **L T P/S C**  
**0 0 10 5**

**OBJECTIVES:**

Designing eco house, green roofs and walls, building with environmentally friendly technologies, sustainable landscape design, green cities. Conserving traditional buildings for sustainability. Designing to mitigate climate change. Building design through simulation. Design through biological and ecological principles.

The project submission should be in the form of drawings, models and reports.

**TOTAL: 150 PERIODS**

**OUTCOMES:**

- Design buildings which are ecologically sensitive considering all traditional and contemporary principles and practices of sustainability.

**EA5312 PROJECT PHASE I - DISSERTATION**      **L T P/S C**  
**0 0 6 3**

**OBJECTIVES:**

- To expose the students to the various thrust areas in architecture.
- To inculcate the spirit of research in architecture by providing opportunities to read on various issues.
- To expose the students to the finer details of technical writing.
- To provide a platform for a prelude to the ‘Design Thesis’

Dissertation is best expressed as ‘Design in text’. It offers an opportunity to look at the research component in architecture in various thrust areas such as history, theory, design and other value based aspects through texts. Students are encouraged to choose any topic of their interest. This may range from analyzing and a critique of the works of an architect, ideologies and philosophies of architects that get transformed spatially, history, typological architecture, sustainability issues and so on the Dissertation must comprise of an aim, the objectives, the scope and limitations of their dissertation, hypothesis (if any), methodology followed by extensive review of literature through references and documentation. The analysis of the work must be substantiated either empirically or through extensive arguments.

A dissertation could also be a Thesis preparation course and gives the student scope for independent study and opportunity to explore specific area of interest which will form the basis of his/ her design thesis project in the next semester. The topic will have to be approved at the start of the semester and reviewed periodically to a jury at the end of the semester.

**TOTAL: 90 PERIODS**

**OUTCOMES:**

- A Dissertation book which is based on accepted norms of technical writing.
- An understanding leading to formation of thesis ideas.

**REFERENCES:**

1. Iain Borden and Kaaterina Ruedi; The Dissertation: An Architecture Student's Handbook; Architectural Press; 2000.
2. John W Creswell; Research design: Qualitative, Quantitative and Mixed Methods Approaches; Sage Publications; 2002.
3. Linda Grant and David Wang, Architectural Research Methods, John Wiley Sons 2001.
4. Ranjith Kumar; Research Methodology- A step by step guide for beginners; Sage Publications; 2005
5. Wayne C Booth; Joseph M Williams; Gregory G. Colomb; The Craft of Research, 2nd Edition; Chicago guides to writing, editing and publishing, University of Chicago Press, 2003.

**EA5412****PROJECT PHASE II - THESIS**

L	T	P/S	C
0	0	20	10

**OBJECTIVES:**

- To integrate the knowledge gained in the previous semesters with respect to issues/ tools of architectural design at a more advanced level.
- To understand and identify issues appropriate to a particular project or area of architecture, through independent thinking as well as to design in a manner appropriate to the project context.

The students will synthesize the areas of knowledge, skills and techniques acquired in the various courses of the previous semesters through a thesis project of their choice. This thesis project would be a design project with a strong research component. The project would desirably extend the critical position developed within the theory and studio projects as well as dissertation. The scale of the project could extend from individual site to settlement levels. The initial process shall be rigorous, incorporating background research on the topic, case studies, documentation of project issues, context, site and building information, programming. The process would culminate in design interventions at scales appropriate to the topic. The project shall desirably have the potential to serve as a starting point for practice and/ or further research.

Students will submit a detailed proposal on their topic of interest(s). The Proposal shall be approved by the thesis review committee. The thesis project will be reviewed periodically by the review committee. At the end of the semester, the final thesis will be submitted and presented through a viva voce examination before a jury.

**TOTAL: 300 PERIODS****OUTCOMES:**

- Students would be able to integrate various contemporary and traditional techniques of sustainability into the architectural design process.
- Students would be able to identify and go in depth into specific and appropriate environmental aspects and reflect this in the realm of design.

<b>EA5001</b>	<b>SUSTAINABILITY AND ENERGY CONSERVATION IN LANDSCAPE ARCHITECTURE</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To expose the students on the issues of sustainability at the global level.
- To Focus on the energy conservation landscape and sustainability at the micro level.
- Sustainable landscape design for various climates of India

**UNIT I INTRODUCTION TO SUSTAINABILITY 10**

Need and concept of sustainability, Brundtland report, World Commission on environment and development, sustainable development, sustainable growth, sustainable economy and sustainable use. Visions of sustainability. Source and ethics of sustainability. Sustainability and Climate Change.

**UNIT II SUSTAINABLE SITE 07**

Sustainable site – LEEDS, BREEM, rating erosion and sedimentation control, site selection, urban development, landscape and exterior design etc., Green Building in the context of sustainability. Ecology and sustainability. Eco-City.

**UNIT III INTRODUCTION TO ENERGY CONSERVATION IN LANDSCAPE 09**

Energy conservation and sustainability, principles of energy systems, energy and global environment, scope for energy conservation in landscape.

