Birla Institute of Technology & Science, Pilani
Hyderabad Campus

ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI-HYDERABAD CAMPUS
FIRST SEMESTER 2021-2022
Course Handout Part II

Date: 12/08/2021

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **CE G553**
Course Title : *Theory of Plates and Shells*
Instructor-in-Charge : Chandu Parimi

Description : Different kinds of plates such as rectangular, circular, and elliptical; Different kinds of shell structures such as shell of revolution: spherical shells, cylindrical shells and special shell structures; Principles and applications of bending of plates, membrane theory, bending of shells, and stability of plates and shells; Kirchoff theory, Reissner-Mindlin-Naghadi type theories, rectangular plates-solution by double Fourier series, membrane theory of shells, and case study on plates and shells using numerical tools.

Scope and Objective of the Course:

The understanding of the analysis procedures and theory of plates and shells is required for accurately designing such structures. Plates act similar to beams with bending and shear stresses, whereas shells are analogous to a cable which resists loads through tensile stresses. Typical applications of plates are slabs in buildings, plates in tanks and so on. A primary difference between a shell structure and a plate structure is that, in the unstressed state, the shell structure has curvature as opposed to plated structure which is flat. Membrane action in a shell is primarily caused by in-plane forces, though there may be secondary forces resulting from flexural deformations. Typical applications of shells are fuselages of aeroplanes, containment shells, mechanical and automobile parts, and roof structures.

This course introduces theory, design, and stability analysis of plates and shells. The course is aimed at providing students with advanced knowledge of principles and applications of bending of plates, membrane theory and bending of shells, and stability of plates and shells.

Learning Objectives –

Students who finish this course should be

1. able to derive various expressions for bending of thin plates
2. able to list assumptions for thick plates
3. able to calculate buckling loads for plates and understand post buckling behaviour
4. able to derive expressions for simple shells

Student Learning Outcomes (SLOs) assessed in this course – **(a), (g), (i) and (e).**

Textbook:

1. Timoshenko, S.P. and Kreiger, S.W., Theory of plates and shells, McGraw-Hill, 2nd ed., 2010

Reference Books*:*

1. Gould, P.L., Analysis of shells and plates, Springer Verlag, 1988
2. Reddy, J.N., Theory and analysis of elastic plates and shells, 2nd ed., 2007
3. Dayaratnam, P., Design of Reinforced Concrete structures, Oxford and IBH Publications, 1983,
4. Ramawamy, G.S., Design and Construction of concrete Shell Roofs, McGraw-Hill, 1968.
5. S. P. Timoshenko and J. Gere, Theory of Elastic Stability, Tata McGraw Hill Education private limited, 2010

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book	SLO*
1-2	able to understand definition of a plate and a shell and their applications to structural engineering	Introduction to the analysis of plates and shells structure	**Class notes**	**(a)**
3-9	able to derive equations for Kirchhoff plates	**Bending theory of flat Plates:** **thin plates:** Kirchhoff theory – strain-displacement relations, constitutive equations, equilibrium equations, boundary conditions, derivation of theory from principle of virtual work,	**2 TB**	**(a)**
10-12	able to solve rectangular plates with Fourier series	**Rectangular plates**-solution by double Fourier series	**5 TB**	**(a)**
13-14	able to derive expressions for circular plates	**Circular plates**	**3 TB**	**(a),(e)**
15-16	able to understand edge effects in plates	Edge effects	**6 TB**	**(a)**
17-17	able to understand behavior of anisotropic plates	Anisotropic and layered plates	**11 TB**	**(a)**
18-19	able to understand the basic assumptions for thick plate theories	**Thick plates:** Introductions to Reissner-Mindlin-Naghadi type theories	**Class notes**	**(a),(e)**
20-21	able to solve problems with plates on elastic foundations	Plates on elastic foundation	**8 TB**	**(a),(e)**
22-25	able calculate buckling in plates and understand post buckling behaviour	Buckling of plates, Moderate deflection analysis and buckling of plates	**R5, 12,13 TB**	**(a)**
26-34	able to derive expressions for shells with axisymmetric loading	**Membrane theory of shells:** equilibrium equations, Application to shells of revolution under axi-symmetric loads, Applications to cylindrical shells under asymmetric loads	**14 TB**	**(a),(e)**
35-43	able to derive bending of cylindrical shells	**Bending theory of shells:** kinetic assumptions and strain displacement relations, cylindrical shell under axi-symmetric	**15,16 TB**	**(a),(e)**

		loads, bending of cylindrical shells		

***Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Assignments	-	15%	Continuous	OB
Project	-	25%	Continuous	OB
Midsemester Test	90 min	25%	TBA	OB
Comprehensive Exam	120 min	35%	17/12 AN	OB

Online Consultation Hour: Will be announced in class

Notices: Will be posted in Google Classroom

Make-up Policy: Make-up will be granted only to genuine cases with prior permission from the IC. Make ups will not be given to students who contact the IC after the evaluation component.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Chandu Parimi
INSTRUCTOR-IN-CHARGE
CE G553