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 5707
Course Title: Gas Turbine System Operation
Number of credits: 3
Contact Period: Three hours of lecture per week

2. Course Description:

English: Study of jet engine performance using energy budgets and its optimization in the jet engine cycle. Study of turbomachine components, such as compressors, combustors, turbines and nozzles, as integrated into a system that produces power aircrafts. Development of a thermodynamic model for a turbofan engine to investigate design and off-design behavior, and the response to external and internal parameters. Study the influence of design criteria such as structural integrity, emissions, acoustics, and operationally-stable throttle response on the integration process.

Spanish: Estudio del rendimiento de la turbina de propulsión usando la utilización de balances de energía y su optimización en el ciclo de la turbine de propulsión. Estudio de los componentes de una turbomaquinaria, tales como el compresor, el combustor, la turbina y la boquilla, como un sistema integrado que produce empuje para las aeronaves. Desarrollo de un modelo termodinámico para un motor turbohelice para investigar el comportamiento dentro y fuera del diseño, y la respuesta a parámetros externos e internos. Estudio de la influencia de los criterios de diseño, tales como integridad.

3. Pre/Co-requisites and other requirements:

Prerequisites: (INME 4002 or INME 4045 or INQU 4012) and INGE 3016 and INME 4707 or Authorization of the Director of the Department.

4. Course Objectives:

After completion of course requirements, students should be able to:

- Identify engine components, such as compressors, combustors, turbines and nozzles, and their interactions in a well-integrated system.
- Apply physical principles to understand both the design and off-design behavior of a system composed of turbomachinery.
- Investigate the response of the system elements to external parameters, such as flight conditions, and internal parameters, such as turbomachine efficiencies.
- Understand the influence of design criteria on the selection of components to build a system.

5. Instructional Strategies:

☒conference ☒discussion ☒computation ☐laboratory

☒seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☒practice ☐trip ☐thesis ☒special problems ☐tutoring

☒research ☒other, please specify: Course Project (Report and Presentation)

6. Minimum or Required Resources Available:

Computers, Internet

7. Course time frame and thematic outline

General Topics	Contact Hours
Introduction to Gas Turbines: Configuration and Components	3
Fundamentals Review (e.g. Thermodynamics, Fluid Dynamics, Flight Economics)	1.5
Aircraft Engine Modeling: Turbojet and Turbofan Engines	3
Gas Turbine Design Parameters	3
Component Matching and Off-design Operation	6
Exam 1	1.5
Inlts/diffusers	3
Fans	4.5
Compressors (velocity triangles, performance maps, blading, design, multi-staging)	4.5
Turbines (e.g. stages, solidity, blade temperature, cooling design)	3
Exam 2	1.5
Compressor/Turbine Matching	4.5
Project: Oral Presentation and Written Report	1.5
Combustion Chamber	1.5
Nozzle Operation	1.5
Structural integrity, engine emissions, acoustics and future trends in aviation	1.5
Total hours: (equivalent to contact period)	**45**

8. Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
☒ **Exams**	**2**	**25**
☒ **Final Exam**	**1**	**25**
☐ **Short Quizzes**		
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	**1**	**20**
☐ **Journals**		
☒ **Other, specify:**	**1**	**5**
TOTAL:		**100%**

10. Bibliography:

Textbook:

Ahmed F. El-Sayed, 2008. *Aircraft Propulsion and Gas Turbine Engines*. 1 Edition. CRC Press. ISBN: 978-0-8493-9196-5.

Other references:

- Hünecke, Klaus, 1997. *Jet Engines: Fundamentals of Theory, Design and Operation.* Airlife. ISBN: 978-1853108341.
- Kerrebrock, Jack L., 1992. *Aircraft Engines and Gas Turbines*. MIT Press. ISBN: 978-0262111621.
- Hill, Philip and Peterson, Carl, 1992. *Mechanics and Thermodynamics of Propulsion*. 2nd Edition. Addison-Wesley. ISBN: 978-0201146592.
- Mattingly, H.D., Heiser, W. H. and Pratt, D. T., 2002. *Aircraft Engine Design*. 2nd Edition. AIAA Educational Series. ISBN: 978-1563475382.
- Cumpsty, N.A., 2003. *Jet Propulsion: A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of Jet Engines*. 2nd Edition. Cambridge University Press. ISBN: 978-0521541442.
- Dole, C. E. and Lewis, J. E., 2000. *Flight Theory and Aerodynamics*. John Wiley & Sons. ISBN: 978-0471370062.

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