

## **The Development and Growth of a Professional Engineering Program**

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### Abstract

In 1982, the Continuing Education Division at Northeastern University began teaching a review course to prepare engineers for the Engineer-in-Training (EIT) exam. This review course has grown to offerings that encompass three sections twice a year of the Fundamentals of Engineering (FE) review courses and seven sections of professional engineering review classes. Two years ago, a seminar series was added to address the continuing education requirements for re-registration in some states.

The Fundamentals of Engineering (FE) course covers the subjects in the first two years of an engineering curriculum. The last two years are covered by regrouping the students into six specialty disciplines (Civil, Mechanical, Electrical, Chemical, Industrial, and General). The courses precede the exam dates. Faculty are selected from Northeastern University College of Engineering faculty and local practicing engineers.

The Professional Engineering (PE) review courses are offered in seven discipline areas. Faculty and professional engineering experts cover each of the topics. Sessions consist of a review of engineering principles and many practice problems.

The seminar series offer full-day seminars for professional engineers. These are designed to cover current topics related to the various engineering disciplines. They provide continued professional development for engineers in practice and/or for renewing Professional Engineering licenses. Five seminars have been held.

The total Professional Engineering Program is currently serving 300 to 350 students per year. The program is offered at four locations in the greater Boston area including local company sites.

### Introduction

Responding to the demand for a review course to prepare for the Engineer in Training exam, the Continuing Education Division at Northeastern University designed and offered the course in the early 1980's. The course, taught by NU faculty and a few outside specialists, rapidly grew in size and expanded to various locations.

In the late 80's, the first Professional Engineering course, Mechanical Engineering, was offered. The course was organized to run for 12 weeks for 2 ½ hours each session. The course topics matched those covered in the exam specification. The first session covered overview and strategy. Subsequent sessions addressed the subject areas. Each session covers major theories, a subject review, and sample problems to illustrate additional concepts. Faculty provide notes and problems. Students purchase a reference manual published by Professional Publications, Inc.

The next year Civil and Electrical Engineering Review Courses were added, and the PE courses were standardized at thirteen weeks. Lastly, Chemical, Industrial, and Fire Protection Engineering were added. The later two were offered once a year to coincide with exam offerings in Massachusetts.

This paper presents details of the courses and the Seminar series. The paper concludes with the future of the program relative to the impact of changing technology, increased competition, and format changes at the national level.

#### The Courses Offered

FE Review courses run two times a year at three locations for 12 weeks. Appendix A illustrates the course outline and the topic coverage by night. In 1996 the first discipline specific exam was given, necessitating the reorganization of the review course. Since the course preceded most of the manuals, faculty prepared notes from National Council of Examiners for Engineering and Surveying (NCEES) sample exams. The last four weeks of the course are divided into the five disciplines and a General Engineering track. The classes are split into six tracks for weeks 9 through 12 (if less than four students select a track, it is canceled). The scheduling for the last four sessions is a logistical nightmare. Plans are developed to change and repackage this portion of the course.

In- plant courses run through the Corporate Education Group in Continuing Education. Yearly offerings have been held at Texas Instruments, Attleboro; and a course was held at Yankee Electric several years ago.

The Professional Engineering (PE) review courses run 13 sessions with each class lasting 2 ½ hours. Each discipline covers the subject area proportional to the specifications prepared by NCEES. The Civil course is unique with two tracks set up to cover the three exams: Traditional Civil, Structural, and Environmental. The courses run on successive nights so that students can select the topics to attend. The course outlines are included in Appendix B to illustrate how all areas for the three exams are reviewed.

Within the Professional Engineering Program, each discipline has a coordinator responsible for

staffing and scheduling. Students receive pass grades unless a letter grade is required for company tuition reimbursement. Grades are given based on attendance. An official transcript is generated that posts 3.2 CEU's for the PE and 3.0 CEU's for the FE course.

Currently, Professional Publications books are used for most courses. The Electrical PE course uses the Great Lakes Press book and Environmental uses a book by the Environmental Engineering Academy authored by King. Fire Protection uses a collection of notes and references. Appendix C contains a list of some of the major publishers producing review books for the FE exams. Most of these publishers produce material for some of the PE examinations.

The authors of this paper teach in the program from the FE through the various PE courses. In 1997, three members of the Northeastern University faculty developed the review manual for the Discipline Specific Electrical Engineering (The lead author is a co-author of this paper). Another writer of this paper has prepared three chapters for a FE Review Manual currently in publication.

### The Seminar Series

Last year the seminar series was started in response to Professional Development Hours Requirements for re-registration in many states and the need for continued education for engineers. The purpose is to provide continuing professional development to the engineering community. The plan is to run three seminars in both the Fall and Spring quarters to offset the offering of the review courses.

