## FACULTY OF ARCHITECTURE

### M.Arch. in Environmental Design

#### Scheme of Teaching & Examination

(Effective from Session 2020)

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### SEMESTER II

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Faculty of Architecture and Planning, AKTU, Lucknow
MARCH. IN ENVIRONMENTAL DESIGN SEMESTER – I

MED – 101 ENVIRONMENTAL DESIGN STUDIO-1 (Building Level)

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OBJECTIVES:
- The aim is to introduce the students to climate and surroundings as an important aspect of environmental design.
- To understand in depth, the environmental factors affecting human comfort and creation of comfort conditions along with the associated building physics.

Module 1 Environment and Comfort
- Global, macro and micro level climate (global warming, greenhouse effect etc.)
- Elements of climate and its quantification
- Earth’s energy balance
- Climatic data and its interpretation
- Other environmental aspects affecting human comfort – Air Quality, Sound, Pollution, Light, Water, Global Warming

Module 2 Building Physics
- Energy balance of human and built environment
- Thermal Environment
- Adaptive model of Thermal Comfort and its application to environmental responsive design of buildings

Module 3 Case/ Literature Studies
- Detailed Analysis of Buildings with respect to its thermal properties, environmental comfort factors and others as individual assignments (report/ppt/sheets)

Module 4 Design Exercise
- Design of a multi-use built form - Office, Hotel, Apartment (and similar) taking into consideration the above design and assessment criteria.

References:
1. Manual of Tropical housing and climate by Koenisberger
2. Climate responsive architecture by Arvind Krishnan
3. Climate Design: Energy Efficient building principles and practices by Watson Donalt
4. Man, Climate and Architecture, B.Givoni
5. Selected Research Papers and Studies
MED – 102 RESEARCH TECHNIQUES AND APPLICATION

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OBJECTIVES:

- To understand the importance of research in Environmental Design.
- To formulate a research plan through application of research techniques, data collection, analysis and interpretation.
- To understand the methods of writing and presenting a research report.

Module-1 Introduction
Significance of research in Environmental Design. Basic research issues and concepts - Orientation to research process - Types of Research: Historical, Qualitative, Co-Relational, Experimental, Simulation and Modelling, Logical Argumentation, Case Study And Mixed Methods- Illustration Using Research Samples

Module-2 Research Problem
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.

Module-3 Research Design
Components of research design. Concepts of dependent and independent variables, unit of analysis. Defining the scope and limitations of a research plan, significance of the research outcome. Preparing time schedule & budget for a research plan.

Module-4 Sampling Design
Steps in Sampling, Characteristics of a good Sample design, Types of Sample design. Quantitative and Qualitative

Module-5 Data Collection
Library and archives - Internet: new information and the role of internet, finding and evaluating sources of 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. Methods of qualitative data collection in Architecture: Interview

Module-6 Referencing
Types of referencing styles. Writing the bibliography using M.S Word and Mendeley. Plagiarism checks and process.

Module-7 Introduction to Statistics
Converting data into numerical form for data analysis. Introduction to the simple statistical methods of analyzing numerical data – frequencies / percentages, mean / median / mode, correlation, chi square test – inferring from the data and interpreting the meaning of those inferences. Use of MS Excel/SPSS for statistical data analysis.

Module-8 Report Writing
Presentation & Reporting: Presentation of the Data: Techniques of presenting the numerical data – graphical (pie charts, bar charts, line
REFERENCES:

1. Research Methodology; C.R.Kothari; New Age International (P) Ltd.
2. Research Methodology; D. K. Bhattachary; Excel Books
3. Research Methodology; Goodday& Hack
5. Research Design: Qualitative, quantitative and mixed methods approaches
20. Selected Research Papers and Studies
MED – 103 TRADITIONAL WISDOM AND SUSTAINABILITY CONCEPTS

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OBJECTIVES:

- The aim is to introduce the culture and knowledge systems of traditional community systems.
- To facilitate application of learnings from traditional and vernacular strategies both at macro and micro levels to mitigate the negative impacts of environment.
- To analyse the viability of sustainable tactics in traditional knowledge and apply it in design of contemporary environment.

Module-1 Philosophy of Primitivism

Module-2 Traditional Wisdom and Vernacular Beliefs
Traditional cities, Historic Buildings, Communities, Neighborhoods and House-Forms as suitable responses to existing environment. Studies from all over the world especially India from the macro to micro levels in lessons for sustainability useful for application in contemporary context.

