**University of Management and Technology**

**Course Outline**

Course code: **AR-315**

Course title: **Environmental Control Systems-II**

## UMT’s Vision

*Our Vision is... Learning*

It defines our existence, inspires all stakeholders associated with us, creates a powerful momentum inside, and responds to the challenges outside. It continues to evolve as present captures new realities and foresight to unfold new possibilities. All in an incessant attempt to help individuals and organizations discover their God-given potentials to achieve Ultimate Success actualizing the highest standards of efficiency, effectiveness, excellence, equity, trusteeship and sustainable development of global human society.

## UMT Mission

*Our Mission is.... Leading*

We aspire to become a learning institution and evolve as the LEADING COMMUNITY for the purpose of integrated development of the society by actualizing strategic partnership with stakeholders, harnessing leadership, generating useful knowledge, fostering enduring values, and projecting sustainable technologies and practices.

### Mission of the School

The mission of the School is to provide the best leadership in the fields of the built environment; particularly in the development, management and innovation in the fields of architecture, urban planning and related specializations and sub-specializations

### Mission of the Department

At the Department of Architecture our mission is to challenge the participants to develop their abilities in solving complex problems by thinking creatively & informed decision making as a core of their professional schooling. Offering them a diverse interdisciplinary and meticulous program of studies led by an adroit faculty in a comprehensive studios or class environment and preparing them for leadership roles in the field of Architecture, Construction, Landscape, Built Environment and community development.

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| --- | --- |
| Program | B.Arch. |
| Credit Hours | 2+0 |
| Duration | 16 Weeks |
| Prerequisites | AR-215, **Environmental Control Systems-I** |
| Resource Person | **Section A :** Ar. Saira Naeem  **Section B :** Ar. Muhammad Nasir Chaudhry |
| Counseling Timing  (Room# 3L-03 ) | **Section A:** Wednesday : 3 – 5 p.m. & Thursday: 10 – 12 a.m. |
| Contact | saira.naeem@umt.edu.pk  [Nasir.chaudhry@umt.edu.pk](mailto:Nasir.chaudhry@umt.edu.pk)  0331-6274724 |

**Instructors signature………………………………..…………….**

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

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

**Program educational objectives (PEO’s)**

**PEO 1:** Ability to think creatively and identify new trends in Architectural design

**PEO 2:** Critical learning for a broad function in various areas of Architectural sciences including structural, mechanical, electrical, environmental, earthquake, and construction management

**PEO 3:** Ability to keep themselves abreast with recent developments in the relevant Architecture.

**PEO 4:** Spirit of discipline and respect for the code of ethics of the profession.

**Program Learning outcomes PLO’s)**

Graduates of the B-Architecture at UMT are expected to have acquired and developed the following set of knowledge, skills and personality traits (these are also referred to as graduate attributes).

**PLO 1** **Architectural Knowledge:** An ability to apply knowledge of mathematics, science, architectural fundamentals and an architectural specialization to the solution of complex architectural problems.

**PLO 2** **Design Analysis:** An ability to identify, formulate, search literature, and analyze complex architectural problems reaching substantiated conclusions using principles of natural sciences and architecture.

**PLO 3** **Design/Development of Solutions:** An ability to design solutions for complex architecture problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

**PLO 4** **Case study analysis:** An ability to investigate complex architecture problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

**PLO 5** **Modern Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern architectural computer simulations, including prediction and modeling, to complex activities, with an understanding of the limitations.

**PLO 6** **The Architect and Society:** An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional architectural practice and solution to complex problems.

**PLO 7** **Environment and Sustainability:** Ability to understand the impact of professional architectural solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

**PLO 8** **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of architectural practice.

**PLO 9** **Individual and Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.

**PLO 10** **Communication:** An ability to communicate effectively, orally and written, on complex architectural activities with the architectural community and with society at large, such as being able to comprehend and write effective reports, design documentation and make effective presentations. To develop an understanding of architectural language through manual and digital ways, in order to make working drawings and presentable sheets using different rendering modes.

**PLO 11** **Project Management:** An ability to demonstrate management skills and apply architectural principles to one's own work as a member and/or leader in a team and to manage projects in a multidisciplinary environment.

**PLO 12** **Lifelong Learning:** Ability to recognize the importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

**Course Learning outcomes (CLO’s)**

After studying this course, the students will be able to better understand:

1. Exercise the concepts related to Solar Geometry (C1)
2. Develop tools to study best possible building orientation and massing (C2)
3. Exercise the concepts related to Passive ventilation using requisite tools (C3)
4. Exercise the concepts related to Passive heating using requisite tools (C4)
5. Exercise the concepts related to Passive cooling using requisite tools (C5)
6. Exercise the concepts related to acoustics using requisite tools (C6)
7. Exercise the concepts related to daylight integration in building using requisite tools (C7)
8. Introduction to Green Building tools and their application on different building types (C8)

