**University of Management and Technology**

**School of Architecture & Planning**

**Department of Architecture**

Course code: **AR-** 607 Course title: **Energy Efficient Architecture**

|  |  |
| --- | --- |
| Program | M-Arch |
| Credit Hours | 3+0 |
| Duration | Course: 16 weeks |
| Prerequisites | None |
| Resource Person | As per timetable |
| Counseling Timing | Kindly see office window |
| Contact | - |

**Chairman/Director signature………………………………….**

**Dean’s signature……………………………** **Date………………………………………….**

**Learning Objective:**

The objective of this course is to familiarize participants with energy efficient strategies that are required during the early phases of design. It will help the participants to reduce energy demand in buildings, thus reducing the environmental impact of buildings. It covers basic principles of thermodynamics and energy use in buildings, thermal comfort, climate and solar geometry, passive design techniques and simulation tools to model the indoor environment and energy analysis.

**Learning Methodology:**

* Lectures as provided in the schedule of the semester activities
* Study of recommended books uploaded on the Moodle and class given notes.
* Presentation on allocated topics

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in percentage** Quizzes 5%

Assignments 5%

Mid Term 25%

Project / Term Paper 15%

Final exam 50%

Total 100%

**Passing Marks = 60%**

**Recommended Text Books:**

* **Sustainability through Energy efficient Buildings** by Amritanshu shukla
* **A Handbook of Sustainable Building Design & Engineering** by Dejan Mumovic
* **Energy Smart Buildings, Design, Construction and Monitoring for improved Energy Efficiency** by Jacob J Lamb, Bruno G Pallet
* **Architecture and the Environment, Bioclimatic Building Design** by Jones
* **Climatic Responsive Architecture: A design Handbook for Energy Efficient Buildings** by Arvind Krishan
* **Environmental control system** by Fuller Moore
* **Passive Solar Architecture; Heating, cooling, ventilation, daylighting and more using natural flows** by David Bainbridge, Ken Haggard
* **Heating, Cooling, Lighting-Sustainable design Methods for Architects** by Norbert Lechner, 4th Edition, 2015,Published by John Wiley & Sons, Inc., Hoboken, New Jersey,
* **The Architectural Expression of Environmental Control Systems** by George Baird; Edition 2004, Taylor and Francis Group
* **Sun, Wind & Light. Architectural Design Strategies** by G.Z.Brown, Mark DeKay,, 2nd Edition, 2001, John Wiley & Sons.
* **Sustainable Building Design** by Chitrarekha Kabre

**Calendar of Course contents to be covered during semester**

**Course code: AR-233 Course title: Environmental Control System - 1**

|  |  |  |
| --- | --- | --- |
| **Week** | **Course Contents** | **Reference Chapter(s)** |
| 1 | Introduction to Energy efficient architecture  Background  Facts related to Energy consumption and crisis  Definition of Energy Efficient buildings  Certifying EE Buildings  EE measures in a building  Reducing Heating Demand  Reducing Cooling Demand  Assignment # 1 | Chapter 1  Energy Smart Buildings, Design, Construction and Monitoring for improved Energy Efficiency  by Jacob J Lamb, Bruno G Pallet  Other Reading Material like research Articles |
| 2 | Heat and temperature  Physics of heat  Theories of heat transfer  Greenhouse effect  (heat flow, time lag) | 1.1 Physics of Heat  From Part 1 of the book by Steven V. Szokolay ( Introduction to Architectural Science)  Chapter 3  From the book by Norbert Lechner |
| 3 | Energy Balance of A building  Methods to calculate energy exchange  Dynamic. Empirical and static methods andd their comparison  Sustainable Buildings --- An approach towards Energy  Efficiency; Impact of Building Envelope (orientation and glazing  material) on Energy Efficiency in semi arid climate (A case study  of Lahore) |  |
| 4 | Introduction to Term Assignment  Allocation of topics  Detailed lecture on gathering required data |  |
| 5 | Building Design and Envelope  Energy efficient Envelope  Creating an energy efficient envelope | - |
| 6 | Creating an energy efficient envelope  Components of building Envelope  Opaque Components  Transparent components  Solar systems  Air Tightness  Thermal bridges |  |
| 7 | Progress on Term Assignment | Chapter 1  From the book by Norbert Lechner |
| 8 | Demonstration of a software for term Assignment | - |
| 9 | Mid Term Examination |  |
| 10 | Workshop on Thermal modeling and analysis by an external focal person (Revit Analysis) |  |
| 9 | Heat and temperature  Physics of heat  Theories of heat transfer  Greenhouse effect  (heat flow, time lag)  Quiz-1 | 1.1 Physics of Heat  From Part 1 of the book by Steven V. Szokolay ( Introduction to Architectural Science)  Chapter 3  From the book by Norbert Lechner |

|  |  |  |
| --- | --- | --- |
| 10 | Impact of User Behaviour on making a building more efficient and comfortable  Rebound Effect  Quiz-2 | - |
| 11 | Building Retrofitting |  |
| 12 | Building Retrofitting  Energy savings & Cost effectiveness  Challenges  Common Solutions of retrofitting |  |
| 13 | Discussion Term Assignment | 1.4 Thermal behavior of buildings Part 1 of the book by Steven V. Szokolay ( Introduction to Architectural Science) |
| 14 | Discussion Term Assignment |  |
| 15 | Energy Audit | Guest Lecture |