M. Arch.

IN

ENERGY EFFICIENT AND SUSTAINABLE ARCHITECTURE

CURRICULUM and SYLLABUS

(For students admitted in 2016-17)
M. Arch.

(ENERGY EFFICIENT AND SUSTAINABLE ARCHITECTURE)

CURRICULUM

The total minimum credits for completing the M.Arch. programme in ENERGY EFFICIENT AND SUSTAINABLE ARCHITECTURE is 60.

SEMESTER - I

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SYLLABUS

AR 701 – ENERGY, ENVIRONMENT & BUILDINGS

Nature and extent of the energy and environmental crises facing the world and the country. Need for implementing energy efficiency on an international, national and individual basis in the context of the building industry & environmental issues. Energy consuming sectors in the country. Primary, delivered and end – use energy.


REFERENCES:

AR 703 – BUILDING SCIENCE AND SUSTAINABILITY

Heat transfer processes in buildings. Thermal conductivity, resistance, transmittance, surface characteristics, surface coefficient, heat capacity, insulation.

Calculation of principle building energy gains and losses. Estimation of building energy performance for heating and cooling for different climatic contexts.

Importance of energy to human development, conventional and renewable energy sources – supply, uses and environmental impact. Assessment future growth in energy demand, availability, potential for sustainable development. Sustainable issues of planning, building design and development.

References:


AR 705 – PASSIVE SOLAR ARCHITECTURE

Classification of passive cooling systems according to the major natural source from which the cooling energy is derived. Minimizing cooling needs by building design: building shape & layout, orientation, size of windows, shading of window, colour of the envelope and climatic impact of plants around building.

REFERENCES:


AR 707 – ASSESSMENT OF BUILT ENVIRONMENT


Reference:


AR 709 – BUILDING ENERGY ANALYSIS STUDIO

Exploration of a range of analytical and design tools. Understanding of capabilities of limitations of various energy analysis tools.

Tools to be explored – Solar shadow modeling tools, heat flow analysis, light simulation tools, modeling of ventilation, fire dynamics, sizing of passive solar features, estimation of energy
conservation. Studio projects involve design and evaluation of buildings to demonstrate energy analysis and efficiency of building designs.

References:


AR 702 – BUILDING ENERGY AUDIT AND MANAGEMENT


Energy management matrix as a tool to diagnose the current state of energy management in any given organization. Management issues covered in the matrix – energy policy, organization, motivation, information systems, Marketing & investment. Determining the organizational profile. Monitoring & Targeting of energy use.

Identification of opportunities for reducing energy consumption – improvements to the building fabric & building services.

Details of building energy survey – building information, building physical data, building envelope construction details, mechanical systems, electrical systems & equipment, hot water systems, indoor environmental conditions for each space, control systems and operating schedules.

References:


AR 704 - GREEN ARCHITECTURE

Definition of Green Building. Impact of design, construction & maintenance of buildings on our environment and natural resources. Benefits of building green. Design of buildings to use renewable energy, optimization of materials use, design of water-efficient, landscaping, recycling waste, use of “gray water”. Siting & Land Use

Materials – choosing low-maintenance, low embodied energy recyclable building materials. Equipment – high-efficiency heating or cooling equipment, lights and appliances and installing water-efficient equipment.

Job Site & Business – protecting trees and topsoil during site work, minimizing job-site waste, making business operations more environmentally responsible. Life cycle costing of the building and components including the economic & environmental impact and performance.

REFERENCE:


AR 706 – LIGHTING DESIGN


Electrical light sources and Luminaires. Task requirements, point-by-point method, Lumen method, Qualitative calculations and Supplementary Artificial Lighting.

REFERENCES:


AR 708 - ENERGY EFFICIENT LANDSCAPE DESIGN

The climatic impact of natural elements. Thermal properties of commonly used building materials for outdoor spaces. Site analysis processes & techniques. Site selection, siting & orientation for energy conservation. Integration of building & site for energy conservation. Site planning, Site design for energy conservation.
Selection & use of landscape elements for microclimatic modification, Radiation modification, Wind modification, Temperature, humidity & precipitation modification.