**Mapping of CLO’s to Program’s Learning outcomes (PLO’S)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Title** |  | **Course Learning outcomes** | **PLO 1: Architectural Knowledge** | **PLO 2: Design Analysis:** | **PLO3: Design/Development of Solutions Design/Development of Solutions Design/Development of Solutions Design/Development of Solutions** | **PLO 4: Case study analysis** | **PLO 5: Modern Tool Usage** | **PLO 6: The Architect and Society** | **PLO 7: Environment and Sustainability** | **PLO 8: Ethics** | **PLO 9: Individual and Team Work** | **PLO 10: Communication** | **PLO 11: Project Management** | **PLO 12: Lifelong Learning** |
| **AR-315** | **Environmental Control Systems-II** | C1 | Exercise the concepts related to Solar Geometry (C1) | √ |  | √ |  |  |  | √ |  |  |  |  | √ |
| C2 | Develop tools to study best possible building orientation and massing (C2) | √ | √ | √ |  |  |  | √ |  |  |  |  | √ |
| C3 | Exercise the concepts related to Passive ventilation using requisite tools (C3) | √ | √ | √ | √ | √ |  | √ | √ | √ | √ | √ | √ |
| C4 | Exercise the concepts related to Passive heating using requisite tools (C4) | √ | √ | √ | √ | √ |  | √ | √ | √ | √ | √ | √ |
| C5 | Exercise the concepts related to Passive cooling using requisite tools (C5) | √ | √ | √ |  | √ |  | √ | √ | √ | √ | √ | √ |
| C6 | Exercise the concepts related to acoustics using requisite tools (C6) | √ | √ | √ |  |  |  | √ |  | √ | √ | √ | √ |
| C7 | Exercise the concepts related to daylight integration in building using requisite tools (C7) | √ | √ | √ | √ |  |  | √ |  | √ | √ | √ | √ |
| C8 | Introduction to Green Building tools and their application on different building types (C8) | √ |  | √ | √ | √ | √ | √ | √ |  |  |  | √ |

**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

**OBJECTIVE:**

Understanding of the basic principles and appropriate application and performance of environmental systems, including **passive strategies,** **acoustics**, **lighting**, **ventilation systems**, and **building envelope**. Also disseminating an understanding of **Green Building Standards**.

**Acoustics**

* Sound: sound and distance, sound pressure level, music and noise, frequency spectrum,
* air borne noise, reverberation & its effects in built environment for good listening conditions.
* Acoustic materials and construction.
* acoustical requirements of different types of building.
* Sensibility of human ear, subjective effects.
* Behavior of sound in enclosed spaces.
* History of acoustics examples from the part, buildings and methods used for good acoustics.
* Effects of geometry and shape; acoustical properties of building materials, absorption coefficient; choice of materials.
* Echoes, reflectors; sound amplification and distribution.
  + Principles of acoustical design process.
  + Source and type of noise in and around buildings, methods of noise control.
  + Sound isolation, speech, privacy, and electronic sound systems, Case studies of auditorium.

**Passive Heating, Cooling, and Building envelope**

* Introduction to elements of nature (i.e. wind, sun) for passive heating and cooling
* Introduction to modes of heat transfer
* Massing and Orientation study for Building envelope
* Introduction to design strategies (i.e. Thermal Mass) for passive heating and cooling
* Sun path analysis
* Wind path analysis
* Purge ventilation for passive cooling

**Passive Ventilation**

* Introduction to Ventilation Mechanics of air motion,
* earth’s boundary layer,
* Perception and measurement of wind speed ventilation (natural/mechanical),
* Ventilation processes such as stack effect, wind effect and turbulence,
* Ventilation rates, distribution and air movement,
* Vertical positioning of apertures,
* Positioning of windows and wing walls, shielding effect of buildings, tall buildings, wind chill etc
* Principles and design strategies for supply and return air, ducts and their sizes, air infiltration, air quality and building environmental assessment.

**Lighting**

* Introduction to design for daylight
* Building orientation and massing for daylight
* Façade design for daylight
* Internal space elements/techniques to complement daylight

**Green Building Standards**

* Introduction to popular Green Building Standards (i.e. LEED, BREEAM)
* Introduction to the framework of LEED standards
* Case study analysis of
* Building orientation and massing for daylight

**Practical**

Assignments, projects, visits to building sites etc. based upon / with reference to above theory course.

**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 15%

Assignments 15%

Mid Term 20%

Final exam 50%

**Total 100%**

**Recommended Text Books:**

**Architectural Acoustics 2nd Edition**

**Reference Books:**

* Architectural Acoustics by David Egan (Author)
* Architectural Acoustics by Christopher N Brooks , Publisher: McFarland & Company (Nov’02)
* Designing Spaces for Natural Ventilation- An Architect’s Guide Ulrike Passe and Francine Battaglia, 2015, Routledge- Taylor & Francis
* Heating, Cooling, Lighting-Sustainable design Methods for Architects by Norbert Lechner, 4th Edition, 2015,Published by John Wiley & Sons, Inc., Hoboken, New Jersey,
* Introduction to Architectural Science- The basis of Sustainable Design by Steven V Szokolay, 2nd Edition 2008, Elsevier
* Design - Tech: Building Science for Architects by Jason Alread & Thomas Leslie, 1st edition , 2007, Elsevier
* The Architectural Expression of Environmental Control Systems by George Baird
* Sustainable Architectural Design by Kuppaswamy Iyengar.
* Sustainable Construction by Sandy Halliday.
* Sun, Wind & Light. Architectural Design Strategies by G.Z.Brown, Mark DeKay,, 2nd Edition, 2001, John Wiley & Sons.
* Climate Responsive Architecture by Arvind Krishan
* Time Saver Standard for Architecture Design data-The Reference of Architectural Fundamentals by Donald Watson, Michael J. Crosbie & John Hancock Callender, 1999 McGraw-Hill
* Building with Earth Design and Technology of A Sustainable Architecture by Minke,Gernot, 2006 Switzerland

