GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Aeronautical Engineering
Subject Code: BE04001021
Subject Name: Aircraft Structure

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Zeal to learn the subject
Rationale:	Aircraft Structures equips students with the knowledge of stresses, strains, and load behaviour in aircraft components, ensuring safety and reliability. It forms the foundation for advanced aerospace design and analysis.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Demonstrate the structural components of aircraft and load applications.	20
CO-2	Apply the fundamental knowledge of stresses and strain in aircraft structural components	20
CO-3	Evaluate stress analysis of statically determinate and indeterminate structures.	25
CO-4	Apply virtual work and matrix methods to solve various structural problems.	20
CO-5	Analyse structural instability of columns and thin plates.	15

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Content:

Sr. No.	Content	Total Hrs
1	**Structural Components of Aircraft and Airworthiness:** Basic Construction Techniques: Airframe and Specific Components along with their Functions, Materials, Airframe Loads: Types of Load on Aircraft and its Parts in Flight, Factors of safety-flight envelope, Load factor determination, Fatigue, Safe life and fail-safe structures, Introduction to Failure Theory.	6
2	**Principal Stresses and Strains:** Hooks law for 3D body, plane stress and strain condition, Principal stresses, principal planes, Two-dimensional stress system, stresses on an inclined plane, Mohr's circle and its numerical. Equation of equilibrium.	7
3	**Statically Determinate & Indeterminate Structures:** Basic Concept of Determinate and Indeterminate Structure, Plane Truss Analysis – Method of Joints, Method of Sections, Deflection of Beams; Area Moment Method, Slope-Deflection Method, Moment Distribution Method. Numerical based on the given content	10
4	**Virtual Work, Energy and Matrix Methods:** Work, Principle of Virtual Work and its Applications, Strain and Complementary Energy, Unit Load Method, Flexibility method, The Reciprocal Theorem. Numerical based on the given content.	8
5	**Bending and Shear of Thin Walled Beams:** Introduction to Symmetrical and Unsymmetrical Bending, Stress distribution, Chaperon's 3 moment equation and moment Distribution method for indeterminate beams. Shear stress in Beams, Flexural Shear flow in thin-walled beams, Shear flow and shear centre for open and closed beam Sections due to bending alone. Numerical based on the given content.	9
6	**Structural Instability:** Euler buckling of columns inelastic stability of columns, effect of Initial imperfections and energy method for the calculation of buckling loads in columns.	5
	TOTAL	45

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**25**	**10**	**10**	**10**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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.

Reference Books:

1. Aircraft Structures for Engineering Students -T H G Megson, Elsevier Publishing
2. Aircraft Structures –Lakshmi Narasaiah, CRC Press
3. Analysis of Structure Vol. I & II: S. S. Bhavikatti, Vikas Publishing
4. Mechanics of Aircraft Structures: C. T. Sun, Wiley-Interscience Publishing
5. Mechanics of structure Vol. 1 by S B Junarkar.

List of Experiments:

1. Introductory exercise for Finite Element Analysis (FEA) using software.
2. A stepped bar FEA analysis using software.
3. Exercise for structural problem using software.
4. Analysis of a simply supported beam with UDL using software.
5. Analysis of truss using software.
6. Unsymmetrical bending of the beams.
7. To determine the Shear center of Open section.
8. To determine the Shear center of Closed section.
9. Validation of Maxwell's Reciprocal Theorem.

Major Equipment: Basic apparatuses of Engineering Mechanics and Software.

List of Open Source Software/learning website:
https://nptel.ac.in/course.php

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any	5 small coding based assignment of 2h each. Total = 10h	Based on the coding solution submitted.

	other relevant software		
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

****