University of North Carolina at Charlotte

Graduate Course Proposal

The William States Lee College of Engineering (Engineering Management Program)

Title: **Adding a New EMGT Graduate Course**

A. Proposal Summary: The Engineering Management Program proposes to add a new graduate course: EMGT 6952 Engineering Systems Optimization.

Proposed Catalog Copy:

Course Description for the Proposed New Course:
EMGT 6952 Engineering Systems Optimization. (3) Prerequisite: Calculus and Linear Algebra or Consent of Instructor. The main objective of this course is to develop fundamental problem solving skills for engineers and engineering managers using techniques for optimizing engineering systems. A systems engineering approach will be followed to analyze practical applications from different engineering disciplines and to optimize complex systems. Model formulation, sensitivity analysis, special cases, solutions using commercially available software applications and practical implementation considerations will be emphasized. (On demand)

B. Justification

1. Need. Optimization is an essential part of engineering systems design. This course is aimed to fill a gap in the Engineering College to provide Engineering and EMGT graduate students the fundamentals of optimization and how to apply it to solve their research and industry work related problems.

2. Prerequisites/Corequisites: Calculus and Linear Algebra or Consent of Instructor.

3. Course Numbering: The proposed course is numbered consistent with the guidelines on the University Catalog.

4. Improvements Resulting: The proposed course will ensure that the Engineering and EMGT graduates have a solid, coherent foundation of systems engineering approaches and decision making ability. It is expected that this course will help improving the quality of research taken by Engineering Graduate Students. Since the course is an applied course each student will also get hands-on experience with the state of the art optimization software and solve a research/industry problem during their project. Addition of this course will also allow the EMGT and other Engineering graduate students to have more choices in EMGT courses that fulfill their needs. This new course provides additional areas of

specialization for the wide range of disciplinary fields in which Engineering Managers are involved.

C. Impact

1. The primary students served by this proposal will be students in the MS in Engineering Management Program. Some other M.S. Engineering or Science students may be interested in taking these courses as electives.

2. These courses will have an impact on existing curricula and courses as follows:
    a. Frequency of offering: as needed or on demand.
    b. Effects on frequency of offering other courses: minimal.
    c. Anticipated enrollment: 15-35.
    d. Effects on enrollment in other courses: minimal.
    e. This course has not been offered previously.
    f. This offering will not affect other areas of catalog copy.

D. Resources Required to support Proposal: no additional resources.

1. Personnel: no additional resources.
2. Physical facility: no additional resources.
3. Equipment and Supplies: no additional resources.
4. Computer: no additional resources.
5. Audio Visual: no additional resources.
6. Other resources: no additional resources.
7. Sources of funding: N/A.

E. Consultation with Library. A copy of this proposal was sent to the Library Reference Staff on April 8, 2005.
Consultation with Other Units. Copies of this proposal were sent to the departments of Civil Engineering, Electrical and Computer Engineering, Engineering Technology, Mechanical Engineering on April 8, 2005 and to the Director of the MBA program on April 8, 2005.

F. Initiation and Consideration of the Proposal

1. Originating Unit: All faculty teaching in the EMGT course area approved of this proposal on April 8, 2005.
2. Other considering units: none.
3. This proposal was not submitted to the Council on General Education.

G. Attachments:
Syllabus of the proposed course is copied below:

THE UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE

The William States Lee College of Engineering
Engineering Management Graduate Program

EMGT 6952 - Engineering Systems Optimization

Course Description:

The main objective of this course is to develop fundamental problem solving skills for engineers and engineering managers using techniques for optimizing engineering systems. A systems engineering approach will be followed to analyze practical applications from different engineering disciplines and to optimize complex systems. Model formulation, sensitivity analysis, special cases, solutions using commercially available software applications and practical implementation considerations will be emphasized.