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

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| --- | --- | --- | --- | --- |
| **Week** | **Course Contents** | | **Reference Chapter(s)** | |
| 1 | Introduction to the course outline.  General Presentation on Environmental Control systems and its terminologies. | | **Design - Tech: Building Science for Architects by Jason Alread & Thomas Leslie, 1st edition , 2007, Elsevier**  *Chapter 4-* Natural Ventilation and Climate ,  *Chapter 6-* Natural Ventilation and Thermal Comfort | |
| 2 | Passive heating  **Assignment # 2** Elaborate 4 passive heating system case studies  2 national/international each  *Quiz # 1 Announcement* | | **Heating, Cooling, Lighting-Sustainable design Methods for Architects by Norbert Lechner**  *Chapter 7- Passive Solar*  **Sustainability in Architecture and Urban Design by Carl Bovill**  *(Part III – The Residential Scale*,  14- Passive Solar Heating | |
| 3 | Passive cooling | | **Heating, Cooling, Lighting-Sustainable design Methods for Architects by Norbert Lechner**  *Chapter 10- Passive Cooling*  **Sustainability in Architecture and Urban Design by Carl Bovill**  *(Part III – The Residential Scale*,  15- Passive Cooling | |
| 4 | Passive Ventilation | | **Heating, Cooling, Lighting-Sustainable design Methods for Architects by Norbert Lechner**  **Sun, Wind & Light. Architectural Design Strategies** by G.Z. Brown, Mark DeKay, 2nd Edition, 2001, John Wiley & Sons. (Part 2- Program And Use, C- Building Parts) | |
| 5 | Architectural Acoustics & Insulations (Part-1) | | Introduction to Architectural Science- The basis of Sustainable Design by Steven V Szokolay,  *Part 3- Sound: The Sonic Environment*  Design - Tech: Building Science for Architects by Jason Alread & Thomas Leslie,  *Chapter 6.5 - Environmental Control: Acoustics* | |
| 6 | Architectural Acoustics & Insulations (Part-2)  **Assignment # 4** Material Board : Collection of 5-5 acoustic-insulation architectural materials from market.  (group of 2 students)  *Quiz # 3 Announcement* | | Introduction to Architectural Science- The basis of Sustainable Design by Steven V Szokolay,  *Part 3- Sound: The Sonic Environment*  Design - Tech: Building Science for Architects by Jason Alread & Thomas Leslie,  *Chapter 6.5 - Environmental Control: Acoustics* | |
| 7 | Daylighting | | *To be announced* | |
| 8 | **Midterm exam**  **(18 – 23 Nov’19)** | | ­­­­­­­­------- | |
| 9 | Effect of Climate on Architectural Expression (local study)  Case study: Shakeel Qureshi House  **Assignment # 5** Material Board: 5-10 Fire protected/resistant materials  (group of 2 students) | | [**Effect of Climate on Architectural Expression**](https://architexturez.net/doc/az-cf-168632)  *In Seminar On Architecture, Edited by [Achyut Kanvinde](https://architexturez.net/documents?f%5Bauthor%5D=28048).* | |
| 10 | Effect of Climate on Architectural Expression (international study)  Case study: Eathship  **Assignment # 6** Report on Daylight use in UMT departments/blocks.  (Each block= group of 5 students) | | To be announced | |
| 11 | | Expression of Environmental Control to Overall Building Form  **Quiz # 04 - (Lec – 9,10)** | | *Chapter # 19*  **The Architectural Expression of Environmental Control Systems by George Baird** | |
| 12 | | Building Envelope study with respect to Passive design, acoustics, and lighting  **Assignment # 7**  Master Material Board  Combination of Assignment 4 & 5 | | *Chapter # 4*  **Sustainable Architectural Design by Kuppaswamy Iyengar**  *Chapter # 9*  **Sustainable Construction by Sandy Halliday** | |
| 13 | | Introduction to Green Building Standards (Part-1)  **Final Term Project** Preparation of scaled room model of 10’ x 10’ using accusative & insulation materials for sound and heat test demos. | | *To be Announced* | |
| 14 | | Introduction to Green Building Standards (Part-2)  **Quiz # 05 - (Lec – 12,13)** | | *To be Announced* | |
| 15 | | **Final project Submission**  **(Application of Learnt Strategies in their Architectural Design project )** | | Class presentation | |
| 16 | | **FINAL EXAM**  **(13 – 24 Jan’20)** | | ---------- | |