Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-1

Subject: Theory of Thin plates & shells – METSE11506

Type of course: Minor Stream

Prerequisite: Mechanics of Solids, Structural Analysis and Engineering Mathematics

Rationale: Plates and shells have gained significant importance in the design of modern infrastructures. Analyzing these structural forms requires a thorough mathematical approach to ensure their safe and reliable design. Understanding the behavior and analysis of plates and shells is essential for engineering sound structures. The course on Plates and Shells is specifically designed to equip students with the necessary analytical methods and methodologies to analyze and design these structural elements effectively.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Static Analysis of Rectangular Plates** Students will select a rectangular plate with specific boundary conditions (e.g., simply supported or clamped) and apply the Navier solution to analyze the plate under different loading scenarios. They will also use the Levy solution for cases with other boundary conditions. The analysis should include calculations, diagrams, and discussions on the effects of different boundary conditions and loadings on the plate's behavior. Results and analysis will be compiled into a report and submitted on the GMIU Web Portal.	10
2	**Analysis of Circular Plates**	10

	Students will perform a detailed analysis of a circular plate subjected to axisymmetric loading, using the governing differential equation in polar coordinates. They will use the Rayleigh-Ritz approach to approximate solutions for simple cases in rectangular plates. The analysis should include calculations of deflections and stresses, and comparisons between exact and approximate methods. Students will prepare a report with their findings, including calculations and graphical representations, to be submitted on the GMIU Web Portal.	
3	**Thermal Stresses in Plates and Shells** Students will perform an analysis of thermal stresses in a plate or shell structure subjected to temperature changes. They will calculate the thermal expansion and resulting stresses, considering both uniform and non-uniform temperature distributions. The analysis should include the effects of boundary conditions and material properties on thermal stresses. Students will prepare a report detailing their calculations, assumptions, and results, which will be submitted on the GMIU Web Portal.	10
Total		**30**

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**Introduction** 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.	11	10
2	**Static Analysis of Plates** 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.	13	25
3	**Circular Plates** Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.	13	25
4	**Static Analysis of Shells: Membrane Theory of Shells** Cylindrical, Conical and Spherical Shells,	11	10
5	**Shells of Revolution with Bending Resistance** Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels. **Thermal Stresses in Plate/ Shell**	14	30

	Total	**60**	**100**

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	NA	NA	NA	NA	NA	NA

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Use analytical methods for the solution of thin plates and shells.
CO2	Use analytical methods for the solution of shells.
CO3	Apply the numerical techniques and tools for the complex problems in thin plates.
CO4	Apply the numerical techniques and tools for the complex problems in thin plates.

List of Practical

Tutorial 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 design problem based on engineering application of Thin plates & shells.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference 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.