Instructor: Professor Ertunga C. Ozelkan, Ph.D.
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Prerequisite: Calculus, Linear Algebra

Textbook: Lecture Notes available through WebCT

Supplementary Books and Materials:

- Optimization Concepts and Applications in Engineering, A. D. Belegundu, T.R. Chandrupatla, 1999, Prentice Hall, ISBN 0-13-031279-7
- Engineering Optimization Methods and Applications, G.V. Reklaitis, A. Ravindran, K.M. Ragsdell, Wiley-Interscience, 1983, ISBN 0-741-05579-4.
- AMPL: A Modeling Language for Mathematical Programming, R. Fourer, D. M. Gay, and B. W. Kernighan, Duxbury Press / Brooks/Cole Publishing Company, 2002, Second edition, ISBN 0-534-38809-4.
- Applied Optimization with Matlab Programming, P. Venkataman, Wiley-Interscience, 2002, ISBN 0-471-34958
- Related journal papers and other materials.

Learning Objectives:

After completing the course, the students will be able to

1. Formulate a given engineering problem using the systems engineering framework.
2. Recognize the problem type and associate with efficient solution techniques.
3. Understand and apply the solution algorithms to optimize the engineering system.

Course Contents & Tentative Schedule:

Weeks	Discussion	Topics
1	Introduction to Engineering Systems Optimization	Course Overview and Objectives Engineering Examples from water resources and civil engineering such as reservoir control, rainfall-runoff modeling, construction engineering such as structural steel beams assortment, mechanical engineering such as mechanical design, and typical engineering problems related to manufacturing
1,2	Systems Engineering	Introduction to Systems Approach -System Lifecycle (A. Wayne Wymore, Model-Based Systems Engineering, CRC Press, 1993) -SIMILAR Process (A. T. Bahill, B. Gissing, Re-evaluating Systems Engineering Concepts Using Systems Thinking, IEEE Transactions on Systems, man, and Cybernetics-Part C: Applications and Reviews, Vol.. 28, No. 4, November 1998)
3	Modeling Linear Engineering Systems	Formulation, Assumptions, Examples
4		Graphical and Excel Solutions
5		Simplex Solution
6		Special cases & Sensitivity Analysis
6, 7	Commercial Software for Large Scale Optimization	Introduction to Modeling using AMPL (A Modeling Language for Mathematical Programming) and CPLEX solvers - creating .mod, .dat, .run files - experimental design for sensitivity analysis - random data generation
8		Exam 1
9		Integer Problems & Branch and Bound Solution
10	Modeling Engineering Networks	Engineering Examples from electrical and telecommunication engineering such as electrical and communication network design, transportation engineering, civil engineering such as hydraulic and irrigation systems, etc. Transportation and Assignment Problems
11		Network Flows (Shortest Path, Minimum Spanning Tree) Solving Network problems using AMPL
12	Modeling Non-linear Engineering Systems	Engineering Examples with examples from highway construction, structural design, mechanical design, electrical networks, and water resources management, etc. Fundamentals Graphical and Excel Solutions
12		1-Dimensional Unconstrained Optimization -Bisection Method -Dichotomous Method
13		Multi-Dimensional Unconstrained Optimization - Gradient Search - Simplex Direct Search Method of Nelder & Mead
14		Multi-Dimensional Constrained Optimization - Complex Direct Search Method
15		Exam 2
16		Project Presentations

Course Requirements and Assessment:

1. Tests: There will be two in-class exams. The exams are open book and notes. No make up exams will be given. Exam 1: 10/13/2004, Exam 2: 11/24/2004

2. Term Project: The students will work in teams on an applied or theoretical project topic. Each team will write a proposal and a final report and present their work during the last week(s) of the class. Specific interests of students related to their job or research work will also be taken into account. The final deliverables are 1) soft and hard copy of the final report, 2) soft copy of the final presentation, 3) presentation in the class.

2. Assignments: Students will be required to do 5 assignments. Assignments must be returned on the specified due dates. Late homeworks are not allowed. For individual assignments, you may discuss the assignments with others but make sure that you complete the work independently. Students handing in identical assignments will be violating scholastic honesty regulations and will not receive credit!

3. Class Attendance & Participation: It is expected that students will attend all classes. It is student's responsibility to make-up for missed classes.

Grading Policy:

Exam-I	25%
Exam-II	25%
Assignments	25%
Term Project	20%
Class Attendance & Participation	5%
Total	100%

The Code of Academic Integrity:

See UNCC Code of Student Academic Integrity at **http://www.uncc.edu/policystate/ps-105.html**.