**UNIT IV ENERGY CONSERVATION METHODS IN LANDSCAPE ARCHITECTURE-CASE STUDIES 10**

Various methods of energy conservation in landscape architecture, energy conservation techniques in various climates- hot and humid, hot dry, etc. Energy efficient site planning and landscape development. Energy efficient planting design.

**UNIT V SUSTAINABLE LANDSCAPE PRACTICES 09**

Sustainable landscape maintenance and management, Sustainable planning and city form. Sustainable urban landscape, landscape sustainability at the national and regional level.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understanding of sustainability from macro to micro level.
- Knowledge on Energy conscious Landscape design

**REFERENCES:**

1. Anne simon Moffat and marc schiler, Landscape design that saves energy, William monow and co.,Inc., New york, 1981.
2. Grady Clay, Water and the landscape McGraw-Hill Inc.,US; First Edition edition 1979)
3. John.F.Benson and Maggie.H.Roe, Landscape and sustainability, John Wiley Publication, New york, 2000.
4. O.R.Gray, Landscape Planning for energy conservation, Van Nostrand Reinhold, 1983.
5. Publications of Centre for Science and Environments, New Delhi and TERI.

<b>EA5002</b>	<b>THERMAL COMFORT AND PASSIVE DESIGN</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- The main objective of this course is to explore the relationship between architectural form, materials and environmental performance, and how this relation should evolve in response to climate and emerging technical capabilities.

**UNIT I HUMAN BEHAVIOUR 09**

Atmospheric and thermal comfort, building performance, and occupant health, safety, and productivity. Factors responsible, energy systems for human comfort, PPD & PMV analysis

**UNIT II NATURAL INFLUENCES 09**

Micro and Macro thermal comfort scales – Interpreting Material data through Bio climatic charts Sun path ,Passive strategies ,Solar heat gain ,Solar radiation, Stack effect ,etc.

**UNIT III DESIGN ELEMENTS 09**

Modifications of Architectural & Landscape Elements – Fenestration, roof, walls, flooring, trees and landscape. Climatic zones and architectural features -Courtyard ,Cross ventilation ,Daylight factor, Walls ,Trombe wall, Buried pipe system ,Wind, Velocity ,Wind tower etc.

**UNIT IV BUILDING MATERIALS 09**

Properties of building materials related to Climatic zones -Properties of Heat transfer and energy flow, U-value , Appropriate materials. Mass materials/components selection strategy - Photovoltaic-Recycled materials-Utilization of building water conserving installation-Evaporative coolers.

**UNIT V HUMAN COMFORT STANDARDS 09**

Designing for optimum Day lighting-Ventilation and Thermal Comfort Standards. Acoustics – Manmade influences –Sick Building Syndrome – Indoor Environment and design of Healthy buildings. Adaptive model of thermal comfort and its application to sustainable design of buildings.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand Human thermal response to natural elements and the influence of architectural design elements.
- Understand human thermal comfort and the means to achieving the same.

**REFERENCES:**

1. Arvind Krishan, SimosYanas, Nick Baker, S.V. Szokolay, Climate Responsive Architecture, Tata McGraw Hill Pub. Co, 2001
2. Daniel D. Chiras, The Solar House: Passive Heating and Cooling, Chelsea Green Publishing, 2002
3. David Lloyd Jones, Architecture and the Environment: Contemporary Green Buildings, Overlook Hardcover, 1998.
4. Givoni, Climate Considerations in Building and Urban Design, Wiley; 1st edition, 1998.
5. Hawkes Dean and Foster Wayne, Energy Efficient Buildings: Architecture, Engineering, and Environment . W. W. Norton & Company; First American Edition, 2002.
6. O.H Koenisberger, Manual of Tropical housing and climate, Longman Group United Kingdom, 2012.

**OBJECTIVES:**

- Expose the students with concepts of cartography as major components of input and output related to cartography.
- To provide exposure to data models and data structures in GIS and to introduce various Raster and Vector Analysis capabilities.
- To expose the concept of quality and design of cartographic outputs in open GIS environment.

**UNIT I FUNDAMENTALS OF CARTOGRAPHY AND GIS****9**

Definition of Map - Mapping Organization in India- Classification based on Function, Scale, Characteristics – Ellipsoid and Geoid – Co-ordinate Systems - Rectangular and Geographic Coordinates – UTM and UPS - Projection – Function - Types of Map Projections – Transformations – Function - Affine transformation - Choice of Map Projection – Evolution of cartography- Geo-Spatial, Spatial and Non-spatial data – Definition of GIS – Evolution GIS – Components of GIS.

**UNIT II GIS DATA MODELS AND DATA INPUT****9**

Point, Line Polygon / Area, elevation and surface – Tessellations - Attributes and Levels of Measurement - Data Sources – Ground and Remote Sensing survey – Collateral data collection – Input: Map scanning and digitization, Registration and Geo-referencing – Concepts of RDBMS - Raster Data Model – Grid – Data Encoding - Data Compression – Vector Data Model – Topological properties – Arc Node Data Structure – Raster Vs. Vector Comparison – File Formats for Raster and Vector – Data conversion between Raster and vector.

