# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Master of Engineering**
**Level: PG**
**Subject Code: ME02000261**
**Subject Name: Theory of Thin Plates and Shells**

| | |
|---|---|
| w. e. f. Academic Year: | 2024-25 |
| Semester: | 2 |
| Category of the Course: | Professional Elective Course |

| | |
|---|---|
| **Prerequisite:** | Mechanics of Solids, Structural Analysis and Engineering Mathematics |
| **Rationale:** | Plates and Shells have become important structural forms of modern infrastructures. Analysis of such structure requires rigorous mathematical treatment. It is essential to understand structural behavior and analysis of plates and shells for their safe design. The course on Plates and Shell equips the students with analysis methodology of plates and shell using analytical methods. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No. | Course Outcomes | RBT Level |
|---|---|---|
| 01 | Analyze plates using analytical methods | Analyze |
| 02 | Analyze shells using analytical methods | Analyze |
| 03 | Apply the numerical techniques and tools for the complex problems of plates. | Analyze |
| 04 | Apply the numerical techniques and tools for the complex problems of shells. | Analyze |

**Revised Bloom's Taxonomy (RBT)*

**Teaching and Examination Scheme:**

| Teaching Scheme(in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Tutorial / Practical | | |
| L | T | PR | C | ESE (E) | PA/CA (M) | PA/CA (I) | ESE (V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |

**Course Content:**

| Unit No. | Content | No. of Hours | % of Weightage |
|---|---|---|---|
| 1. | **Introduction:**<br>Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions. | 05 | 10 |
| 2. | **Static Analysis of Plates:**<br>Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.<br>Analysis of Circular Plates under Axi-Symmetric Loading, Governing Differential Equation in Polar Co-ordinates.<br>Approximate Methods of Analysis - Rayleigh-Ritz approach for Simple Cases in Rectangular Plates. | 20 | 45 |
| 3. | **Static Analysis of Shells:**<br>Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.<br>Shells of Revolution with Bending Resistance - Cylindrical and Conical Shells.<br>Application to Pipes and Pressure Vessels. | 15 | 35 |
| 4. | **Thermal Stresses in Plate and Shell** | 05 | 10 |
| | **Total** | **45** | **100** |

**Suggested Specification Table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| **10** | **20** | **30** | **40** | **00** | **00** |

*Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)*

**References/Suggested Learning Resources:**

**(a) Books:**

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.

2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
3. Thin Elastic Shells, KrausH., John Wiley and Sons.
4. Theory of Plates, Chandrashekhara K., Universities Press.
5. Design and Construction of Concrete Shells, Ramaswamy G.S.

**(b) Open source software and website:**

https://ndl.iitkgp.ac.in/
https://nptel.ac.in/
https://ocw.mit.edu/courses/2-081j-plates-and-shells-spring-2007/

**Suggested Course Practical List:**

Practical work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended problem based on engineering application of thin plates and shells.

* * * * * * *