INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ENERGY EFFICIENT BUILDINGS								
III Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BSTE33	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

This course provides comprehensive knowledge of energy efficiency in buildings by integrating principles of building science, architecture, and indoor environmental quality. It emphasizes the assessment of thermal, visual, acoustical, and air quality factors influencing human comfort, along with ventilation strategies and their role in energy conservation and healthy indoor climates. The course explores passive and active heating/cooling techniques, solar energy utilization, and energy-efficient building services such as HVAC, lighting, and electrical systems. Energy management practices, including monitoring, targeting, energy audits, demand-side management, and landscape-based microclimate modifications, are introduced to enhance efficiency. Through analytical exercises and case studies, students gain practical exposure to evaluating the energy balance of buildings, retrofitting strategies, and the application of software tools to achieve sustainable, energy-efficient, and healthy built environments.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The principles of energy efficiency in buildings, including building science, indoor environment components, and the role of energy audits in reducing consumption.
II. Indoor environmental quality with respect to thermal, visual, acoustical, and air quality comfort, and assess the contribution of building services (HVAC, lighting) to energy performance.
III. Ventilation strategies, passive and active solar heating/cooling techniques, and energy-efficient technologies to improve building performance across various climatic zones.
IV. Energy management practices and analyze case studies to assess energy balance, retrofit opportunities, and software-based approaches for achieving sustainable, low-energy, and healthy buildings.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Understand the principles of energy efficiency in buildings, including building science, materials, and energy audit practices.
CO 2 Evaluate indoor environmental quality by analyzing thermal, visual, acoustical, and air quality comfort factors, and their impact on energy performance.
CO 3 Apply ventilation strategies, passive and active heating/cooling techniques, and energy- efficient technologies to reduce energy demand in buildings across different climatic zones.
CO 4 Analyze energy management practices such as monitoring, targeting, demand-side management, and energy conservation strategies in building systems.
CO 5 Demonstrate the ability to calculate and assess the energy balance of buildings through case studies, identifying opportunities and contradictions in energy efficiency and indoor climate.
CO 6 Develop independent problem-solving and reporting skills by investigating energy and indoor climate issues and presenting findings effectively in technical formats.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO ENERGY EFFICIENCY IN BUILDINGS (9)
Introduction to energy efficiency in buildings-Architecture- Building Science and its significance- Indoor Environment. Components of Indoor Environment - Classification of building materials based on energy intensity-Energy Management of Buildings and Energy Audit of Buildings.

MODULE-II: QUALITY OF INDOOR ENVIRONMENT (09)
Quality of Indoor Environment. Human Comfort-Thermal, Visual, Acoustical and Olfactory comfort. Concept of Sol- air temperature and its significance. Building technology and building services engineering (HVAC) Contribution to lower energy consumption, with different conditions for new and existing buildings.

MODULE-III: VENTILATION AND IS SIGNIFICANCE (9)
Ventilation and is significance. Cooling and heating concepts, Passive solar heating, active solar heating and solar electricity - Passive concepts appropriate for the various climatic zones in India- Electric efficiency for fans, pumps, lighting etc. Heat pumps. Heat exchangers. Experiences from existing energy efficient buildings.

Building related problems and health issues. Indoor climate issues regarding air quality, thermal indoor climate and acoustics. The importance of ventilation for energy efficiency and indoor climate. Building technology and calculations regarding moisture problems.

MODULE-IV: ENERGY MANAGEMENT (09)
Energy management matrix monitoring and targeting. Energy Efficient Landscape Design - Modification of microclimate through landscape elements for energy conservation, Energy conservation in lighting, HVAC, and building envelope. Energy auditing procedures and reporting. Demand-side management and load management strategies. Case studies of energy-efficient buildings and campuses.

MODULE-V: CASE STUDIES (9)
Case studies: Calculations of the energy balance of buildings without available energy calculation programs, primarily monthly calculations for residential buildings. Energy efficiency and conservation requirements for existing buildings, contradictions and opportunities. Energy efficiency and healthy buildings, contradictions and opportunities, Softwares.

V. TEXT BOOKS:

1. Sodha M. Bansal N.K., Bansal,P.K Kumar, A. and Malik, M.A.S., "*Solar Passive Buildings*", Pergamon Press, 1986.
2. Koenigs berger, O.H., Ingersoll, T.G., Mayhew Alan and Szokolay, S. V., "*Manual of Tropical Housing and Building part 1: Climatic Design*", OLBN 0 002120011, Orient Longman Limited, 1973

VI. REFERENCE BOOKS:

1. Levenspiel, Octave. "*Understanding Engineering Thermo. Upper Saddle River"*, NJ: Prentice Hall, 1996.
2. Ian M. Shapiro, "Energy Audits and Improvements for Commercial Buildings", John Wiley & Sons, 2016.
3. Lal Jayamaha (2006), Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance, McGraw Hill Professional.

VII. ELECTRONICS RESOURCES:

1. https://elearning.iea.org/courses/course-v1:IEA+BUILDINGS1+Open/about
2. https://www.energy.gov/eere/energy-efficiency-buildings-and-industry

VIII. MATERIALS ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation