DESIGN OF TIMBER AND MASONRY STRUCTURES

ENCE 301

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

Course Objectives:
The objective of the course is to develop conceptual and analytical skills for designing timber structures and masonry structures. The first part of the course deals with timber structures, where students will learn to design timber beams and columns, based on material properties and structural behavior. The second part deals with masonry structures, introducing students to classification, construction technologies and behavior of masonry structures.

1 Structural Timbers (2 hours)

1.1 Introduction to timber structures
1.2 Characteristics and classification of structural timbers
1.3 Factors affecting the strength of structural timbers
1.4 Grade of structural timbers and permissible stresses
1.5 Cross-laminated timber, glued-laminated timber, nail-laminated timber, and dowel-laminated timber

2 Joints in Timber Structures (4 hours)

2.1 Types of mechanical fasteners: Bolts, nails, screws
2.2 Behavior and design of bolted and nailed joints
2.3 Joint (Connection) detailing

3 Structural Elements of Timber Structures (8 hours)

3.1 Types of timber columns and columns bases
3.2 Design of axially loaded columns
3.3 Design of column subjected to combined bending and direct stresses
3.4 Types of timber beams
3.5 Design of flexural members (Beams and flitched beams)

4 Masonry Structures (4 hours)

4.1 Introduction, history and use of masonry structures
4.2 Characteristics of brick, stone, concrete block, hollow block, and compressed earth block

4.3 Stone masonry structures: Types and characteristics
4.4 Brick masonry structures: Types (English, Flemish and rat-trap bonds) and characteristics
4.5 Reinforced and un-reinforced masonry
4.6 Confined masonry

5 Design of Masonry Walls for Gravity Loads (8 hours)

5.1 Codal provisions
5.2 Design of solid walls under gravity loads
5.3 Design of walls with openings
5.4 Design of walls subjected to eccentric loads
5.5 Design of walls acting as columns

6 Masonry Structures Under Lateral Loads (7 hours)

6.1 In-plane and out-of-plane behavior of masonry structures
6.2 Typical damage patterns in masonry structures due to lateral loads
6.3 Ductile behavior of reinforced and unreinforced masonry structures
6.4 Lateral force distribution for rigid and flexible diaphragms
6.5 Design of masonry walls for wind loads
6.6 Elements of lateral load-resisting masonry system

7 Seismic Design and Strengthening of Masonry Buildings (8 hours)

7.1 Seismic behavior of unreinforced and reinforced masonry
7.2 Seismic design principles for masonry construction
7.3 Seismic design of masonry walls: Axial load and bending
7.4 Codal provisions for seismic design of masonry
7.5 Seismic strengthening measures of masonry structures

8 Testing of Masonry Elements (4 hours)

8.1 Compressive strength of bricks and walls
8.2 Diagonal shear test
8.3 Non-destructive tests: Ultra-sonic pulse velocity test; Elastic wave tomography; Semi-destructive tests (Flat-jack test, push shear test)

Tutorial (15 hours)

1. Connection detailing of timber joints
2. Design of different types of timber columns
3. Design of different types of timber beams
4. Design of solid wall under gravity loads
5. Design of solid wall with piers
6. Design of wall with openings under gravity loads
7. Design of walls subjected to eccentric loadings

8. Design of walls acting as columns
9. Design of masonry walls subjected to wind loads
10. Design of shear wall under seismic loads

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	4
2	4	6
3	8	10
4	4	4
5	8	12
6	7	8
7	8	10
8	4	6
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Arya, A. S. (1992). Masonry and timber structures including earthquake resistant design (Latest Edition). Nem Chand & Bros.
2. Dayaratnam, P. (2017). Brick and reinforced brick structures. Oxford & IBH Publishing.
3. Handry, A. W., Sinha, B. P., Davies, S. R. (1981). An introduction to load bearing brick design (Latest Edition). University of Edinburgh.
4. Drysdale, R. G., Hamid, A. A., Baker, L. R. (1999). Masonry structures: Behaviour and design (Latest Edition). Prentice Hall.
5. Tomazevic, M. (1999). Earthquake-resistant design of masonry buildings (Latest Edition). Imperial College Press.