**UNIT III RASTER AND VECTOR DATA ANALYSIS****9**

Raster Data analysis: Local, Neighborhood and Regional Operations – Map Algebra – Vector Data Analysis: Topological Analysis, point-in-polygon, Line-in-polygon, Polygon-in-Polygon – Proximity Analysis: buffering, Thiessen Polygon – Non-topological analysis: Attribute data Analysis- concepts of SQL– ODBC UNIT IV NETWORK ANALYSIS AND SURFACE ANALYSIS 9 Network – Creating Network Data - Origin, Destination, Stops, Barriers – Closest Facility Analysis, Service Area Analysis, OD Cost matrix analysis, Shortest Path Analysis – Address Geocoding – Surface Analysis – DEM, DTM - Point data to Surface interpolation – DEM Representation - Applications

**UNIT V DATA OUTPUT AND WEB BASED GIS****9**

Map Compilation – Cartographic functionalities for Map Design – Symbolization – Conventional signs and symbols – Spatial Data Quality – Lineage, Positional Accuracy, Attribute Accuracy, Completeness, Logical Consistency - Meta Data – Web based GIS: Definition, Merits - Architecture – Map Server – Spatial Data Infrastructure – Spatial Data Standards

**TOTAL: 45 PERIODS****OUTCOMES:**

On completion of this course, the student shall

- Acquire knowledge about cartographic principles, spatial data models and spatial analysis.
- Understand the cartographic outputs in open GIS environment.

**REFERENCES:**

1. C.P. Lo, Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006, ISBN-13: 9780131495029
2. John Jensen, Ryan Jensen, Introductory Geographic Information Systems, International Edition, Pearson Publishers, 2012, ISBN-10: 0136147763, ISBN-13: 9780136147763
3. Kang-tsung Chang, Introduction to Geographic Information Systems with Data Set CDROM, 6th Edition, Mc Graw Hill, 2013, ISBN-10: 0077805402, ISBN-13: 978-0077805401

**OBJECTIVES:**

- To explain concept of various forms of renewable energy
- To outline division aspects and utilization of renewable energy sources for both domestic and industrial applications
- To analysis the environmental and cost economics of using renewable energy sources compared to fossil fuels.

**UNIT I SOLAR ENERGY 09**

Solar radiation its measurements and prediction - solar thermal flat plate collectors concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes.

**UNIT II WIND ENERGY 09**

Atmospheric circulations – classification - factors influencing wind - wind shear – turbulence - wind speed monitoring - Betz limit - Aerodynamics of wind turbine rotor- site selection - wind resource assessment - wind energy conversion devices - classification, characteristics, applications. Hybrid systems - safety and environmental aspects.

**UNIT III BIO-ENERGY 09**

Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of biogas Plants- applications

**UNIT IV HYDROGEN AND FUEL CELLS 09**

Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types - construction and applications.

**UNIT V OTHER TYPES OF ENERGY 09**

Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection, and geothermal power plants.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Understand the various types of renewable energy sources.
- Also understand the environmental and cost economics of using renewable energy sources compared to fossil fuels.

**REFERENCES:**

1. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, 1980.
2. Bridgurater, A.V., Thermochemical processing of Biomass, Academic Press, 1981.
3. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
4. Hart, A.B., and Womack, G. J., Fuel Cells: Theory & Applications, Prentice Hall, 1997.
5. Khandelwal K.C, Mahdi S.S., Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986.





## REFERENCES:

1. Ervin H. Zube, Robert O Brush, Julios G.Y.Fabos, Landscape assessment –values, perceptions, 1975.
2. G. Tyler Miller Jr., Living in the Environment: Principles, Connections, and Solutions, Brooks / Cole publishers co., 2004.
3. Richard T.T.Forman & Michel Godron , Landscape Ecology, John Wiley & Sons; 1986
4. Tom Turner, Landscape Planning and Environmental Impact Design, UCL Press, London, 1998.
5. William M. Marsh, Landscape planning – Environmental Application, John Wiley and sons Inc., 1997.

<b>EA5005</b>	<b>ENVIRONMENTAL MANAGEMENT SYSTEMS AND AUDITING</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To impart an understanding of systems approach as per ISO 14001 and skills for the management of environmental issues.

### **UNIT I ENVIRONMENTAL MANAGEMENT STANDARDS 09**

Development, trade and environment linkages – Environmental guidelines - Business and Citizen Charters for Sustainable Production and Consumption - National policies on environment, abatement of pollution and conservation of resources - Environmental quality objectives – Environmental standards - Concentration and Mass standards- Effluent and stream standards – Emission and ambient standards -Minimum national standards - Measuring performance evaluation: Indicators, Benchmarking - Systems approach to environmental management

### **UNIT II PREVENTIVE ENVIRONMENTAL MANAGEMENT 09**

Pollution control vis a vis Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction and elimination, process modification – Cleaner Production Assessment- Material or resource balance – CP option generation and feasibility analysis

### **UNIT III ENVIRONMENTAL MANAGEMENT SYSTEM 10**

EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.