Topics have included Forensic Engineering Techniques, Product Liability, Searching the Internet for Engineering Data and Applications, Designing and Maintaining Web Pages, and Engineering Projects Management. Registered professional engineering faculty or practicing engineers cover these topics. These experts are paid to develop and deliver the eight hour seminars. Participants pay \$250 and receive a certificate, 0.8 Continuing Education Units on an NU transcript, a comprehensive notebook, and lunch.

Brochures are prepared and mailed to PE's in Massachusetts and neighboring states. The Web site for the program also contains information about the program, courses, and seminars. The Web address is: [www.neu.edu/cont-ed/FE-PE](http://www.neu.edu/cont-ed/FE-PE).

The National Society of Professional Engineers published, in the May 1996 issue of Engineering Times, the rationale for professional development. "There is no argument on one front. Staying current in a rapidly changing field like engineering remains a must. It will help your career and benefit your company, as well. 'Knowledge has become the only source of long-run, sustainable competitive advantage' says Lester Thurow, professor of economics and management at MIT and author of The Future of Capitalism. Recent studies show that rates of return for industries that invest in knowledge and skill are more than twice those of industries that concentrate on plant and equipment."

The article continues with a statement from Robert Hermann- “Have an R&D plan for yourself, and a plan to become worth ever more. Keeping up becomes a given, but engineers still have to pick and choose among a variety of options: outside reading, on-the-job learning, teaching, networking, and taking classes. When it comes to course work, factors such as cost, accessibility, convenience, content, and extras should figure into the equation.

An employer that wants to stay competitive will invest in its employees’ development. Ultimately, lifetime learning is the employee’s responsibility. It comes down to personally keeping yourself on track as you undergo several job transitions during your career and not relying on one employer to provide the map. It is no small task, but a necessary and rewarding one.”

### Future Issues

Plans have been formulated to develop a Surveying Certificate to be offered by NU Continuing Education. The unique feature of this program would be that academic credit is awarded for Surveying courses taken at the Lowell Institute School (a degree granting unit at NU for accredited engineering technology programs). The total certificate, both credit and CEU courses, would be equivalent to 40 to 48 quarter hours of academic credit.

An assessment will be started to determine if some or all of FE classes will be integrated on the Web. Course registration, billing, and taking the class will all be on the Internet. Communication with faculty will utilize email. Other PE courses must be evaluated to determine their applicability and feasibility in a Web based environment. The Internet will be expanded for advertising and promotion of courses and seminars. The focus of this effort will be to link NU web pages to other web pages. The effort will be focused on ensuring that the web pages are cited by search engines.

In the Engineering Times, Jan/Feb 1998 issue, NCEES observed a glimpse of what may be the future may be in a demonstration of the new computerized Architect Registration Exam (ARE) at the council’s summer annual convention. “The ARE went electronic in February, 1997. Proceeding with caution, NCEES has appointed a task force to observe the test takers’ response to the ARE and weigh the positives of computerized testing such as: accessibility and quickness against the negatives, such as increased cost and unfamiliarity..... NCEES President Steven Schenk says the task force will present an action plan and report at next August’s annual convention..... ‘the Fundamentals of Engineering, Fundamentals of Land Surveying, and Principles and Practice of Land Surveying would come first because their computerization would serve the largest slice of the pie immediately’ Phaneuf says ‘...computerizing the Principles and Practice of Engineering is certainly in the picture at this point, but would depend on the results of the other tests’.

Martin of the New York State Board for Architecture confirms that the price of the ARE is now \$998, quite an increase from last year’s \$668 written exam. Schenk says that the financial implications of computerized testing for both engineering candidates and NCEES are top considerations of the council. The National Council of Architectural Registration Board

(NCARB) attests, however, that the benefits far outweigh the costs and that the new test actually eliminate some costs.”

Other plans for the NU Program include lengthening the classes to three hours and shortening the length of the courses. The format of the FE courses may be changed reduce the number of sessions on the discipline specific classes. For the PE classes, plans are to increase the sessions relating the Structural exam by creating a third focus track. This track will run for a maximum of six classes.

Plans for the Seminar series include running the seminars in different locations. Consideration is also being given to vendor displays at some seminars, where appropriate.

### Summary

The development and growth of a professional engineering program must primarily respond to the needs of the engineering community for review courses to prepare for the two examinations to become a Registered Professional Engineer. The courses provide the discipline and structure to prepare for the exams. Faculty cannot teach all material but can highlight where additional preparation is required. The courses have been beneficial to the participants, and they achieve a high pass rate on the exams.

Continued professional development for registration and competency demands the development of a quality program of professional seminars and course offerings. These courses and seminars have been successful in both the campus and in plant settings. The future will see the introduction of technological changes. The responsibility of answering the needs of the practicing engineer continues to be a growing challenge.