Module-3 Water Management Systems from Traditional Settlements
Responses of Traditional Communities all over the world to land form and Water Systems for effective management drainage and suitable use. Indian Examples from diverse climate zones & Cultures for understanding resource management as steps to Sustainability. For e.g. Kunds, Baolis, Tankas, Stepped wells, Dongs, Jhalaras, Talabs, Ahar Pynes along with city level schemes.

Module-4 Learning from Vernacular & Traditional Architecture
Study of Traditional and Vernacular architecture in history of the world, with special emphasis on Indian architecture to understand shelter based on functions, building materials and construction techniques, art and craft, local conditions, traditions, climate and geography, religion & culture. Brief overview of the varied learnings from vernacular including Sense of Place, Spontaneity & variation, Control, Open Ended form Relationship, Symbols & Meanings.

Module-5 Sustainability concepts
Sustainable Built Environment: An Indian experience. Perceiving the built environment as a closed and inter-dependent system. Identifying the environmental, social, cultural and economic benefits of each approach.

Module-6 Heritage and Cultural Landscape
Landscape Heritage, meaning, significance especially in Indian Context, Need for their revival as response to Environment, Understanding evolving attitudes to open space design in India: ancient horticultural tradition, Mughal and British colonial influence. Examining Cultural and Sacred Landscapes and their capacity to build knowledge.
REFERENCES:

2. Gram Swaraj by M. K. Gandhi, Navjeevan Trust publication, Ahmedabad
3. Gram Geeta by Rashtrasant Tukdoji Maharaj, Govt. of Maharashtra publication.
4. Tribes of Central India, Publications of Vriksha mitra, Chandrapur, M. S.
5. Green is Red, by Ar. Anil Laul, New Delhi.
Objectives:

- To understand how to apply the basic thermodynamics to the human environment.
- To comprehend the basic composition, structure and dynamics of the atmosphere.
- To explore the working of the hydrologic cycle and discuss the mechanisms of water transport in the atmosphere and in the ground.
- To examine specific environmental problems such as noise pollution, ozone depletion and global warming in the context of an overall understanding of the dynamics of the atmosphere.

Module 1: Thermodynamics


Module 2: Meteorology and Atmosphere

Structure and composition of the atmosphere, ozone in the atmosphere, greenhouse effect, global warming, hydrosphere and hydrologic cycle. Atmospheric transport of pollutants, Meteorological parameters such as wind direction, wind velocity, temperature, solar radiation, humidity, topography, precipitation, inversion etc. Instruments and systems of their measurements.

Module 3: Daylight

Radiation spectrum, spectral sensitivity of eye, visual cone and comfort, daylight assessment, types of reflection, glare and quality and spread of light in buildings. Principals of day lighting, day lighting requirements in building, prediction techniques, day lighting systems, simulation techniques and methods.

Module 4: Noise and noise controls

Sound waves, audible range of sounds, equal loudness controls, noise reduction systems, sound transmission path. Sound principles, Noise and noise control in various climates, design aids.

Module 5: Material Properties

Thermal conductivity, emissivity, radiation, reflectivity and convection. Density, specific heat, latent heat, thermal bridging, diffusivity, thermal insulation. Heat loss through common building elements due to transmission, R-values and U-values - imperial and SI units.

Module 6: Advanced heat exchange systems

Reduction of Heat Transfer or Enhancement, insulation properties of materials and built forms. Radiation versus other Heat Transfer Methods. PCM, Radiant cooling, Chilled beam, Geo-thermal, etc.

Module 7: Renewable energy resources

Working of Renewable energy resources like Solar, Wind, earth and water.
REFERENCES:

1. Nigel Mason and Peter Hughes: Introduction to Environmental Physics: Planet Earth, Life and Climate, Taylor and Francis, 2001
2. Baird, George. The architectural expression of environmental control systems
12. Kulbhushan Jain, Earth Architecture
MED – 105 ENVIRONMENTAL MODELLING AND COMPUTER APPLICATION

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OBJECTIVES:

- To introduce and give an overview of methods for environmental modelling and its purpose.
- To impart knowledge and experience in model construction and its evaluation.
- To familiarize software simulation tools for energy efficiency, noise, acoustics, air quality, fire, etc.

Module-1  Introduction

Key concepts within Environmental Modelling, for including calibration, verification, validation, robustness, model error, oscillation, discretization, and distinguishing between deterministic and stochastic models. Identifying dominant processes and carrying out sensitivity analyses.

