



UNIVERSITY OF PUERTO RICO
MAYAGÜEZ CAMPUS
COLLEGE OF ENGINEERING
INDUSTRIAL ENGINEERING DEPARTMENT



COURSE SYLLABUS

General Information

Course Number: ININ 4015

Course Title: **Engineering Economic Analysis**

Credit-Hours: Three

Course Description

Criteria and techniques of economic analysis as related to decision making in engineering projects where time and money are the primary trade-offs. Discounted cash flows; comparison of alternatives using equivalent annual cost, present worth, or rate of return; break-even analysis, depreciation, tax effects, replacement, sensitivity, and risk analysis.

Prerequisites

MATE 3032 -Calculus II

Textbook and References

- **Newman D.G., Eschenbach, T.G., and Lavelle, J.P., 2014, Engineering Economic Analysis, 12th Edition, Oxford University Press, Inc.**
- Blank, L., and Tarquin, A. J., 2004, Engineering Economy, 6th Edition, McGraw Hill.
- Park, C.S., 2007, Contemporary Engineering Economics, 4th Edition, Pearson-Prentice Hall.
- Riggs, J. L., Bedworth, D. D., and Randhawa, S. U., 1996, Engineering Economics, 4th Edition, McGraw Hill.
- Sullivan, W.G, Wicks, E.M., and C.P. Koelling, 2008, Engineering Economy, 14th Edition, Prentice Hall.
- Thuesen, G. J., and Fabrycky, W. J., 2000, Engineering Economy, 9th Edition, Prentice Hall.
- White, J.A., Case K.E., and Pratt, D.E., 2008, Principles of Engineering Economic Analysis, 5th Edition, Wiley.

Purpose

This is a fundamental course for majors in engineering. The purpose is to prepare students understand the time value of money and how it affects engineering decisions. This course is a co-requisite for ININ 4155 Production Systems and Inventory and ININ 4040 Facilities Layout and Design. It is a requirement for the Bachelor of Science in Industrial, Electrical and Computer Engineering.

Course Goals

At the completion of each respective section of the course the student will be able to:

- Recognize, describe and gather financial, income and cost data necessary for a project evaluation under certainty. Use the financial data to calculate a capital cost. Interpret the mathematical result and based on it and the market characteristics establish a reasonable

minimum attractive rate of return (MARR). Understand and explain the importance of the MARR established.

- Define and explain simple and compound interest, discounting and compounding. Recognize the difference between lender and lessee. Interpret different money, time, interest and compounding quantities and identify the factors necessary to make them equivalent. Calculate and compare calculated quantities and use results to make a decision as to which alternative is best.
- Recognize pertinent data and decision criteria and use it in the before tax calculations necessary to rank alternatives using the break-even, equivalent annual costs, present worth, rate of return, or benefit / cost method under certainty.
- Recognize pertinent data and use it in depreciation, depletion, tax and cash flow calculations. Use these after tax cash flows and other pertinent data and decision criteria to rank alternatives under certainty using the above methods.
- Recognize pertinent data and use it in inflation, deflation, tax and cash flow calculations. Use before and after tax with or without inflation cash flows and other pertinent data and decision criteria to rank alternatives under certainty using the above methods.
- Apply the above methods to make replacement decisions.
- Recognize the difference among certainty, uncertainty and risk environments. Identify the decision environment. Use sensitivity, decision trees or risk analysis with the above methods to make decisions under these environments.

Requirements

All students are expected to:

- Complete all lessons.
- Do all assigned readings and related homework.
- Come to class prepared to use a calculator to solve practice problems.
- Come to class all the time and on time.
- Satisfy all assessment criteria to receive credit for the course.

Operating radios, tape recorders, cellular telephones, beepers and other audio or video equipment are not permitted in the classroom at any time. Smoking is not permitted in any area other than those areas designated for smoking.

Department and Campus Policies

Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies)

Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero or "F" in the examination missed. (Bulletin of Information Undergraduate Studies)

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays (see Bulletin of Information Undergraduate Studies).

Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar (see Bulletin of Information Undergraduate Studies).

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes (see Bulletin of Information Undergraduate Studies).

Disabilities: After been identified with the professor and the institution, the students with disabilities will receive reasonable accommodations in their courses and evaluations. For more information, please contact *Student Services with Disabilities* at the Student Dean's Office at (Q-019), 787-265-3862 ó 787-832-4040 x-3250 ó 3258.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

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.

