



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 4210 Course Title: System Dynamics Number of credits: 3 Contact Period: Three hours of lecture per week
2. Course Description:
English: Study of dynamic systems in the mechanical linear-rotational, electrical, hydraulic, thermal and electromechanical domain. Modeling of linear dynamic systems, linearization of nonlinear systems, use of analytical tools to predict the dynamic behavior of systems. Use of Laplace transform, block algebra, frequency diagrams and simulation in the analysis and design of systems.
Spanish: Estudio de sistemas dinámicos en el dominio mecánico lineal / rotativo, eléctrico, hidráulico, térmico y electromecánico. Modelado de sistemas dinámicos lineales, linealización de sistemas no lineales, uso de herramientas analíticas para predecir el comportamiento dinámico de los sistemas. Uso de la transformada de Laplace, álgebra de bloques, diagramas de frecuencia y simulación en el análisis y diseño de sistemas.
3. Pre/Co-requisites and other requirements:
Prerequisites: MATE 4009 & INEL 4075 & (INGE 4010 or INGE 4015) & (INGE 4012 or INGE 4019) Co-requisite: INME 4015
4. Course Objectives:
Upon successful completion, students will be able to: <ul style="list-style-type: none">• Identify, formulate, and solve the governing ordinary differential equations that represent a basic mechatronic system by applying principles of engineering, science, and mathematics (1);• Model and solve first and second order systems through analytic and computational methods in order to obtain the response of the system under different input signals;• Perform basic signals and linear time-invariant systems analysis such as Laplace and inverse Laplace transform, zeros/poles, impulse and step responses, stability using Routh table and complex plane pole plot, Bode plot, Nyquist plot;• Perform basic closed-loop control systems property analysis including closed-loop stability analysis, step response steady-state error analysis, gain/phase margin analysis, bandwidth determination and sampling frequency selection;• Translate time-domain step response specifications into closed-loop transfer function form (natural frequency and damping ratio) for model based controller design;<ul style="list-style-type: none">- Analyze and design mechanical and feedback control systems in the time and frequency domain with the purpose of acquiring a specific performance;• Find, evaluate and use resources to learn independently in the area of modern mechatronics systems (7).

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: Monograph

6. Minimum or Required Resources Available:

Classroom, Computer Laboratory Access, MATLAB Program Access

7. Course time frame and thematic outline

General Topics	Contact Hours
Introduction to System Dynamics and Controls	1
Review of complex variables, solution of differential equations with Laplace transforms, linearization, final value theorem and state space representation	3
Matrices	8
First order systems (transfer function form, time-constant, and time response)	2
Modeling of mechanical, electrical, hydraulic, pneumatic, and thermal first-order systems	3
Second order systems with and without damping (transfer function, natural frequency, damping ratio, damped frequency, and time response)	5
Modeling of mechanical, electrical, hydraulic and combined second order systems, use of block diagrams, reduction of block diagrams	7
Stability analysis	1
Basic control action (on-off, proportional, integral, ...)	1
Example and modeling of dynamics systems with controllers	3
First and second order frequency response	3
Control Specifications and Design Rules (time response)	3
Control Specifications and Design (frequency response)	3
Tests	2
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent *
<input checked="" type="checkbox"/> Exams	2-3	50-75
<input checked="" type="checkbox"/> Final Exam **	1	0-25
<input checked="" type="checkbox"/> Short Quizzes	0-3	0-10
<input checked="" type="checkbox"/> Oral Reports	0-4	0-25
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	0-1	0-50
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homework	0-5	0-25
TOTAL:		100%

*All evaluation strategies will add to 100%

** In design courses a capstone project may replace the final exam.

10. Bibliography:

Textbook:

Palm, W. J. (2013). *System dynamics*. New York, NY: McGraw-Hill. **

** These books are key classic references and remain as the top books for the subjects covered in the course and there are no up-to-date textbooks to substitute these books.

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