Module-2  Environmental Modelling Tools

Familiarization of some simulation tools for Environmental Modelling of Noise, Pollution, Fire, Energy, Daylight, Thermal Comfort, Urban Heat Islands, Natural Ventilation among others

Module-3  Material and Schedules Input


Module-5  Simulation Results and Analysis

Modelling the Building performance enabling optimization of the design for using lesser Energy and Water; along with Noise and Pollution Control; Fire and Rescue Services; and Life Cycle Cost Analysis

Module-7  Application

On introductory level, communicating environmental modelling for different users, and describing its role within research and development, environmental (including risk) and policy issues. Application on the on-going Design Project.

REFERENCES:

8. Energy Simulation in Building Design by Joseph Clarke
MED – 106 ELECTIVE-I (DEPARTMENTAL)

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OBJECTIVES:

A variety of Electives have been proposed to facilitate the design process of Initial Semester Environmental Design Studios

A. FAÇADE DESIGN FOR ENVIRONMENTAL RESPONSIVENESS

B. BIOMIMICY & BIOMIMETICS
This course will familiarize students with some of the processes and methods of establishing principles through observations, experimentation, and constructing models of living organisms. Assisting students to comprehend how nature (biology) responds to the dynamics of environment and Geology. Students are encouraged to ascertain learnings from nature that be incorporated within the design process. The focus is on the integration among the components of ecosystems: living organisms; climate; and the chemical environment. The ultimate goal of the course is to encourage students to apply the lessons of nature into their design experience in varied fashion and come up with design products supporting sustainability principles.

C. LANDSCAPE DESIGN FOR SUITABLE ENVIRONMENT
The objective of this course is to examine the involvement of developmental activity and its intervention in natural processes in order to minimize its impact. The course introduces the art and general principles of designing, modifying and beautifying natural landscapes using suitable plant species along with other landscape elements. Aspiring to equip students with skills in designing, planning and managing green spaces and natural landscapes in context to urban areas. This course sensitizes students with the importance of landscape design in planning and development of environmentally suitable urban areas along with providing students with knowledge on the types and management of plants suitable for that region. Indoor Gardens, Vertical Garden Terrace Garden etc. for contemporary built environment. How to reduce urban heat islands & Make public spaces more comfortable by efficient Landscape Design.

D. POLLUTION MONITORING & CONTROL
This course is to familiarize students with Pollution – Sources, Causes / Pollutants and their Effects, Emission Sources, Vehicular Emissions, Techniques of Monitoring of Emissions, Emission Standards, and Ambient Air Quality. Concepts of Relevant Meteorological Parameters, and Interpolation of Data, Wind System Measurement, Turbulence, Mixing Height, Plume Use, Dispersion Models. Varied Types of Pollution their control and Monitoring Systems along with Analyses.

E. BUILDING PERFORMANCE ANALYSIS
The objective of this course is to understand Metering systems - Analysis of collected data from existing buildings - Economic aspects of energy simulation results: LCA, payback analysis, break even analysis, benefit cost analysis, present worth analysis, etc. - Selection of appropriate ECM from modelling results - Recalibration of the model from actual performance data.
M. ARCH. IN ENVIRONMENTAL DESIGN SEMESTER – I

F. SUSTAINABLE BUILDING MATERIAL & TECHNOLOGIES

To introduce concepts of Eco Friendly building materials and Technologies along with alternative methods of building energy efficient construction. Environmental impact of building materials & Technologies, Eco Friendly building materials, their composition, production and recycling, physical properties etc. Embodied energy of materials like steel, flyash bricks, gypsum, eco-boards etc. Life Cycle assessment of materials. Introduction to alternative building technologies: Traditional, Curtain Walls, Pre-fabrication and Modular etc. An In-depth understanding of Sustainable Technologies and their applications.

REFERENCES:
7. Cever Francisco a: Elements of landscape world of environment.
10. Ethics In Design. Thames And Hudson,
11. Randhawa M S: Flowering Trees. India
MED – 201 ENVIRONMENTAL DESIGN STUDIO-2 (Campus design)

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OBJECTIVES:

- To apply the design principles for energy efficiency and sustainable development
- Design of Institutional Campus, Group Housing, IT campus etc. OR Project with increased complexities with respect to energy efficiency and sustainable principles.
- Study and the application of environmental planning at settlement level.

Module 1

- **Environmental Planning**
  - Introduction to Environmental Planning, Definition of environment, types of environment, pollutants and their effects. Ecosystem - types, components, energy flow, interactions is ecosystem. 
  - Physical Environment - air environment, water environment, soil environment.

