



University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Mechanical Engineering
Bachelor of Science in Mechanical Engineering



Course Syllabus

1. General Information: Alpha-numeric codification: INME 5717 Course Title: Aircraft Structural Analysis and Design Number of credits: 3 Contact Period: Three hours of lecture per week
2. Course Description: English: Application of work and energy principles, and numerical methods, to the design of flight vehicles. Study of deflection and load analysis using the principle of virtual work, principle of contemporary virtual work, analytical weak form solutions, and the finite element formulation. Wing design considering: fatigue, aeroelasticity, divergence, environmental loads, aerospace materials, dynamic stability of thin-walled compression members, and structural dynamics. Spanish: Aplicación de los principios de energía y trabajo, y métodos numéricos, para el diseño de vehículos de aviación. Estudio del análisis de deflexión y carga usando el principio de trabajo virtual, principio de trabajo virtual complementario, soluciones analíticas usando la forma débil y la formulación de elemento finito. Diseño de alas tomando en consideración: fatiga, aeroelasticidad, divergencia, cargas ambientales, estabilidad dinámica de elementos de paredes finas en compresión y dinámica estructural.
3. Pre/Co-requisites and other requirements: Prerequisites: (INME 4717 and (INGE 4019 or INGE 4012)) or Authorization of the Director of the Department.
4. Course Objectives: After completion of course requirements, students should be able to: <ul style="list-style-type: none">● Design structures which withstand static loads;● Successfully conduct design for fatigue on mechanical parts;● Determine the Torsional and Bending Stiffness, as well as the rotation and displacement, of a given section in a multicell wing structure;● Handle the non-anisotropic behavior of Composites, and know their failure modalities;● Carry out a wing design such that the aeroelastic instabilities does not occur;● Be able to implement the principles of structural optimization during the design of simple aeronautical structures.
5. Instructional Strategies: <input checked="" type="checkbox"/> conference <input checked="" type="checkbox"/> discussion <input checked="" type="checkbox"/> computation <input type="checkbox"/> laboratory <input checked="" type="checkbox"/> seminar with formal presentation <input checked="" type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop <input type="checkbox"/> art workshop <input checked="" type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input checked="" type="checkbox"/> special problems <input type="checkbox"/> tutoring

research other, please specify: Audiovisual Resources may be used, such as slides and/or videos

6. Minimum or Required Resources Available:

Materials, equipment, and physical facilities needed to fulfill the course objectives.

7. Course time frame and thematic outline

General Topics	Contact Hours
Fatigue with variable stress amplitude	8
Bending of thin plates	3
Stiffened-shell structures	2
Torsion of thin-walled, multi-cell close sections	4
Stresses due to shear in thin-walled, multi-cell close sections	6
The effect of taper	3
Primary bending instability and failure of columns	3
Instability and failure of plates	3
Honeycomb sandwich panels	2
Introduction to aerolastic instabilities	5
Fundamentals of structural optimization	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	60
<input checked="" type="checkbox"/> Final Exam	1	20
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Textbook:

The principal material to study is constituted by the class notes that the students are supposed to take during lectures (in particular, as regards the topics about Fatigue).

R.M. Rivello, Theory and Analysis of Flight Structures, McGraw-Hill Book Company

Other references:

- B. Atzori, *Appunti di Costruzione di Macchine tratti dal Corso del Prof. B. Atzori*, 2nd Edition, Ed. Libreria Cortina, Padova, 2003*
- N.E. Dowling, *Mechanical Behavior of Materials*, 3rd Edition, Pearson, Prentice Hall
- R.G. Budynas and J.K. Nisbett, *Shigley's Mechanical Engineering Design*, 10th Edition
- V. K. Goyal, V. K. Goyal and H. M. Rodríguez, *Aircraft Structures for Engineers*, 2016

- T.H.G. Megson, *Aircraft Structures for Engineering Students*, IV (or also V) Edition, Elsevier Aerospace Engineering Series***
- HEXWEB™ Honeycomb sandwich design technology (provided by the Professor to the Students)
- HEXWEB™ Honeycomb Attributes and Properties (provided by the Professor to the Students)

R. Olsson, *Composite Mechanics and Laminate Theory*, Department of Aeronautics, Imperial College, London, 2006 (Updated and corrected at Swerea SICOMP, March 2016). (Provided by the Professor to the Students)

*For any book in languages other than English and Spanish: all the requested contents will be explained during lectures.

***can be used in the case **was not available

The lectures may provide knowledge which is not provided by the aforementioned textbooks.

11. Law 51: The Comprehensive Educational Services Act for People with Disabilities:

States that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information, contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

12. Academic Integrity

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.—

13. Certification 06-43 of the Academic Senate

"The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 06-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

14. Sexual Harassment: Certification 130-2014-2015 states:

Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.