On the Structure of Engineering Economics Course for Engineering Technology Majors

S. Kant Vajpayee
The University of Southern Mississippi

Abstract

As an engineering economics instructor, I have faced two major limitations while teaching this course to engineering technology (ET) majors. These are student lack of proficiency in math and unavailability of ET-oriented textbook. Over the years I have tried to cope with these limitations by developing a course structure that is appropriate for ET majors. This article presents the course structure and discusses its strengths. An emphasis on cashflow tables and diagrams goes a long way to make engineering economics interesting to ET majors. Another enhancement in instruction can be achieved by keeping the equations and their derivations to a minimum. Use of first principles proves, in certain cases, to be superior to the corresponding equation. The instruction material for the developed course is to be published next year by Prentice-Hall as an engineering economics textbook especially suited for ET majors.

Introduction

As required by TAC/ABET, we at The University of Southern Mississippi include a course on engineering economics in the curricula of all six of our accredited BS programs in engineering technology (ET). We offer it as ENT 390 at the junior level and use Newnan's textbook. I have taught ENT 390 to our ET majors several times. During these years I have discovered two major difficulties that impede the instruction of engineering economics to ET majors. These are lack of student math skills and textbook bias toward engineering majors. Even the usual coverage in textbooks for engineering students has been suggested for improvement[1].

The math skills expected in engineering economics are primarily in algebra, some in geometry and trigonometry, and little in calculus. Since the ENT 390 enrollees have had the prerequisite math courses, their lack in math skills is difficult to explain. The only plausible explanation is their general weakness in math compared to those in engineering programs. To circumvent this difficulty, I have developed over the years a course content that works well for ET majors.

Regarding the textbook, we considered several texts on engineering economics for our ET students. The text we currently use is probably the best in the market. It also encourages the use of spreadsheets[2]. In the meantime, I have worked with Prentice-Hall and am half-way through authoring a text especially for ET majors. Several of the ideas generated during ENT 390 instruction are being incorporated in the text to be available next year.

This article comprises four more sections. In Section 2 the course outline is presented. Section 3 highlights its special features, while 4 provides the rationale. The last section offers some concluding remarks.

The Course

ENT 390 is offered as a one-semester course with contact time of 40 hours. The sequencing of the text material is modified to suit the needs of ET majors. The outline of ENT 390 as provided to the enrollees is given below. The actual handout contains other relevant information, such as policies on grading and absences, which, for brevity, has been excluded here.

Week	Topics
1	Introduction to the Course; Its Why, How, and Value to Engineering Technologists
2	Cashflow Tables & Diagrams
3	Single Payment
4	Multiple Payments
5	Review; Test 1 and its post-mortem
6	Decision Criteria; Payback & PW Methods
7	FW and AW Methods; *Term Paper*
8	ROR Method
9	B/C Ratio Method; Criteria Comparison
10	Review; Test 2 and its post-mortem
11	Realism to the Analyses; Depreciation
12	Income Taxes; Inflation
13	Replacement Analysis
14	Advanced Topics
15	Review; Test 3 and its post-mortem

16 Term Paper due; Review for Final;
    Exit Interview
17 Final Exam

Special Features

As seen in the above outline, the entire course is divided into three modules, each five-weeks long. The last two meetings are reserved for review, term papers, final exam, etc. At the end of each module a test is given. Following the grading, each test is reviewed in the class as a "post-mortem" exercise. The post-mortem has been found to be very effective in honing student skills in solving problems. During the fourteenth week, we briefly discuss under advanced topics some of the material routinely taught to engineering majors.

The three-module approach is analogous to building a house, and I explain this analogy to the class as part of the course introduction. The first module is similar to building the foundation. The second module can be looked upon as building the walls and the roof, the doors and the windows, and providing utilities. Obviously, the second module is effective only if a strong foundation has been laid in the first module, i.e., students have learned the basic principles of cashflow manipulations. Furthermore, even though the physical construction of the house is complete when doors and windows, and walls and roof have been finished, and utilities hooked up, the house is not yet inhabitable. Likewise, though students have learned quite a lot by the end of the second module, the knowledge is "rough-cut." As we need carpets, drapes, furniture, and kitchen appliances for the house to become livable, we need to consider depreciation, income taxes, inflation, etc., to render the learning of engineering economics really practical. The third module serves this purpose by honing the skills developed in the first two modules.