### **UNIT IV ENVIRONMENTAL AUDIT 08**

Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement - Due diligence audit

**UNIT V APPLICATIONS****09**

Applications of EMS , Waste Audits and Pollution Prevention opportunities in Textile , Sugar, Pulp & Paper, Electroplating, Mining, petroleum refining, Tanning industry, Dairy, Cement, Chemical industries, etc

**TOTAL: 45 PERIODS****OUTCOMES:**

- Understand the Environmental standards as per ISO 14001 and environmental auditing systems as per ISO 19011

**REFERENCES:**

1. Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – a step by step guide" Earthscan Publications Ltd, London, 1999.
2. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001.
3. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004
4. ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002
5. Paul L Bishop 'Pollution Prevention: Fundamentals and Practice', McGraw-Hill International, Boston, 2000.

**EA5006****ENVIRONMENTAL PSYCHOLOGY**

L	T	P/S	C
3	0	0	3

**OBJECTIVES:**

- To impart an understanding of systems approach as per ISO 14001 and skills To introduce the students about interdisciplinary social science approaches and to explore ways that people experience environments and make decisions about them, both as individuals and also in the social contexts where environmental decision making is institutionalized.

**UNIT I INTRODUCTION TO ARCHITECTURAL PSYCHOLOGY****09**

Introduction to the discipline, its importance in the field of Architecture Understanding the principle of psychology– Form, perception, attention, concepts, types of concepts ,physical settings and varied emotions.

Creative Thinking: Process of creativity, visual and creative thinking ,types of thinking, directed thinking, Convergent thinking divergent, articulation of masses and spaces, sense and sensation modalities – language of architecture and its role in creativity, like rhythm, harmony, balance and other visual traits.

**UNIT II ENVIRONMENTAL AND HUMAN RESPONSE****09**

Environmental variables-fixed feature variable, semi- permanent feature variable, ambient feature variable and human compartment, human adaptation to the given environment, collective behavior and spatial orders ,effects of colour and behavior in built environment

**UNIT III CONCEPT OF BEAUTY AND HUMAN ATTITUDE****09**

Philosophies of beauty ,aesthetics and physio -psychological association to it and the human mind, simulated by 'pull' and 'push' factors of the environment physical manifestation and emotional impact attitudes towards typical physical settings from ,space and attitude relations.

**UNIT IV APPLICATION OF PSYCHOLOGY IN ARCHITECTURE DESIGN 09**

Evaluation of the satisfactory levels of a residential building. Parameters to provoke desired emotions in the built environment application of the knowledge in the design of a residence, community, neighborhood in all stages of design.

**UNIT V THE PSYCHOLOGY OF SUSTAINABLE BEHAVIOR / GREEN INTERVENTIONS 09**

The green organizational imperative- Green work performance- The psychology of going green- Green recruitment, development and engagement-Maslow’s Hierarchy of Needs- Herberg’s Theory. The Cycle of organisational Change and Progression -Challenges to sustainability and participation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students gain knowledge of application of spatial and color psychology in architectural design

**REFERENCES:**

1. Bakker, A.B. & Leiter, M.P. Work engagement; A handbook of essential theory and research. Hove: Psychology Press 2010.
2. Canter D.V & Lee.T. Psychology and the built Environment”, Architectural Press, London, 1974.
3. Hall E.T.“The Hidden Dimension” New York, Doubleday, 1966.
4. Kayem,S.M., “Psychologyin relation to design”, Dowden, Hutchinson and Ross, 1973
5. Morgan T. of Clifford, “Introduction to Psychology”, Tata McGraw–Hill publications New York, 1983
6. Proshansky, H.M. 1987. "The field of environmental psychology: securing its future." 'Handbook of environmental psychology.' D. Stokols and I. Altman. New York, John Wiley & Sons.
7. Proshansky. H.I Hleson. W.H."Environment Psychology-people and their physical settings”, Newyork, Holt, Rinchatand Winston, 1976

<b>EA5007</b>	<b>CARBON FOOT PRINT AND MEASUREMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- By the end of this course students will be expected to Calculate the carbon intensity of the electricity supply for a specific geographic area. Conduct full life cycle analysis of greenhouse gas emissions from a defined consumer product

**UNIT I TRENDS IN BUILDING SECTOR EMISSION 09**

Energy consumption in different sectors like residential, commercial and public buildings, offices, markets, hospitals, research laboratories. Environmental data in these sectors. -Carbon emission resulting from energy use in buildings.

**UNIT II GHG MITIGATION OPTIONS IN BUILDINGS 09**

Energy efficiency principles, building energy management systems, -lighting systems, day-lighting, appliances, on-site power, and cost estimate of GHG mitigation in buildings.

**UNIT III      LOW CARBON REFURBISHMENT IN BUILDINGS      09**

Low carbon refurbishment process-3 different phases (prepare, design, construct) refurbishment policy, embodied energy considerations for existing buildings in different sectors. Constraints in adopting building techniques- Limitations of traditional building designs- misplaced incentives- regulatory barriers- social engineering (culture, behavior, rebound effect)- interaction of mitigation options with vulnerability and adaption.