## Appendix A FE Course Outline

### ME5168 FUNDAMENTALS OF ENGINEERING PREPARATION COURSE

Northeastern University  
Center for Continuing Education  
370 Common St., Dedham, MA 02026  
781-320-8026 FAX: 781-320-8012

TERM: WINTER 1999  
January 12 - March 30, 1999  
6:00-8:30 p.m.

WEEK	DATE	TOPIC	INSTRUCTOR	REFERENCE CHAPTER
1	1/12/99	Introduction/Materials	George Kent	36,37,38
2	1/19/99	Mathematics	Jane Devoe	4,5,6,7,8,9
3	1/29/99	Chemistry	Kevin McLaughlin	33,34,35
4	2/2/99	Circuits	Ronald Scott	39,40,41,42

5	2/9/99	Statics/Kinematics	Eric Hansberry	10, 11, 12, 13 14, 15, 16, 17, 18, 19
6	2/16/99	Kinetics/Mechanics of Materials	George Kent	20, 21
	2/23/99	Engineering Economy/ Computers/Ethics		
7			Thomas Hulbert	47, 48, 49, 43, 44, 50 26, 27, 28, 29, 30, 31,
8	3/2/99	Thermodynamics/Fluids	Mohammed Taslim	22, 23, 24, 25
9	3/9/99	See discipline specific schedule		
10	3/16/99	See discipline specific schedule		
11	3/23/99	See discipline specific schedule		
12	3/30/99	See discipline specific schedule		

#### WINTER 1999

#### FE DISCIPLINE SPECIFIC SCHEDULE

All classes meet from 6:00 - 8:30 p.m.

#### CIVIL - BOSTON MAIN CAMPUS

WEEK DAY	TOPIC	INSTRUCTOR
9 Thu 3/11	Environmental Engineering	Paul Doran
10 Thu 3/18	Soils Engineering	Tom Sheahan
11 Thu 3/25	Transportation	Robert Ashburn
12 Thu 4/1	Structural Design	Dennis Bernal

#### MECHANICAL - DEDHAM CAMPUS

WEEK DAY	TOPIC	INSTRUCTOR
9 Wed 3/10	Statics, Dynamics, Stress Analysis	George Kent
10 Wed 3/17	Mechanical Design	George Kent
11 Wed 3/24	Thermodynamics and Fluid Mechanics	Hameed Metghalchi
12 Wed 3/31	Heat Transfer & Power Plant Systems	Hameed Metqhalchi

#### ELECTRICAL BURLINGTON CAMPUS & HIGH SCHOOL

WEEK DAY	TOPIC	INSTRUCTOR
9 Tue 3/9	Circuits, Systems, Communications	Robert Angus
10 Tue 3/16	Instrumentation, Control Systems	Robert Angus
11 Tue 3/23	Solid State, Analog, Digital Electronics; Numerical Methods	Ron Scott
12 Tue 3/30	Fields, Transmission Lines, Power Systems & Machines	Ron Scott

#### CHEMICAL BOSTON MAIN CAMPUS

WEEK DAY	TOPIC	INSTRUCTOR
9 Tue 3/9	Material and Energy Balances	Ralph Buonopane
10 Tue 3/16	Chemical Thermo & Heat Transfer	Edgar Gutoff
11 Tue 3/23	Chemical Reaction Kinetics & Reactors	Behrooz Satvat
12 Tue 3/30	Distillation & Mass Transfer	Richard Stewart

GENERAL LOCATIONS TBA

WEEK DAY	TOPIC	INSTRUCTOR
9 Wed 3/10	Circuits	Ron Scott
10 Wed 3/17	Statics, Stress	Eric Hansberry
11 Wed 3/24	Thermodynamics	Hameed Metghalchi
12 Wed 3/31	Mathematics	Jane Devoe

**Appendix B PE Course Outlines**

PROFESSIONAL ENGINEER'S LICENSE EXAM PREPARATION COURSE

Northeastern University  
Center for Continuing Education  
370 Common St., Dedham, MA 02026  
781-320-8026 FAX: 781-320-8012

CIV5450 CIVIL ENGINEERING STRUCTURAL FOCUS

SUMMER 1998

July 15 - October 7, 1998

Boston Main Campus

Wednesday

6:00-8:30 p.m.