Hostigamiento Sexual: La Certificación 130-2014-2015, indica: El hostigamiento sexual en el empleo y en el ambiente de estudio es una práctica ilegal y discriminatoria, ajena a los mejores intereses de la Universidad de Puerto Rico. Toda persona que entienda ha sido objeto de actuaciones constitutiva de hostigamiento sexual en la Universidad de Puerto Rico podrá quejarse para que se investigue, de ser necesario, y se tome la correspondiente acción por parte de las autoridades universitarias. Si quien reclama fuera estudiante, deberá referir su queja a la Oficina de la Procuradora Estudiantil o al Decanato de Estudiantes.

Certification 36 (2018-2019): Discrimination by Sex and Gender on Modality of Sexual Violence:

“The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, may turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or formal complaint.”

Certification 06-43 of the Academic Senate states, "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 16-43 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.

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.

Campus Resources

General Library and the University Computer Center are available for reference and assignment work. The University's Counseling Office has a tutorial program for students who need extra help.

General Topics

Lecture	Topics	Readings
Part I: Before Tax Analysis Under Certainty		
1 – 2	Introduction and making economic decisions	Ch. 1, pp. 1-22 Problems: 11, 23, 50
3 – 5	Estimating engineering costs and benefits Engineering costs Cost estimating Estimating models Estimating benefits Cash flow diagrams Breakeven analysis (linear and non-linear)	Ch. 2, pp. 31-60 Professor's notes Problems: 4, 5, 6, 8, 12, 15, 47, 49

Lecture	Topics	Readings
6 – 8	Interest and equivalence; Equivalence for repeated cash flows Time value of money-simple & compound interests, repaying debts Economic equivalence Interest factors-single payment, uniform series, Arithmetic gradient & geometric gradient Nominal & effective interest Continuous compounding	Ch. 3, pp. 72-98 Problems: 25, 26, 31, 37, 40, 42, 45, 53, 60 Ch. 4, pp. 104-142 Problems: 2, 4, 8, 70, 104, 110
9 – 11	Present worth analysis Assumptions Economic Criteria Techniques	Ch. 5, pp. 154-178 Problems: 32, 37, 44, 53, 66, 78, 80, 81
12 – 14	Annual cash flow analysis Annual cash flow calculation Annual cash flow analysis Analysis period	Ch. 6, pp. 191-211 Problems: 38, 42, 51, 53, 57
15 – 18	Rate of return analysis; Choosing the best alternative Internal Rate of return Calculating Rate of return Loans and investments Incremental analysis Difficulties in solving for an interest rate	Ch. 7, pp. 221-249 Problems: 9, 24, 27, 31, 42, 74, 86, 87 Appendix 7A, pp. 258-267 Problems: 1, 4, 18 Ch. 8, pp. 270-286 Problems: 23b, 24b, 26b
19 – 20	Other analysis techniques Payback Sensitivity and breakeven analysis Spreadsheets for economic analysis	Ch. 9, pp. 294-320 Problems: 33, 39, 44, 47, 53 Computer Workshop
21 – 23	Economic analysis in the public sector Investment objectives Selecting an interest rate Benefit cost ratio Incremental Benefit Cost-Analysis	Ch. 16, pp. 537-559 Problems: 23, 28, 31
Part II: After Tax Analysis under Certainty		
24 – 27	Depreciation Basic aspects Methods (Straight line, SOYD, Declining balance, MACRS) Depreciation and asset disposal Depletion	Ch. 11, pp. 367-397 Problems: 26, 33a&c, 37

Lecture	Topics	Readings
28 – 31	Income taxes for corporations Calculation of taxable income Income tax rates Economic analysis taking income taxes into account Capital gains and losses Estimating the After tax rate of return	Ch. 12, pp. 405-419 Problems: 24, 27, 37, 40, 42, 43, 67
32 – 35	Inflation and price change Meaning & effect of inflation Analysis in constant vs. then-current dollars Price change with indexes Inflation effect on after tax calculations	Ch. 14, pp. 479-503 Problems: 8, 15, 50, 68, 85
36 – 39	Replacement analysis Replacement problem Decision Map Minimum cost life - challenger Defender's marginal cost data Techniques Complications After tax analysis	Ch. 13, pp. 442-468 Problems: 10, 13, 14
Part III: Risk Analysis		
40 – 42	Uncertainty in future events Estimates and their use in economic analysis Range of estimates Economic Decision Trees Risk Risk versus return Simulation	Ch. 10, pp. 331-358 Problems: 19, 23, 24, 33, 42, 43

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Revised by Dr. Mayra I. Méndez Piñero on January 2017