**UNIT IV      CARBON FOOT PRINTING DURING CONSTRUCTION      09**

Social and economic aspects. –Promoting low carbon construction materials- reducing environmental impacts during construction, - aspects of sustainability. Carbon foot print measurement, Methodology of calculating carbon foot print, carbon trust, - system boundary, functional units, life cycle inventory data, carbon credit.

**UNIT V      ROAD MAP FOR REDUCING EMISSIONS      09**

GHG inventory, baseline measures- strategic climatic action plans, - implementation mechanism Techniques to reduce energy consumption in building, Steps to be adopted for reduction, usage of low carbon materials, green travel, transport carbon- case study analysis

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand Human thermal response to natural elements and the influence of architectural design elements.
- Understand human thermal comfort and the means to achieving the same.

**REFERENCES:**

1. ICLEI – Local Governments for Sustainability USA, “The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions”, October 2012 (Appendix C-I)
2. What colour is your building? David H. Clark, RIBA publishing house, London-2013
3. World Resources Institute and World Business Council for Sustainable Development, The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (revised edition), pages 10-33.

<b>EA5008</b>	<b>PREDICTIVE BUILDING MODELLING SOFTWARES AND PASSIVE STRATEGIES</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- This course will investigate the Modelling techniques and passive strategies for assessing the energy performance, environmental response and impact of built form.

**UNIT I      PREDICTIVE BUILDING MODELLING      09**

Modelling-Simple Modelling, Advanced Modelling . Understanding and familiarizing with Layers and Zones, Objects and Nodes, Element, Types ,Object Relationships ,Display Options ,Viewing the Model and Operational Modes.

**UNIT II      SOLAR ANALYSIS      09**

Solar Analysis- Shading Analysis , Shading Design.

Learning to:

- Display and animate complex shadows and reflections,
- Generate interactive sun-path diagrams for instant overshadowing analysis and
- Calculate the incident solar radiation on any surface and its percentage shading

**UNIT III LIGHTING ANALYSIS 09**  
 Lighting Analysis–Day lighting Analysis, Artificial Lighting Analysis. Learning to work out daylight factors and artificial lighting levels either spatially or at any point.

**UNIT IV THERMAL ANALYSIS 09**  
 Thermal Analysis- Thermal Modelling Issues, Basic Thermal Analysis ,Advanced Thermal Analysis. Understanding how to calculate monthly heat loads and hourly temperature graphs for any zone.

**UNIT V INTEGRATED PASSIVE ENERGY STRATEGIES 09**  
 Cognitive ,analytical and simulated modeling and design of buildings .zero net energy (ZNE) building-Traditional buildings-electrical grid - HVAC and lighting-Net Zero Energy Building -Case studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students gain knowledge of predictive Modelling techniques and passive strategies for assessing the energy performance.

**REFERENCES:**

1. Clarke, Joseph; "Energy Simulation in Building Design", Second Edition Butterworth, 2001.
2. Energy Efficient Buildings in India,The Energy and Resources Institute, TERI, 2009.
3. Kabele, K., "Modeling and analyses of passive solar systems with computer simulation", in Proc. Renewable energy sources, PP. 39 – 44, Czech Society for Energetics Kromeriz 1998.
4. Manual of the selected software – Ecotect Analysis 2011 ,TAS-version 9.2.1.6, etc
5. MoneefKrarti, Energy Audit of Building Systems- CRC Press, 2000 ESRU,. Building Energy Simulation Environment; User Guide Version 9 Series. "ESRU Manual U 96/1, University of Strathclyde, Energy Systems Research Unit, Glasgow, 1996.
6. Voss, Karsten; Musall, Eike: "Net zero energy buildings - International projects of carbon neutrality in buildings", Munich, 2011.

<b>EA5009</b>	<b>DESIGN OF ENERGY EFFICIENT AND HEALTHY BUILDINGS</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- The main objective of this course is to have a holistic understanding of healthy buildings and the various preventives and technologies available to ensure healthy buildings.

**UNIT I HEALTHY BUILDINGS THEORY 09**  
 Performance of building services against standards, Work place standards of health, Observation and analysis of health risk in buildings, and maintenance requirements, Environmental and health impact of building materials.

**UNIT II INVESTIGATIONS OF HEALTHY LIVING PRACTICES 09**  
 Washing people, washing clothes, removing waste, improving nutrition, reducing crowding, separating people from animals, vermin or insects, reducing dust, controlling temperature and reducing trauma.

**UNIT III DESIGN OF BASIC AIR CONDITIONING SYSTEM FOR BUILDINGS 09**  
 Process of air conditioning system selection, heat load estimation, and design of air distribution. Air conditioning design for energy efficiency. A C system components : Fans, coils, filters and heat rejection equipment. Sick building syndrome, Issues of Indoor air quality.

**UNIT IV FUNDAMENTAL PRINCIPLES OF FIRE SAFETY ENGINEERING 09**

Fire safety in large modern buildings, fire detection and suppression systems. Design of manual and automatic water based systems to warn / extinguish fires. Alternatives to conventional prescriptive design.

**UNIT V SOURCE AND NATURE OF HAZARDOUS WASTE 09**

Impact on Environment – Hazardous Waste – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understanding methods to remove pollutants from indoor environment.
- Methods to enhance IAQ

**REFERENCES:**

1. Abrams, D. W., "Low Energy Cooling: A Guide to the practical Application of Passive Cooling and Cooling Energy Conservation Measures", Van Nostrand Reinhold Co., N Y
2. Chadderton, D. V., "Air Conditioning: A practical Introduction", E & FN Spon, London
3. Chadderton, David, V., "Building Services Engineering", E & FN Spon.
4. K.M.Hangos and I.T.Cameron, "Process Modeling and Model Analysis", Academic Press, 2001
5. Stoecker, W. F., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi.
6. Torr, A. R., "Refrigeration and Air Conditioning", Butterworth publishers, London, 1989.

<b>EA5010</b>	<b>WATER CONSERVATION PRACTICES IN BUILDINGS</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- The main objective of this course is to understand the methods for water management and conservation. An understanding of the traditional and contemporary methods of water conservation

**UNIT I WATER CONSERVATION 09**

Basic concepts of soil erosion; control of soil erosion; Mechanics of wind and water erosion; water and wind erosion control practices; concept of runoff and its estimation; Design, construction and maintenance of vegetated waterways; Planning, Design, Construction and maintenance of terraces, contours and bunds; Design of water harvesting structures and farm ponds.

**UNIT II WATERSHED DEVELOPMENT AND WATERSHED MANAGEMENT 09**

Concept of watershed development and management; collection of hydrological data; watershed characteristics and hydrologic cycle; problems of land degradation; Land use capability classification and topographical characteristics of watershed; Appropriate soil and water conservation measures, Hydrological and sediment monitoring of watershed; Estimation of peak design runoff rate; Planning, management and economic evaluation of watershed development projects; case studies.

**UNIT III WATERSHED PLANNING AND MANAGEMENT 09**

Concept of characteristics of watershed, causes and consequences of watershed deterioration, Identification of watershed Management, people's participation in watershed Management, Socio economic survey of watershed, Land use capability, classification, appropriate soil and water conservation measures for watershed Management, Integrated multi disciplinary approach for watershed Management.

**UNIT IV FOREST WATERSHED MANAGEMENT 09**

Concept, characteristics and hydrology of forest watershed; Investigation of streams; Impact of land use changes; Deforestation, road building and other forest uses on forest stream quality and quantity; Radiation energy and water balance; Interception process and estimation; Precipitation and run-off estimation; Soil erosion in forest watershed; Selection and design of soil and water conservation structures; Simulation of hydrological processes in forest watershed.

**UNIT V WATER CONSERVATION PROJECTS 09**

Procedure for planning of soil and water conservation projects; Survey and investigation; Analysis of watershed problems; Calculation techniques of different watershed parameter; Legal, organizational and financial aspects of soil and water conservation projects; Responsibilities of different operation offices; Economic and financial analyses of soil and water conservation projects; Project evaluation; Management of soil and water conservation projects; Education, training and peoples participation in watershed development projects; Case study

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand methods to conserve and manage water for human consumption and other uses.

**REFERENCES:**

1. A Text Book of Environmental Studies edited by Dr. Shanta Satyanarayan, Dr. Suresh Zade, Dr. Shashikant Sitre, Dr. Pravin Meshram, 2009, Allied publishers.
2. Irrigation - Theory & Practices Vikas Publishing House, New Delhi - 801. Michael A.M.
3. Manual of soil & water conservation practices by Gurmel singh, C. Venkatraman, G.Sastry-1990. Oxford & J.B.H. Publication, New Delhi
4. Water Shed Management By Dhruvanarayan

<b>EA5011</b>	<b>ENVIRONMENT, DEVELOPMENT AND DISASTER MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- At the end of the course, the students must have an understanding of the resource optimization and the measures to be taken in the face of a disaster

**UNIT I ENVIRONMENT, DEVELOPMENT AND DISASTER MANAGEMENT – 06**  
**INTERFACE**

Resource use, exploitation and conservation; Impact of human activities on environment; Environment and economy interaction, introduction to environmental accounting.

**UNIT II ENVIRONMENTAL MANAGEMENT 09**

Environmental Impact Assessment, thresholds, indicators, audits, environmental certification, lifecycle analysis, environment and poverty links, environmental policy, Acts and regulations; Environmental education, participatory approaches, emerging concepts. Disaster classification, concepts, hazards, vulnerability, risks, human response to disaster, impacts

**UNIT III CONCEPTS OF HAZARD 12**

Vulnerability, Risks, Natural Disasters (earthquake, Cyclone, Floods, Volcanoes), and Man Made Disaster ( Armed conflicts and civil strip, Technological disasters, Human Settlement, Slow Disasters (famine, draught, epidemics) and Rapid Onset Disasters(Air Crash, tidal waves, Tsunami) Risks, Difference between Accidents and Disasters, Simple and Complex Disasters,



Refugee problems, Political, Social, Economic impacts of Disasters, Gender and Social issues during disasters, principles of psychosocial issues and recovery during emergency situations, Equity issues in disasters, Relationship between Disasters and Development and vulnerabilities, different stake holders in Disaster Relief. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters. Impact on Environment.

