BUILDING SCIENCE I

ENAR 205

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 0

Course Objectives:
This course introduces the concept of architectural climatology and thermal aspects in relation to architectural design. It deals with the use of climatology and thermal aspects for comfort and security in building and built-up environment.

1 Introduction to Building Science (2 hours)

1.1 Importance of Building Science
1.2 Application of Building Science for comfort and security in building and built-up environment

2 Climatology (15 hours)

2.1 Concepts of climatology
- 2.1.1 Objectives of climatology for building design and planning
- 2.1.2 Climate/weather, micro/macro, urban climate and site climate
- 2.1.3 Primary climatic factors: Solar radiation, wind, temperature, humidity, precipitation, sky condition
- 2.1.4 Secondary climatic factors: Earthquake, storm, thunder
- 2.1.5 Types of climates of the world and Nepal
- 2.1.6 Climate change and its impacts

2.2 Solar Radiation
- 2.2.1 Types of solar radiation: Direct, diffuse and reflected
- 2.2.2 Absorption and reflection of solar radiation on earth
- 2.2.3 Geometry of solar movement (Sun and earth relationship)
- 2.2.4 Solar chart and its uses

2.3 Designing with solar radiation
- 2.3.1 Designing with solar radiation control techniques: Orientation, site planning, space planning, shading by vegetation, water body, color, texture and narrow alleys
- 2.3.2 Internal and external shading devices
- 2.3.3 Shadow angles for shading devices
- 2.3.4 Design of external shading devices with calculation

3 Thermal Aspects (14 hours)

- 3.1 Concept of thermal aspects
  - 3.1.1 Process of heat transmission: Conduction, convection and radiation
  - 3.1.2 Thermal properties: Absorptivity, reflectivity and emissivity
  - 3.1.3 Thermal resistivity, conductivity and transmittance
  - 3.1.4 Sol-air temperature, solar gain factor
- 3.2 Heat exchange in a building
  - 3.2.1 Heat gain and loss in a building
  - 3.2.2 Thermal balance in a room
  - 3.2.3 Thermal transmittance: Wall, roof and floor
  - 3.2.4 Calculation of thermal transmittance of walls
  - 3.2.5 Time lag and decrement factor
- 3.3 Thermal comfort and thermal control techniques
  - 3.3.1 Thermal balance for human body
  - 3.3.2 Adaptive thermal comfort
  - 3.3.3 Thermal comfort in a room
  - 3.3.4 Thermal control techniques in hot climate
  - 3.3.5 Thermal control techniques in cool climate
  - 3.3.6 Thermal resistance
  - 3.3.7 Insulation and insulation techniques in wall, partition, roof, floor

4 Different Shelters for Different Climates (6 hours)

- 4.1 Different shelters in different climatic zones of Nepal
  - 4.1.1 Shelter design in Terai region of Nepal
  - 4.1.2 Shelter design in Hilly region of Nepal
  - 4.1.3 Shelter design in Mountain region of Nepal
- 4.2 Different shelters in different climatic zones of world
  - 4.2.1 Shelter design in warm humid climate
  - 4.2.2 Shelter design in hot arid climate
  - 4.2.3 Shelter design in composite climate
  - 4.2.4 Shelter design in cold climate

5 Building Design and Town Planning According to By-laws (2 hours)

6 Building Design in different Condition (4 hours)

- 6.1 Buildings design with respect to wind movement and natural ventilation
- 6.2 Building design in high and low humidity
- 6.3 Condensation and prevention of condensation

7 Internal Comfort (2 hours)

7.1.1 Physical comfort
7.1.2 Visual comfort
7.1.3 Thermal comfort
7.1.4 Psychological comfort

Tutorial (15 hours)

1. Observation and study of table with weather records of various places
2. Calculation of Solar angles of different places from solar chart
3. Calculation of shadow angles for shading devices
4. Calculation of thermal transmittance of composite walls
5. Study of annual temperature graph and comfort range of different places
6. Case Study and analysis of vernacular design and construction of shelters in different climatic zone of Nepal
7. Preparation of Report

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution*
1, 2	14	21
3	14	21
4	6	6
5, 6	5	6
7, 8	6	6
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Koenigsberger, O.H., Ingersoll, T.G., Mayhew, A. (2020). Manual of Tropical Housing and Building. India: Universities Press.
2. Szokolay, S.V., Krishan, A. (2001). Climate Responsive Architecture. New Delhi:Tata McGraw- Hill.
3. Pahari, B. (2002). Passive Building-Concept & Design. KEC: Lalitpur, Nepal.
4. Dept of Meteorology, GON, Climatological Records of Nepal
5. Boch-Isaacson, J.M. (1987). Architecture & Construction management in the highland and remote areas of Nepal. Nepal: Sahayogi Press.
6. Nienhuys, S. (2003). Insulation for Houses in high altitudes Renewable Energy. SNV Nepal: Documents-2003.