WEEK	DATE	TOPIC	INSTRUCTOR
1	7/15/98	Orientation/Eng. Economy	Thomas Hulbert
2	7/22/98	Structural Analysis I	Michael Tarnowski
3	7/29/98	Structural Analysis II	Michael Tarnowski
4	8/5/98	Steel I	Alexander Newman
5	8/12/98	Steel II	Alexander Newman
6	8/19/98	Basic Soil Mechanics	Thomas Sheahan
7	8/26/98	Soil Strength/Compressibility and Shallow Foundations	Thomas Sheahan
8	9/2/98	Retaining Structures and Deep Foundations	Thomas Sheahan
9	9/9/98	Timber and Masonry	Alexander Newman
10	9/16/98	Construction Materials	Nandi Nanthikesan
11	9/23/98	Seismic Design	Daniel Rencurrel
12	9/30/98	Concrete I	Dennis Bernal
13	10/7/98	Concrete II	Dennis Bernal

ENV5350 CIVIL ENGINEERING ENVIRONMENTAL FOCUS

SUMMER 1998

July 16 - October 8, 1998

Boston Main Campus

Thursday

6:00-8:30 p.m.

WEEK	DATE	TOPIC	INSTRUCTOR
1	7/16/98	Orientation/Eng. Economy	Thomas Hulbert
2	7/23/98	Air Pollution	Constantine Gregory
3	7/30/98	Surveying	Robert Ashburn
4	8/6/98	Hydraulics/Hydrology	Paul Doran
5	8/13/98	Hydrology	Paul Doran
6	8/20/98	Solid & Hazardous Waste	Irwin Silverstein
7	8/27/98	Environmental Protection I	Jack Price
8	9/3/98	Environmental Protection II	Jack Price
9	9/10/98	Water Treatment	Irvine Wei
10	9/17/98	Transportation I	David Navick
11	9/24/98	Transportation II	David Navick
12	10/1/98	Wastewater Treatment I	Paul Doran
13	10/8/98	Wastewater Treatment II	Paul Doran

### **Appendix C Publishers FE Review Materials**

Note: NSPE does not endorse any of the publishers at this time. This was due to the lack of complete review materials for the PM discipline specific booklets. See April 1998 Engineering Times for a review of some of the listings below

#### **Professional Publications, Inc.**

1250 Fifth Ave  
Belmont, CA 94002

Engineering-in-Training Reference Manual and Solutions Manual  
EIT Review Manual for AM exam and General PM exam  
Discipline Specific Manuals for 5 disciplines

#### **Great Lakes Press**

PO Box 483  
Okemos, MI 48805

Fundamentals of Engineering, FE/EIT Review Manual AM and General PM  
Discipline Specific FE/EIT Exam Review 4 Disciplines(missing IE)

#### **Engineering Press**

PO Box 200129  
Austin, TX 78828-0219

Engineering-in Training License Review Manual  
5 paper back review Manuals for Discipline Specific

#### **Professional Engineering Development Manual**

7398 Center Ave  
Huntington Beach, CA 92467

FE/EIT Review Manual

#### **Barron's Educational Series, Inc.**

250 Wireless Blvd.  
Hauppauge, NY 11788-3917

How to Prepare for the FE/EIT Exam (in preparation)  
Covers AM exam plus a review of General PM exam



#### THOMAS E. HULBERT

He is a Professor Emeritus at Northeastern University. For 32 years, he served as a faculty member and administrator in the College of Engineering. For the last 12 years, he was Director and Associate Dean of the School of Engineering Technology. Currently, he serves as Coordinator of the Professional Engineering Program and Consultant in Continuing Education. He is currently developing and teaching a Data Acquisition program for technicians. Prior to joining Northeastern, he worked as a Senior Industrial Engineer for 8 years. He also consults in the areas of facilities design, productivity improvement, and inventory control. He has written and presented numerous papers on educational innovations and contributed to several textbooks. He is a Registered Professional Engineer in Massachusetts, a member of honor societies and ASEE, and cited in several directories.

#### ROBERT B. ANGUS

He is a Senior Lecturer at Northeastern University with more than 50 years of teaching experience covering mathematics, physics, electrical engineering, and electrical technology courses. He has authored or co-authored eleven textbooks and numerous technical papers. He has been an engineer, engineering manager, and senior engineering specialist for more than 20 years and has been an engineering consultant for the past 20 years. His specialty has been circuit and system design, curriculum development, and technical manual writing. He is currently working on the data acquisition project with Hulbert. He is a Registered Professional Engineer in Massachusetts and a life member of IEEE.

#### ERIC W. HANSBERRY

He is an Associate Professor at Northeastern University has taught graphics and mechanics courses for engineering and technology students for over 20 years. He has also worked as a design engineer in the ship building industry for 15 years. He has authored several technical papers, primarily in the areas of teaching innovation and curriculum design. He was responsible for acquiring the College of Engineering's first computer automated drafting (CAD) system for teaching first year students over 15 years ago He is a Registered Professional Engineer in Massachusetts and New Hampshire.