



University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Mechanical Engineering
M.S./Ph.D. in Mechanical Engineering



Course Syllabus

1. General Information: Alpha-numeric codification: INME 6040 Course Title: Advanced Kinematics Number of credits: 3 Contact Period: Three hours of lecture per week
2. Course Description: English: Kinematic synthesis by analytical and computer assisted methods. Advanced topics in kinematic synthesis of linkages. Computerized design for function, path and motion generation. Spatial mechanisms and robotics. Spanish: Síntesis cinemática usando métodos analíticos y computacionales. Tópicos avanzados en síntesis cinemática de elementos de barras. Diseño computacional de funciones, trayectoria y movimiento generalizado. Mecanismos espaciales y robótica.
3. Pre/Co-requisites and other requirements: Pre-requisite: Authorization of the Director of the Department
4. Course Objectives: <ul style="list-style-type: none">• Evaluating the mobility of a spatial mechanism;• Classifying a mechanism design task as function, motion, or path generation;• Analyzing closure equations for determining I/O relationship for spatial mechanisms;• Creating programs to evaluate position, velocity, and acceleration of spatial mechanisms;• Applying design decisions based on results of position, velocity, and acceleration analysis;• Understanding the relation between homogeneous coordinates for points, lines, and planes;• Understanding the relation between ruled surfaces, congruencies, and line complexes; and• Understanding the relation between screw coordinates, reciprocity, and axodes
5. Instructional Strategies: <input checked="" type="checkbox"/> conference <input type="checkbox"/> discussion <input type="checkbox"/> computation <input type="checkbox"/> laboratory <input type="checkbox"/> seminar with formal presentation <input 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 <input type="checkbox"/> research <input type="checkbox"/> other, please specify:
6. Minimum or Required Resources Available: None

7. Course time frame and thematic outline

General Topics	Contact Hours
Mechanism components: links; belts and pulleys; gear pairs; cam systems	3
Joints (connections)	3
Mobility (planar and spatial)	3
Displacement analysis (forward & reverse)	3
Velocity and acceleration analysis	6
Creativity with mechanisms (open/closed loop chains)	3
Planar synthesis (function, path, and motion generation)	6
Gear pairs (planar, worn, bevel, hypoid, and non-circular)	3
Coordinate transformations	3
Screw theory: Homogeneous coordinates (point, plane, line, and screw); Ruled surfaces, congruencies, and line complexes; Centroides, axodes; Reciprocity	12
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (S/NS) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	40
<input checked="" type="checkbox"/> Final Exam	1	20
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	1	20
<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:

Bauchau, O. A. 2011. *Flexible Multibody Dynamics*. New York: Springer.
<http://dx.doi.org/10.1007/978-94-007-0335-3>. [Available via Springer eBooks, UPRM General Library Databases]

Other resources:

1. Bottema, O., and B. Roth. 1979. *Theoretical Kinematics*. Amsterdam: North Holland. [Available at the Circulation Collection (QA841. B66 1979), UPRM General Library](*)
2. Phillips, J. 1984. *Freedom in Machinery, V.1-2*. London: Cambridge University Press. [Available at the Circulation Collection (TJ175. P48 1984), UPRM General Library] (*)
3. Struik, D. J. 1961. *Lectures on Classical Differential Geometry*. Massachusetts: Addison-Wesley. [Available at the Circulation Collection (QA641. S72 1961), UPRM General Library] (*)
4. Wang, Lihui, and Jeff Xi. 2008. *Smart Devices and Machines for Advanced Manufacturing*. New York: Springer. <http://dx.doi.org/10.1007/978-1-84800-147-3>. [Available via Springer eBooks, UPRM General Library Databases]

5. McCarthy, J. Michael. ed. 2013. *21st Century Kinematics*. New York: Springer.
6. Electronic resources available through the Library's website:
<http://www.uprm.edu/library/cre/listdbsp.php?l=1&st=0&topic=77>.

* These are classical handbooks

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