REFERENCE:


AR 710 – BUILDING MODELLING & SIMULATION

Creating primitive objects. Moving objects in 3D space. 3D modeling data and operations; Solids (geometry+ topology); Creating "cameras", projections from 3D to 2D, saving3D images. Creating a shading group. Placing texture maps on an object. Adding lighting to a scene. Test rendering a single frame. Setting up motion blur. Rendering images using the software renderer. Applications of 3D animation. Survey of modeling tools. Basic concepts in GIS and CAD/GIS data interchange techniques, Creating a contoured base-map, developing a surface model, developing a slope map, aspect map.

Introduction to virtual reality and virtual environments. Issues covered will include VR technology, software design, 3D human-computer interaction, and applications of VR.
REFERENCE


AR 711 – STATISTICS FOR ENVIRONMENTAL DESIGN


Binomial, Poisson and Normal Distributions. Data Visualization and analysis for Curve fitting – Multiple and partial correlation – regression. Introduction to ANOVA.

Type I and II errors in testing – tests concerning mean, proportion and variances (small and large sample tests) – T test for single mean, difference between two sample means – F test for variances of two samples. Working with statistical software to handle large sets data. Testing of Significance, Hypothesis, ANOVA conducting and reporting of Statistical investigations.

REFERENCES:


**AR 713 – ENVIRONMENT AND BEHAVIOR**


Environment and Behavior studies related to Noise, Weather, Climate, Territoriality, Disasters, Crowding. Issues related to built environment such as design of residential, institutional, work, learning and leisure environments.

**REFERENCES:**


**AR 715 – ENVIRONMENTAL LIGHTING**

Lighting Design – Effect of light on user orientation, room comprehension, form, structure and materials. Impressions of visual clarity, spaciousness, relaxation, privacy etc. Interior lighting design requirements for offices, factories, commercial interiors, museums and galleries, etc.
Exterior lighting: Functional requirements, buildings and facades, pedestrian routes and surrounding areas, parking areas and landscape lighting. Emergency lighting: Escape lighting, shutdown lighting and standby lighting, equipment and system design. Integration of daylight and artificial lighting. Economics of supplementary lighting.


REFERENCES:


AR 717 – NATURAL VENTILATION


Ways of natural ventilation – single side ventilation, cross ventilation, stack effect and reverse stack effect. Dissipation of structural heat. Ventilation strategies for various climatic zones in India. Air movement around the buildings and air movement through the buildings. Effects of building form and orientation. Fenestration design of buildings to enhance air movement and ventilation.

REFERENCES:


AR 712 - RESEARCH METHODS

Research aims and philosophy; research paradigms. Literature search and review; the use of libraries and databases; aim and structure of a literature review. Presentation; Introduction to scholarly writing; writing and publishing a paper; writing and presenting a conference paper; presentation of scientific research.

Analysis of a new problem, principles of experimental design, field surveys, theoretical models and laboratory experiments. Introduction to behavioral research and physical research.

Behavioral research: Obtain data; questionnaires, interviews, un-obstrusive & obstrusive measures; scales such as a semantic differentials. Physical research: laboratory; resources available; equipment for laboratory and site measurement.

REFERENCES:

AR 714 – HEALTHY BUILDINGS


Fundamental principles of fire safety engineering. 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.


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.

References:

AR 716 – INTELLIGENT BUILDINGS


Building automation systems - approaches, application – lighting, security, fire detection, office automation, vertical transportation, surveillance. Technologies – field devices, digital
controllers, system controllers, man-machine interface, Sensors. Automation control strategies.

References:


AR 718 - POST OCCUPANCY EVALUATION OF BUILDINGS


Students are required to carry out post occupancy evaluation of a building and document the relationship between building design, energy use, occupant satisfaction, environmental impact and report their observations.

References: