

CN5005 DESIGN OF ENERGY EFFICIENT BUILDINGS

DETAILED SYLLABUS

OBJECTIVES

To study the design of energy efficient buildings which balances all aspects of energy, lighting, space conditioning and ventilation by providing a mix of passive solar design strategies and to learn the use of materials with low embodied energy.

UNIT I INTRODUCTION

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Green house Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations– Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain– Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds – Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odour removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts – Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION

Hourly Solar radiation– Heat insulation– Terminology– Requirements– Heat transmission through building sections– Thermal performance of Building sections– Orientation of buildings – Building characteristics for various climates– Thermal Design of buildings – Influence of Design Parameters– Mechanical controls– Examples. Ventilation – Requirements– Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

REFERENCES

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2001
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi,2007.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995
4. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
5. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
6. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.