During the seventh week, students begin work on individual term papers which require them to learn about the software provided with the text. The objective of the term paper is software's application in solving problems. The term paper is due during the sixteenth week which is reserved for review towards the final examination that takes place during the seventeenth (last) week. Also scheduled during the sixteenth week is an exit interview with the enrollees to gather feedbacks on the course, especially on how to improve it further.

The sequencing of learning in engineering economics can be explained by comparing it with an onion. Each week's coverage is like a layer of the onion, except that we begin from the inside. The first module is like the core of the onion on which the materials of the other two modules are laid as layers as the instruction progresses.

Rationale

If we look closely at the outline, we notice that the cashflow tables and diagrams are introduced in the very beginning, during the second week. Their strengths in summarizing the given data are illustrated by using statements from typical engineering economics problems; no attempt is made to solve any problem at this stage. Most textbooks and course outlines delay the introduction of cashflow tables and diagrams until the compounding law has been discussed.

An early introduction of cashflow tables and diagrams is very helpful in generating student interest in the course. Moreover, the use of problem statements illustrates the types of decision making involved in engineering economics. ET students feel comfortable with tables and diagrams which are effective tools to explain a problem. Their introduction to these tools in the very beginning helps them visualize the problem, removing the "fear" of engineering economics to a large extent.

A full week is devoted to single payment problems to introduce the concepts of interest and compounding. After pointing out its limitations for the "real-world", multiple payments are discussed, and relevant equations are introduced.

I devote a lot of time and effort in explaining how to modify or "tailor" a given cashflow diagram to one of the standard diagrams for which functional notations exist. The tailoring is very effective in illustrating how a variety of problems can be solved easily by exploiting a few standard cashflow patterns.

I try to keep the theoretical aspects of the equations to a minimum. Only the basic equation $F = P(1+i)^n$ is discussed thoroughly. Its functional notation and the use of compound interest tables are introduced through several examples. Other equations and their derivations are "cut-down" to their minimums. Noting that this course is for ET majors, I leave out the derivations of gradient formulas and introduce their functional notations only. For the same reason, continuous compounding is not covered since in engineering projects it is less relevant.

228

Concluding Remarks

Engineering economics is one of the difficult courses for ET majors. Lack of math skills and the unavailability of suitable textbooks are the two primary reasons. Heavy "doses" of cashflow tables and diagrams are helpful to ET majors. Keeping the equations and their derivations to a minimum is also an effective instructional approach. Coverage for ET majors should be sequenced differently from that for engineering majors, as discussed in this article. A forthcoming Prentice-Hall text is especially suited for ET majors.

References

1. Chang, Tsong-how (1995) Toward the Development of a Course in Economy Engineering. 1995 Annual ASEE Conference Proceedings, pp. 755-69.

2. Johnson, Bruce (1995) The Use of Window-based Spreadsheets to Teach Engineering Economics Concepts. ibid, pp. 744-49.

S. KANT VAJPAYEE

Dr. S. Kant Vajpayee is a professor of engineering technology at The University of Southern Mississippi. He has been associated with university teaching and research in USA, Canada, England, and India for over twenty-five years. He worked in a British company as noise and vibration engineer. Dr. Vajpayee has published over eighty articles and three books. He is working on his fourth text, entitled *Economics for Engineers and Technologists*, to be published by Prentice Hall. He has held grants totaling $1.2 million dollars. He was a Commonwealth Scholar of the U. K. government. Dr. Vajpayee is associated with SME, CASA/SME, Mississippi Academy of Sciences, and Institution of Engineers (India). He led and directed the formation of Southern Mississippi Chapter of SME (# F270) and was its founder chairman. His interests lie in environmental science and technology, modern manufacturing, quality, and noise and vibration.