ESE-834: Sustainable Buildings

Background

1. Buildings account of nearly one third of global energy consumption, approximately one fourth of total GHG emissions and significant amount of potable water. Sustainable Buildings can reduce their energy use by 25 – 50%, GHG emissions by more than 40%, water consumption by nearly 40% and reducing solid waste generation by approximately 70%. Furthermore, people spend nearly 90% of their time inside the buildings, hence indoor environmental quality significantly affects the health, well-being, productivity and behavior of the occupants. Sustainable Buildings provide superior indoor environmental quality and hence have strong positive impact on the occupants.

Rationale

2. To equip the students with knowledge and expertise in the field of Sustainable Buildings

To enable USPCASE to become leading educational institute in Pakistan with expertise in the field of Sustainable Buildings

3. **Educational Objectives**

   a. Elaborate the fundamental concepts of Sustainable Buildings
   b. Discuss the best practices adopted worldwide to design and operate energy efficient, sustainable buildings with improve indoor environmental quality.
   c. To prepare students to carryout research in the fields related to Sustainable Buildings
   d. To develop necessary expertise and infrastructure in USCPASE to undertake funded projects pertaining to Sustainable Buildings

Input Obtained from Industry/Corporate Sector/Subject Specialists/Academia

4. The working paper has been sent to the following personals for their valuable feedback.

   a. Prof Harvey Bryan, Arizona State University (ASU)
   b. Aqrab Rana, Chief Executive Office, Pakistan Green Buildings Council (PGBC)
   c. Sikandar Ajam Khan, Dean, School of Art and Design (SADA), NUST

International Practice

5. Specify the universities of repute where the proposed course is being conducted.
   a. Arizona State University (ASU)
   b. Stanford University
   c. University of California, Davis

Proposed Timeframe of Commencement

6. Spring Semester 2019 (Elective course in MS degree programs in ESE, TEE and EP)

Course Contents

7. Give details of the course, on the following lines:
   a. Course Code ESE-834: Sustainable Buildings
   b. Title Sustainable Buildings
   c. Credit Hours 3
   d. Objectives

8. The objectives of this course are:
   a. Elaborate the fundamental concepts of Sustainable Buildings
   b. Learn the best practices adopted in wide to for sustainable buildings design and operation
   c. To prepare students to carryout research in the field Sustainable Buildings
   d. To develop necessary expertise and infrastructure in USCPASE to undertake funded related to Sustainable Buildings

Outcomes

9. The course should enable students to:
   a. Understand the importance of Sustainable Buildings
   b. Carryout applied research projects in the field of energy efficient buildings, indoor air quality, water conservation etc.
   c. Excel in the profession of green buildings and allied fields

10. **Contents with suggested contact hours:**

No.	Topics	Semester Weeks	Contact Hours
1.	Introduction • Importance of Sustainable Buildings • Features of Sustainable Buildings • Types of Green Building Rating Systems • Relevance with UN Sustainable Development Goals (SDGs) • Careers in Sustainable Buildings Field • ASHRAE Standard 189.1 • Project Management for Sustainable Buildings	1 Week	3
2.	Energy Consumption in Buildings • Significant Energy Users (SEUs) in Building • ASHRAE / ISO Energy Audits of Buildings • Features of Building Envelope • HVAC Systems • Energy Efficiency and Energy Conservation Measures • Renewable Energy Technologies for Buildings • Passive Design of Buildings • Net Zero Energy Buildings • Energy Manager System (EnMS – ISO 50001) for Building Applications • Commissioning of New and Existing Buildings • ASHRAE Standards 90.1 and 90.2 – 2016 • ASHRAE Standard 209 – 2018 • ASHRAE Standard 169 – 2013 • IECC – 2018	3 Weeks	9
3.	Water Conservation in Buildings • Water Consumption for Indoor & Outdoor Applications • Water Auditing and Water Conservation Measures • Water Efficient Fixtures	1 Weeks	3

	• Storage and Usage of Rain Water • Energy Policy Act (EP Act), Uniform Plumbing Code (UPC) 2006 and the International Plumbing Code (IPC) 2006		
4.	Indoor Environmental Quality (IAQ) • IAQ and Human Heath • Non-Organic Pollutants • Volatile Organic Compounds (VOCs) • ASHRAE Standard 62.1-2013 • Thermal Comfort of Occupants • ASHRAE Standard 55 • Indoor Lighting Levels • ANSI/ASHRAE/IES Standard 90.1-2016 • ASHRAE 52.2 • EPA Indoor Air Quality Building Education and Assessment Model (I-BEAM)	2 Weeks	9
5.	Materials and Resources • Sustainable Building Materials • Strategies to Minimizing Construction Waste • Waste Generation from Existing Buildings and Recycling	1 Weeks	3
6.	Location and Transportation 1. Carbon Footprint of Commuters 2. GHG Reduction Strategies e.g. Walking, Cycling, Car Pooling, Public Transportation, Green Transportation Technologies	1 Week	3
7.	Applications of Simulation Software and Benchmarking Tools • Energy Star and Portfolio Manager (Benchmarking Energy and Water Consumption) • eQUEST Software (for Energy Modeling) • HAP Software (for HVAC Design) • EDGE Software • DIALux Software (for Lighting Design)	2 Weeks	6

8.	Financing, Performance Contracting, Measurement and Verification • Options for Financing • Performance Contracting and ESCOs • Measurement and Verification (Baseline and Savings) • ASHRAE, US DoE and IPMVP Guidelines	2 Week	6
9.	Case Studies	1 Week	3
	Total	15 Weeks	45

No	Title	Author	Type
1.	Handbook of Green Building Design and Construction (2012)	Sam Kubba	Textbook
	Green Construction Project Management and Cost Oversight (2010)	Sam Kubba	Reference Book
3.	ASHRAE Standards (latest versions): 90.1, 90.2, 55, 62.1, 62.2, 52.1, 52.2, 169, 209, 14, 140, 100 IECC, EPA Indoor Air Quality Building Education and Assessment Model (I-BEAM) EVO Standards: IPMVP Volume I – III Core Concepts SMACNA Standards: IAQ Guidelines for Occupied Buildings Under Construction, Indoor Air Quality - A Systems Approach, Energy Systems Analysis and Management		Standards
3.	ASHRAE e-Libraries (lectures): Fundamentals, HVAC Systems, HVAC Design and Operation, Advanced Technologies, Control Systems, Standards		Online Courses
4.	LEED Reference Guides (latest versions): BD+C, O+M, ID+C, ND, Homes	USGBC Team	Book
5.	USGBC Educational Resources	USGBC Educational Partners	Online Courses

11. Details of lab work, workshops practice (if applicable).

No lab is required.

12. Recommended Reading (including Textbooks and Reference books).