STRUCTURE II

ENCE 260

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

Course Objectives:
The course aims to develop a conceptual understanding of structural principles in building design, fostering students' interest in structural systems as an integral part of architectural design. It provides knowledge on the behavior of modern structural materials, including timber, masonry, steel, and reinforced concrete. The course also aims to provide fundamental knowledge of timber, masonry, steel, and reinforced concrete structures, helping students understand and select appropriate structural systems for different architectural designs with basic concept of earthquake resistant design of buildings.

1 Timber Structures (3 hours)

1.1 Types of timber and mechanical properties
1.2 Structural use of timber in the building: Timber floors, roofs, posts, columns
1.3 Joints and connections in the timber truss, beams and columns
1.4 Connections between different members in ancient structures
1.5 Design of simple timber floor, beams and columns

2 Masonry Structures (8 hours)

2.1 Modes of failure: In-plane failure and out-of-plane failure
2.2 Slenderness ratio of masonry wall
2.3 Concept of wall density
2.4 Common deficiencies observed in masonry structures during past earthquakes
2.5 Importance of box action in masonry structures: Horizontal and vertical bands, bandages, splints and ties
2.6 Role of vertical reinforcement at corners/junctions and jambs

3 Steel Structures (12 hours)

3.1 Structural steel: Mechanical properties and stress-strain curve of mild steel
3.2 Simple design of compression and tension (Ties) members
3.3 Introduction to simple steel beams
3.4 Riveted and welded connections: Codal requirements
3.5 Introduction to standard and built-up steel sections, functions and use
3.6 Introduction to steel trusses for large span covering and space trusses

4 Reinforced Concrete (RC) Structures (12 hours)

4.1 Types of RC structures
4.2 Properties of concrete and reinforcing steels
4.3 Design philosophy RC structures
4.4 Limit state method (LSM) of design for RC sections for bending and shear
4.5 Concept of bond strength and development length
4.6 Serviceability limit states (SLS) of deflection and cracking
4.7 Design of RC beam, one-way slabs, two-way slabs and columns

5 Earthquake Resistant Design of Buildings (10 hours)

5.1 Nature of earthquake forces
5.2 Behavior of structures in past earthquakes
5.3 Earthquake effects on the structures and deficiencies in the buildings
5.4 Principles of earthquake resistant design
5.5 Effect of building configuration, regular shapes, load path regularity and effect of floor and roof systems
5.6 Regular building: Geometry, mass and stiffness regularities
5.7 Plan irregularity
5.8 Elevation irregularity
5.9 Soft storey and weak storey effects
5.10 Codal provisions on configurations of buildings and ductile detailing

Tutorial (15 hours)

1. Simple timber beams and columns
2. Design of compression and tension members of steel structure
3. Simple steel beams
4. Steel connections
5. Design of reinforced concrete beams
6. Design of reinforced concrete columns
7. Design of reinforced concrete one-way and two-way slabs

Final Exam

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

Chapter	Hours	Marks distribution*
1	3	5
2	8	10
3	12	15
4	12	15
5	10	15
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Duggal, S. K. (2013). Earthquake Resistant Design of Structures. India: OUP India.
2. Pillai, S. U., Kirk, D. W. (1988). Reinforced Concrete Design. United Kingdom: McGraw-Hill Ryerson.
3. Punmia, B. C., Jain, A. Kr., Jain, A. K. (2012). R.C.C. Designs (Reinforced Concrete Structures). India: Laxmi Publications.
4. Garrison, P. (2005). Basic Structures for Engineers and Architects. United Kingdom: Wiley.
5. Sozen, M. A., Ichinose, T. (2018). Understanding Structures: An Introduction to Structural Analysis. United Kingdom: CRC Press.
6. Duggal, S. K. (2007). Earthquake Resistant Design of Structures. India: Oxford University Press.
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8. Macdonald, A. J. (2018). Structure and Architecture. United Kingdom: Taylor & Francis.
9. Charleson, A. (2015). Structure As Architecture. United Kingdom: Taylor & Francis.
10. Limit State Design of Steel Structures. (2010). India: McGraw-Hill Education (India) Pvt Limited.
11. IS 800 (2007): General Construction in Steel – Code of Practice, Bureau of Indian Standards.
12. IS 456 (2000): Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards.
13. IS 13920 (1993): Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice, Bureau of Indian Standards.
14. NBC 105:2020, Seismic Design of Building in Nepal, Department of Urban Development and Building Construction, Government of Nepal.