

Course no.:	ENR 115
Course title:	Building energy and green buildings
Core or Elective:	Elective
Number of credits:	3
Number of lectures-tutorials-practicals:	13-17-24
Course coordinator:	Dr. Najmur Rahman & Mr. Pradeep Kumar

Course Objectives:

This elective course aims to train the student in understanding and familiarization of different heat flow calculations and building simulation software. Several case studies will be presented to demonstrate how the various passive, low energy and energy saving concepts have been applied to real life buildings. The concepts of green buildings will be introduced and different rating systems for green buildings will be explained.

Evaluation procedure:

- Assignments: 30%
- Minor project: 40%
- Major test: 30%

Details of course content and allotted time

S. No.	Topics	Allotted time (hrs)		
		L	T	P
1	Review of topics on thermal comfort, classification of climate zones, review of traditional architecture	2		
2	Heat flow calculations in buildings: Unsteady heat flows through walls, roof, windows etc. Direct heat gains through windows. Convective gains/losses, air exchange rates. Gains from people, appliances etc. Air conditioning load calculations.		2	6
3	Passive and low energy concepts and applications. Passive cooling/heating concepts, building form and orientation, internal and external shading devices, ventilation, passive concepts for composite climates, evaporative and nocturnal cooling, earth-air tunnel, sky-therm system, solar chimney-based hybrid system.	2	2	

S. No.	Topics	Allotted time (hrs)		
		L	T	P
4	Introduction and use of different building simulation software for modeling of non-air conditioned spaces such as TRNSYS, ECOTECH etc.	2	2	12
5	Case studies of non-air conditioned buildings		4	
6	HVAC systems. Description of different components of HVAC systems	2	2	
7	Introduction and use of different building simulation software for modeling of air conditioned spaces such as VISDOE, EPLUS etc.	1	1	6
8	Case studies of air conditioned buildings		4	
9	Rating systems in different countries. Green building rating systems such as LEED and GRIHA. BEE and ECBC	4		
	Total	13	17	24

Recommended readings

1. Minke G, 2006. Building with Earth: design & technology of a sustainable architecture, SpringerLink
 2. Givoni B, 1969. Man, Climate and Architecture. Elsevier Publishing Company Ltd.
 3. Givoni B, 1998. Climatic Considerations in Buildings and Urban Design, John Wiley & Sons, Canada
 4. NK Bansal, Gerd Hauser, Gernot Minke, 1994. Passive building design: a handbook of natural climatic control, Elsevier Science B.V.
 5. Krishnan A, Baker N, Yannas S, Szokolay S, (Eds) 2001. Climate Responsive Architecture- A Design Handbook for Energy Efficient Buildings, Tata McGraw-Hill, New Delhi
 6. Givoni B, 1994. Passive and Low Energy Cooling of Buildings, John Wiley & Sons Inc., New York
 7. Santamouris M, 1996. Passive Cooling of Buildings, James & James (Science Publishers) Ltd., London
 8. Karlen M and Benya J, 2004. Lighting Design Basics, John Wiley & Sons Inc., New York
 9. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): Fundamentals, Equipment
 10. Indian Society of Heating, Refrigerating and Air-Conditioning Engineers (ISHRAE) Standards
 11. Richard R Janis and William K Y Tao, 2008. Mechanical and Electrical Systems in Buildings, Prentice Hall
 12. Vedavarz A, Kumar S and Hussain Md, 2007. HVAC: Heating, Ventilation and Air-Conditioning Handbook for design & Implementation, Industrial Press, New York
 13. Jan F Kreider, Peter S Curtiss and Ari Rabl, 2010. Heating and Cooling of Buildings- Design for efficiency, revised second edition, CRC Press, USA
 14. BEE, 2007. Energy Conservation Building Code
 15. <http://www.usgbc.org/>, United States Green Building Council, USA
 16. <http://www.igbc.in> , Indian Green Building Council, LEED India
 17. <http://www.grihaindia.org/> , GRIHA Website, India
 18. TERI, 2004. Sustainable Building Design Manual, Vols 1 & 2.
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Reviewers

Dr. Vinod Gupta, Space Design Associates, New Delhi

Prof. Ashok Lal, School of Planning and Architecture, Delhi

Mr. Pradeep Kumar, TERI, Delhi