Module 2

- **Application of Campus planning environmental design codes**
  - GRIHA and IGBC etc. guidelines for campus planning

Module 3

- **Case Studies**
  - Analysis of a campus in terms of its thermal properties, infrastructure etc. as an individual assignment in form of a report/ppt/ sheets

Module 4

- **Design Problem**
  - Design of a campus – Housing, institute, commercial etc. considering environmental design concepts

References:

MED – 202 DESIGN FOR LIGHTING, WATER AND WASTE TREATMENT SYSTEM (MEP-I)

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OBJECTIVES:

- To introduce the services like Mechanical, Electrical and Plumbing (MEP) and its sustainable usage and management for environmental benefits.
- To introduce environmental technologies for lighting design, waste management, water management and waste to energy, at city and building project level.

Module 1 Introduction

Introduction to Infrastructure Planning & Management, Aspects of Mechanical, Electrical and Plumbing (MEP) services at building and campus level.

Module 2 Sustainable lighting Design


Module 3 Sustainable Water Management


Module 4 Sustainable Waste Management


Module 5 Application

Services studied should be applied to Environmental design studio problem.

References:
Faculty of Architecture and Planning, AKTU, Lucknow

M.Arch. in Environmental Design Semester – II

MED – 203 ECOLOGY AND BIODIVERSITY (LAND, WATER AND VEGETATION)

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OBJECTIVES:

- To study effect on vegetation, water and Land due to excessive usage, and human interventions.

Module 1  Ecosystem Concept  Biotic and abiotic factors in the environment. Food chains, Food web, Ecological pyramids and energy flow, Ecological niche, Ecological limits, adaptation to environment, Biogeochemical Cycles [N, S & P]

Module 2  Major Ecosystems, Biogeography  Aquatic: Marine & Freshwater  Terrestrial: Forests, Deserts & Grasslands

Module 3  Biodiversity  Biodiversity and interrelationships between species and their environment and how these interrelationships sustain biodiversity. Biodiversity at Global level, Major Biodiversity areas of the world, Biodiversity Hot Spots, Biodiversity at Indian level


Module 6  Vegetation  Vegetation as a design element affecting function, comfort, energy efficiency and aesthetic quality. Selection of appropriate vegetation to serve functional and aesthetic purposes. Specifications for planting design.

References:
1. Modern Concepts Of Ecology (E.D. 5) by Kumar H. D.
2. Ecology (ED. 2) by Odum Eugene P.
3. Global Biodiversity Assessment by Heywood V.H. & Watson, R.T.
4. Conservation biology: voices from the Tropics by Gibson, L. & Raven, P.HG.
MED – 204 REMOTE SENSING & GIS APPLICATION

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<tr>
<th>PERIODS</th>
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OBJECTIVES:
- To comprehend the evolution of urban form and conscious urban planning
- To understand the various strategies planners employ for an ideal urban plan.

Module-1 Introduction to Remote Sensing
- Basic concepts; Multi-concepts in Remote Sensing
- Advantages of Remote Sensing data
- Applications of Remote Sensing

Module-2 Remote sensing tools and methodology
- Remote Sensing Platforms & Sensors
- Remote sensing Data products
- Referencing scheme
- Digital data format and characteristics
- High resolution images
- Image processing software

Module-3 Remote Sensing analysis
- Geometric & Radiometric corrections
- Visual image interpretation methods
- Digital image enhancement
- Digital image classification methods
- Accuracy assessment

Module-4 Geographical Image System
- Basic concepts of GIS
- Digital representation of geographic data, digitization of features;
- Database creation
- Raster and vector based GIS data
- Overlay analysis, Buffering, Query, Spatial analysis / 3D analysis
- Introduction software, Application of GIS

Module-5 Data and national Policies
- National Spatial Data Infrastructure in India, National Urban Information system, National Map Policy.

REFERENCES:
# MED – 205  ENVIRONMENTAL CODES: ENERGY RATINGS, AUDIT & IMPACT ASSESSMENT

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## OBJECTIVES:

- Introduction to energy conservation in buildings, international and national energy conservation building codes and rating systems, use and application of various codes in India, Use of codes or certification.
- The aim of the subject is to introduce the students to techniques for carrying out an assessment of the impact on the environment.

