

| Structures - I (4537)      |           |        |          |                              |               |       |    |    |          |
|----------------------------|-----------|--------|----------|------------------------------|---------------|-------|----|----|----------|
| Teaching Schedule Per Week |           |        | Test     | Examination Schedule (Marks) |               |       |    |    |          |
| Lectures                   | Practical | Credit |          | Theory                       | Practical Ex. | Total |    |    |          |
| 4                          | -         | 4      |          | Theory                       | Test          | Total | TW | PR | Gr Total |
| Pre-requisite              | Source    |        | Semester | 75                           | 25            | 100   | 50 | -  | 150      |

**RATIONALE:** In this curriculum the student will be first introduced to the basic understanding of the behaviour of a structure with respect to the different structural systems, forces and reactions. The student should also be able to understand the philosophy behind the design and execution of different structural components like slabs, beams, columns etc. and the causes of distress to the buildings and prevention of the same.

**INSTRUCTIONS:**

1. Very little mathematics to be used while presenting the concept of structures to the students of Architecture.
2. Structural Concepts to be presented either with the help of models or motion pictures or charts.
3. Frequent site visits should be arranged for better understanding of the subject matter.

| Sr. No | COURSE CONTENTS                                                                                                                                      | Hrs | Mks |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 1.     | <b>FORCE AND EQUILIBRIUM:</b>                                                                                                                        | 10  | 15  |
|        | 1.1 Definition of force, characteristics, units.                                                                                                     |     |     |
|        | 1.1.1 Effects of forces on a body - External, Internal.                                                                                              |     |     |
|        | 1.1.2 Classification of forces - Concentrated, distributed over an area, distributed over a volume, U.D.L. Uniformly varying load, equivalent force. |     |     |
|        | 1.2 Law of parallelogram of forces, Principle of transmissibility of forces, equilibrium, resolution of forces.                                      |     |     |
|        | 1.3 Moment of a force.                                                                                                                               |     |     |
|        | 1.4 Definition of Couple.                                                                                                                            |     |     |
| 2.     | <b>INTRODUCTION TO STRUCTURAL MATERIALS:</b>                                                                                                         | 2   | 10  |
|        | 2.1 Properties of structural materials like various grades of concrete, various types of steel etc.                                                  |     |     |
|        | 2.2 Permissible stresses, concrete to mix design.                                                                                                    |     |     |
| 3.     | <b>INTRODUCTION OF STRUCTURES:</b>                                                                                                                   | 10  | 10  |
|        | 3.1 History of structures-historical background.                                                                                                     |     |     |
|        | 3.2 Types of structures-solid. Skeleton and surface function.                                                                                        |     |     |
|        | 3.3 Types of forces and their effects on the behaviour of structure and factors affecting them. Compression, tension, bending.                       |     |     |
|        | 3.4 Basic structural elements, their arrangements and behaviour.                                                                                     |     |     |
|        | 3.5 Various structural systems and their behaviour                                                                                                   |     |     |
|        | 3.5.1 Load bearing.                                                                                                                                  |     |     |
|        | 3.5.1.1 Terminology, materials, design considerations, structural design, general requirements, special consideration in earthquake zones.           |     |     |
|        | 3.5.1.2 Guidelines for approximate design of non-load bearing wall.                                                                                  |     |     |
|        | 3.5.2 Post beam type of system.                                                                                                                      |     |     |
|        | 3.5.3 Rigid frame type and flat spanning type.                                                                                                       |     |     |
|        | 3.5.3.1 Difference between Short and long column, One way and two way slabs, brief concept of working stress and limit state method of design.       |     |     |
|        | 3.5.4 Brief introduction to space truss type of system.                                                                                              |     |     |
|        | 3.5.5 Study of elements of masonry structure for eg. Corbelling, arches, vaults and domes.                                                           |     |     |

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| 4. | <b>CENTER OF GRAVITY:</b><br>4.1 Center of gravity, Centroid<br>4.2 Determination of Central of simple sections                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4  | 5  |
| 5. | <b>BENDING MOMENT, AND SHEAR FORCE:</b><br>5.1 Types of beams with different end conditions.<br>5.2 Types of loads.<br>5.3 Concept of transverse loading in producing bending moment and shear force.<br>5.4 Critical sections from point of view of B.M & S.F. in simply supported beams, cantilevers, continuous beams, fixed beams.(only qualitative)<br>5.5 Stresses produced in cross section of beam due to B.M &S.F. physical concept only of torsion and stresses produced due to bending in structures (only qualitative).                                                                                                                                                                                                 | 10 | 20 |
| 6. | <b>REHABILITATION/REPAIRS OF STRUCTURES:</b><br>6.1 Causes and prevention of cracks in buildings.<br>6.2 Classification of cracks-structural and non structural.<br>6.3 Types of internal stresses in building components-Tensile, compressive, shear method of distinguishing between tensile and shear cracks.<br>6.4 Principle causes and occurrence of cracks in buildings-moisture changes, thermal movements, elastic deformations, creep, chemical reactions, foundation movement and settlement of soil, vegetation.<br>6.5 Methods of prevention of cracks in structures, choice of material, specifications, architectural design of building, structural design, foundation design, construction practice and techniques | 13 | 45 |

#### **PRACTICALS:**

- 1) Demonstration of Structural design software
  - a) Plane frame analysis
  - b) Space frame analysis
- 2) Demonstration of use of Finite element Analysis.
- 3) Site Visit, visit to Concrete Laboratory

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#### **REFERENCE BOOKS:**

- 1) Applied Mechanics by R.S. Rhuani
- 2) Structures by Roger Bull
- 3) National building Code of India
- 4) IS 456, 2000
- 5) Handbook on causes and prevention of cracks in buildings.