



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



Course Syllabus

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| 1. General Information: Alpha-numeric codification: INME 4717 Course Title: Introduction to Aircraft Structural Analysis Number of credits: 3 Contact Period: Three hours of lecture per week |
| 2. Course Description: English: Introduction and application of solid mechanics to analyze aerospace structures. Study of aircraft components and their design philosophy. Environmental load design diagrams. Development and application of elasticity to describe the stress, strain, and displacement fields of one- and two-dimensional problems in aerospace structures. Analysis of bending, shear and torsional theories for arbitrary, multimaterial, and multicell wing cross-sections. Analysis of thin-walled single and multicell stiffened shell sections using analytical and numerical solutions. Spanish: Introducción y aplicación de la mecánica de sólidos aplicado a las estructuras aeroespaciales. Estudio de los componentes de aeronaves y su filosofía de diseño. Diseño de diagramas de cargas ambientales. Desarrollo y aplicación de elasticidad para describir el campo de esfuerzo, deformación y deflexión de problemas de una y dos dimensiones en estructuras aeroespaciales. Análisis de teorías de flexión, cortante y torsión para alas con secciones arbitrarias, de multi-material y multi-paredes. Análisis de estructuras de paredes delgadas compuestas de una o más secciones rígidas usando soluciones analíticas y numéricas. |
| 3. Pre/Co-requisites and other requirements: Prerequisites: INGE 3016 and (INGE 3035 or INGE 3032) and (MATE 4009 or MATE 4145). |
| 4. Course Objectives: Upon successful completion, students will be able to: <ul style="list-style-type: none">● Identify and explain the function of typical aircraft components, and discuss the behavior of monocoque and semi-monocoque constructions;● Formulate multi-directional environmental loads;● Identify and explain stress, strain, and displacement concepts in aerospace analysis;● Identify and evaluate thin-walled cross-sectional plane area properties;● Use methods to analyze wing cross-sections;● Explain one-dimensional wing behavior;● Use of a computer software to study one-dimensional wing behavior. |
| 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 type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input 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 |
|--|---------------|
| Stress, strain, and their mutual relationship | 4 |
| Brief revision of the diagrams of shear and bending moment Torsion of beams, also in the case of thin-walled section | 4 |
| Brief revision of Mohr's Circles | 4 |
| Finite Element Theory – Matrix Methods | 4 |
| Stress Concentration Factors | 4 |
| Inelastic Strain | 4 |
| Von Mises Criterion | 4 |
| Fatigue and factors affecting long-life fatigue strength | 4 |
| Fatigue design | 4 |
| Aircraft Structural Components | 3 |
| Composite Materials | 3 |
| Tests | 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 | 2 | 50 |
| <input checked="" type="checkbox"/> Final Exam | 1 | 25 |
| <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 checked="" type="checkbox"/> Other, specify: Attendance | | 5 |
| TOTAL: | | 100% |

10. Bibliography:

Textbook:

T.H.G. Megson, *Aircraft Structures for Engineering Students*, V (or also VI) Edition, Elsevier Aerospace Engineering Series

(However, the class lectures may provide knowledge which is not provided by the aforementioned textbook, for example as regards the lessons about Fatigue)

- 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)**

Other references:

- D. J. Peery, *Aircraft Structures*, Dover Publications, Inc.
- R.M. Rivello, *Theory and Analysis of Flight Structures*, McGraw-Hill Book Company
- 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

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.

Revised: February, 2019