**UNIT IV DISASTER MITIGATION AND MANAGEMENT 09**

Relevance of disaster management in development and environment, disaster preparedness, prevention, displacement and development, Role and responsibilities of government and non-government organizations, Disaster Education – awareness of individuals, communities and participation at various levels; Integrating disaster mitigation in the spatial planning process, provision of infrastructure for disaster mitigation.

**UNIT V POLICIES AND LEGISLATION PERTAINING TO ENVIRONMENT AND DISASTER MANAGEMENT 09**

Policies and Legislation at various levels., Institutional and Legal Arrangements Disaster Management Act, 2005. Role of Central Ministries and Departments, and States, Communications and Information Technology (IT) Support, Community Based Disaster Preparedness, Stakeholders’ Participation , Corporate Social Responsibility (CSR) and Public-Private Partnership (PPP).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the various contexts leading to disaster. Also understand the correctives to help humans and the environment bounce back to normalcy.

**REFERENCES:**

1. Jegadish Gandhi P Disaster Mitigation & Management Post Tsunami Perspectives 2007 Deep & Deep Publications Pvt Ltd, New Delhi
2. Ministry of Home Affairs Model Amendment in Town and Country Planning Legislations, Regulation for Land Use Zoning and Building Byelaws for Structural Safety 2004 MHA 8. Ministry of Home Affairs National Policy on Disaster Management(NPDM) 2006 MHA
3. NDMA Disaster Management Guidelines 2007-11 NDMA
4. P C Sinha Introduction to Disaster Management 2007 Anmol Publications, New Delhi
5. Pardeep Sahni, Alka Dhameja, Uma Medury Disaster Mitigation: Experiences and Reflections 2008 PHI Learning Pvt. Limited, New Delhi
6. Rajib Shaw Community, Environment and Disaster Risk Management 2010 Emerald Group Publishing Limited
7. Rajib Shaw Hari Srinivas, Anshu Sharma Urban Risk Reduction An Asian Perspective 2009 Emerald Group Publishing Limited

<b>EA5012</b>	<b>NATURAL RESOURCE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- This course provides an overview of the main management issues which relate to natural resources, particularly land, water, biodiversity, forests and fisheries. The range of topics covered in the course will provide students with a wider perspective on many national and international natural resource management issues and challenges. The focus of the course is to develop understanding for linking community resource management systems with macro-level policies and programmes to create long-enduring management systems.

<b>UNIT I</b>	<b>INTRODUCTION TO NATURAL RESOURCE MANAGEMENT</b>	<b>09</b>
Overview of the Subject – Need and Scope; Basic Concepts of Natural Resource Management like Common Property Rights, Collective Action, Traditional Knowledge about Natural Resources Management, Community Based Natural Resource Management		
<b>UNIT II</b>	<b>LAND</b>	<b>09</b>
Perception of Land Degradation; Understanding the Causes of Land Degradation; Land Management Practices; Like Soil Conservation, Watershed Management, Management Issues and Challenges		
<b>UNIT III</b>	<b>WATER</b>	<b>09</b>
Water Supply and Demand, Water Quality Issues, Understanding the Causes, Water Management Practices, Management Issues and Challenges		
<b>UNIT IV</b>	<b>BIODIVERSITY</b>	<b>09</b>
Biodiversity Services and Human Well-Being; Global and National Trends in Biodiversity Loss; Understanding the Causes, Biodiversity Management Practices, Management Issues and Challenges Forests- The Principles of Sustainable Forest Management; Forests and Economic Development; Forest Ecosystem Services; Forest Certification Schemes; Community Forest Management. Joint Forest Management, Management Issues and Challenges		
<b>UNIT V</b>	<b>WILDLIFE AND FISHERIES</b>	<b>09</b>
Conserving Wildlife through Sustainable Use; The Drivers of Marine Fisheries Depletion. Current Approaches to Implementing Sustainable Fisheries Management, Management Challenges and Issues		

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the various natural environmental resources and the ways to manage them.