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<tr>
<th>Module 1</th>
<th>Introduction</th>
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<tr>
<th>Module 2</th>
<th>The Environment (protection) Act</th>
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<td>The Environment (protection) Act 1986, rules to regulate environment pollution and Prevention, control and abatement of environmental pollution and institutional mechanism.</td>
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<th>Module 3</th>
<th>Study of Indian codes &amp; Rating systems</th>
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<th>Module 4</th>
<th>Energy Audit</th>
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<td>detailed energy audit, quantify energy consumption and establish baseline energy information, Construct energy and material balance, Perform efficiency evaluation of energy &amp; utility systems, Compare energy norms with existing energy consumption levels, Identify and prioritization of energy saving measures and to analysis of technical and financial feasibility of energy saving measures, study of energy efficient technologies and alternate energy sources.</td>
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<th>Module 5</th>
<th>Environmental impact assessment</th>
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<td>Introduction and components such as physical, biological and socio-economical of Environmental impact assessment (EIA) in India based on the Environmental Protection Act (EPA), 1986, Ministry of Environment and Forest (MoEF) January 1994 for Environmental Clearance (EC) known as EIA Notification, 1994. Subsequent, amendments. The current practice is adhering to EIA Notification, 2006 and its amendments.</td>
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</table>
Module 6  Application

Use of codes and guidelines to get certification and rating for new and old buildings/campuses. Case studies to understand practical application of various codes.

References;
1. The Environment (protection) Act 1986
2. The Energy Conservation (Amendment) Act 2001, and Amendments
MED – 206 ELECTIVE-II (DEPARTMENTAL)

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OBJECTIVES:
- Electives are such that it facilitates in the design process of the Second Semester Environmental Design Studio based on the Campus Level design problem. Students can select from the following departmental level electives.

A. RESTORATION OF ECOLOGICAL DISTURBED CITIES
The goal of this course is to provide the skills and knowledge that need to restore any ecosystem of city that has been degraded, damaged or destroyed. It will focus on the underlying principles and approaches used in ecological restoration. Historical development of restoration concepts and the role that restoration can serve in the future stewardship of natural resources. The major ecological principles underlying the successful restoration of ecosystems of cities including concepts of disturbance and succession. Ecological and management principles and select appropriate methods and tools for designing and conducting restoration projects.

B. ENVIRONMENTAL ECONOMICS
This course introduces the economic perspectives on modern environmental issues. Students will study economic theories related to natural resources, with an emphasis on the strengths and weaknesses of alternative viewpoints. To learn that economic objectives do not necessarily conflict with environmental goals, and that markets can be harnessed to improve environmental quality. The limitations of economic analysis to provide policy guidance on environmental issues. The empirical techniques used by economists to put values on environmental commodities. Students should able to express an informed view regarding the potential of economics to help societies achieve their environmental goals.

C. SMART CITIES
The overall goals of this course is to obtain basic knowledge of smart cities and to learn how to analyze and compare existing smart cities projects. To learn how to analyze smart cities data using GIS and other related software. To explore how advances in information communication technologies affect the built environment at various scales (e.g., cities, districts, neighborhoods, blocks, buildings and to understand the role of multiple actors working at the intersection of technology and urbanism. To explore how urban spaces are shaped, for better or worse, by the complex interaction of technology, human societies, and the natural environment.

D. LIFE CYCLE THINKING FOR BUILDINGS
This course aims to provide knowledge and understanding about how cost and environmental issues affect the choice of design solutions and which measures need a longer term perspective than others, in order to get back the investment costs or make the building sustainable. To provide knowledge and understanding related to different types of actors’ interests (city-owned property owners, private property owners, property developers (build and sell), private home owners, builders, manufacturers etc). Aspects of barriers and possibilities. To explore methodology and tools for determining life cycle perspective issues like life-cycle costs and environmental certification.

E. HEALTHY BUILDINGS
This course attempts to answer two questions: What makes a building healthy, comfortable and productive for its occupants? How can we influence design, construction and operations to ensure healthy, comfortable and productive buildings? Healthy buildings theory. 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. Investigations of healthy living practices: washing people, washing clothes, removing waste, improving nutrition, reducing crowding, separating people from animals, vermin or insects, reducing dust,
controlling temperature and reducing trauma.

**F. ENVIRONMENTAL COMPLIANCE AND REPORT MAKING**

This course aims to provide students insight and knowledge of the process of environmental compliance process and methods of report making. This would be done through exploring existing environmental compliance reports of sustainable or green buildings achieved any of the green building rating. Second part of the course include report making for environmental compliance for their own design project of the previous semester.

**References;**

15. Manandhar, M., & Buick, P. 2012. Hospital, Heal Thyself, Clamor is hazardous to your health. Designer have the Rx., ArchitectureBoston