**REFERENCES:**

1. A Methodological Framework for Gender Participation in Agricultural Resources: A Study of Jhabua District of M.P., Singh S.P. and K.N. Krishna Kumar
2. Community Forest Management in Tribal States of India (with special reference to Madhya Pradesh), Dasgupta S. and D. Debnath, International Book Distributors
3. Criteria and Indicators for Sustainable Forest Management, Kotwal P.C. and M.D. Omprakash, International Book Distributors, Dehradun
4. Ecotourism and Livelihoods, Bhattacharya A.K., Concept Publishing Company, New Delhi
5. Forest Certification: A Tool for Sustainable Forest Management, Yadav M., P.C. Kotwal and B.L. Menaria, ISBN: 81-7969-047-4
6. Governing the Commons: The Evolution of Institutions for Collective Action, Elinor Ostrom
7. Natural Resources, Agarwal et. all, International Institute for Environment & Development
8. The Science of Sustainable Development: Local Livelihoods and the Global Environment, Jeffrey Sayer, Cambridge University Press

<b>EA5013</b>	<b>ENERGY, CLIMATE CHANGE AND URBAN DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- The objective of this course is to make students aware of the scenario of climate change and to provide exposure on discussions happening at national and international levels. After attending this course, the students will be in a position to appreciate the role of settlements in climate change mitigation at the same time they will be able to address impact and adaptations issues faced by human settlements.

**UNIT I INTRODUCTION 09**  
 Energy, Climate change and Urban Development – Interface. Understanding Climate Change: Greenhouse gases, Anthropogenic causes, Carbon Cycle, Global Warming, Inventory of GHGs, Urban Heat Islands

**UNIT II ENERGY GENERATION AND CONSUMPTION 12**  
 Energy Supply and Demand, Energy Consumption in cities, determinants of energy demand, phenomenon of climate change, factors influencing climate change, impacts of climate change

**UNIT III ENERGY PLANNING AND MANAGEMENT, AND MITIGATION AND ADAPTATION TO CLIMATE CHANGE 07**  
 Energy efficient development, Compact city form, Transit oriented development. Mechanisms and measures for mitigating and adapting to climate change at various levels

**UNIT IV PLANS, POLICIES AND STRATEGIES 05**  
 Related to energy planning, conservation, climate change mitigation and adaptation.

**UNIT V CLIMATE CHANGE 12**  
 An introduction to the Earth’s Climate System and Climatic Zones as Basis for Human Activity and Settlements, The Development of Society in Relation to the Local Climatic and Topographic Conditions, Resources Availability (Food, Building Material, Energy), Technical Skills and the Societal Framework, The Conditions for Development, Evolution and Collapse of Civilizations. An Assessment of Population Development and its Implications on Settlements, Buildings and Resource Consumption with Particular Focus on Energy Consumption

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the various issues involved in climate change and the strategies to mitigate the same.

**REFERENCES:**

1. Andres Duany, Jeff Speck and The Smart Growth Manual 2009 McGraw-Hill
2. Bicknell, Jane Adapting cities to climate change: understanding and addressing the development Change 2009 Earthscan, London
3. Jenks, Mike; Burgess, Rod Compact cities: Sustainable urban forms for developing countries 2000 Spon Press, London
4. Mike Lydon David Owen Green Metropolis: Why Living Smaller, Living Closer, and Driving Less are the Keys to Sustainability
5. S.K Dash Climate change: an Indian perspective, New Delhi 2007 Cambridge University Press

<b>EA5014</b>	<b>THEORY OF ENVIRONMENTAL PLANNING</b>	<b>L</b>	<b>T</b>	<b>P/S</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To enable the student to understand the various aspects of environment, their characteristic and mechanism. The policies pertaining to the conservation of the natural environment system.

**UNIT I CONCEPTS OF ECOLOGY, ECOSYSTEM AND ENVIRONMENTAL PLANNING 09**

History of Environmental Planning, Development of habitat patterns, settlement structure and form in response to environmental challenges; Concepts of Ecology and Ecosystem, Urban Ecosystem.

**UNIT II RESOURCE ANALYSIS AND CONSERVATION 12**

Resource analysis for various ecosystems and development imperatives (land, geology, soil, climate, water, vegetation) characteristics, exploitation, causative factors for degradation, analytical techniques.

**UNIT III ENVIRONMENTAL ZONES 12**

Environmental Zones (Hill, coastal, arid, characteristics, resources, settlements pattern, problems and potentials, regulating mechanisms for development.

**UNIT IV ENVIRONMENTAL POLICIES, SIGNIFICANT CONVENTIONS, CONFERENCES 06**

Environmental Policies and initiatives including policies, strategies, protocols, treaties and agreements.

**UNIT V ENVIRONMENTAL LEGISLATIONS IN INDIA 06**

Evolution of Indian Legislation( Brief Overview of environment related laws in India); Environmental Movements; Union Government Initiatives • Indian Environmental Acts, Laws and Notification

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Understand the various aspects of environment and the policies for its protection.

**REFERENCES:**

- Andrews, Goudie The Human Impact on the Natural Environment – Past, Present and Future 2006 Wiley Publishers
- J.S. Singh, S.P. Ecology Environment and 2008 Anamaya Publishers, New Delhi
- James K. Lein Integrated Environmental Planning 2002 Wiley Publishers
- Singh, and S.R. Gupta Resource Conservation Delhi.
- V.H. Dale, Mary R. English Tools to Aid Environmental Decision Making Latest Edition Swinger
- William Fox, Enslin Van Rooyen (eds.) The Quest for Sustainable Development 2004 Juta & Co. Ltd., Cape Town