ESTABLISHMENT OF A BACHELOR OF SCIENCE IN SYSTEMS ENGINEERING

I. Proposal Summary and Catalog Copy

I.A. Summary

The changing global business environment is focusing engineering companies in the U. S. to move from self-sufficient engineering operations toward the integration of various engineering operations, including design, production and manufacturing, logistics, sales, and services, at global locations and companies. The education of future engineers must reflect this changing trend and demand. The Systems Engineering (SE) discipline provides this critical need of education to handle the increasing demands of systems efficiency, effectiveness, and integration in engineering and business operations. It is critical that current engineering education in the state of North Carolina and the U. S. remain competitive for engineering graduates in these global engineering operations. This need is reinforced by G. Wayne Clough in an editorial in the summer 2006 issue of the National Academy of Engineering’s The Bridge. “The Engineer of 2020 ... offered ideas for (1) the teaching of introductory courses in ways that would engage students and arouse their curiosity, (2) encouragement of a systems approach rather than the traditional piecemeal approach, (3) interdisciplinary courses, and (4) internships and cooperative experiences to supplement classroom exercises.” To meet this demand, the College of Engineering at UNC Charlotte plans to establish a Bachelor of Science degree program in Systems Engineering (BSSE) beginning in Spring 2008.

The BSSE curriculum takes into account several key perspectives including industry needs and competition. Based on our analysis, it is expected that the need for Systems Engineers and SE education will grow due to economic and population growth in the Charlotte region. Benchmarking against the major SE programs nationally indicates growing enrollment trends in SE programs. Currently, in the state of North Carolina, there are no academic institutions offering a BSSE degree, and there are only a few programs at the undergraduate and graduate levels that relate to SE. This picture presents an opportunity to enhance SE education in the state of North Carolina. The proposed BSSE program will be timely and will also complement the existing Engineering Management Graduate Program.

As part of a strategic analysis, the UNC Charlotte Engineering Management Program identified the Charlotte area as the home to the headquarters of nine Fortune 500 companies including Bank of America, Wachovia Corp., Duke Energy, Nucor Corp., Sonic Automotive, SPX, Family Dollar, Goodrich Corp., and Lowe’s. In addition, 306 other Fortune 500 companies are represented in the Charlotte area covering a variety of industries in the manufacturing, transportation and distribution, and financial services. Due to the ever-improving business opportunities and increasing population, this region is expected to have a
growing need for educational services at both the undergraduate and graduate levels. Since the SE graduates will be prepared to work in a wide variety of industries, local industry needs from the major industrial sectors demonstrate that UNC Charlotte is an excellent location for the new BSSE program.

Based on our analysis, the following areas capture the main SE skills required in industry, both regionally and globally:

- Decision and Risk Analysis
- Systems Modeling and Optimization
- Systems Design, Planning and Analysis
- Supply Chain and Logistics Engineering
- Quality Engineering
- Engineering Management
- Effective Communication and Presentation
- Understanding of Global Business Dynamics

The Directorate for Engineering of the National Science Foundation (NSF) released a conceptual document for reorganization in June 2005 [1]. In the document, one of the main emphases in the three major Engineering divisions, Division of Electrical, Communications and Cyber Systems; Division of Civil, Manufacturing, and Mechanical Innovation; and Division of Chemical, Biological, Environmental and Transport Systems; is on research dealing with the complexity in integrating systems that include engineering, engineered, and natural systems. Hence, the systems engineering discipline plays an important role in current and future NSF research efforts.

For the Carolinas, with its growing business opportunities and increasing population in Charlotte and the surrounding areas, there is a need for educational services at the undergraduate and graduate levels in managing systems and global supply chain operations. Systems engineering and engineering management are the essential and complementary disciplines that produce graduates with interdisciplinary engineering, management, and business skills that are highly valued by many companies that compete in the global market.

Currently, there are no academic institutions offering the BSSE degree in the state of North Carolina. Among the 16 campuses of the UNC system, only four (4) offer systems engineering-related programs within their engineering program offerings. Among these four, only two are established departments (NC State and NC A&T), while the other two are either a graduate-level program (UNC Charlotte) or an undergraduate-level concentration area (ECU). In addition, Duke University has a Master’s-level Engineering Management Program.

This proposed B.S. in SE program also is connected to a range of university goals including: (a) to provide services that impact positively the many challenges facing the region, state, and nation; (b) to train students who possess interdisciplinary skills and capacities that can be applied to a variety of situations and professions in an ever-changing global economy; (c) to improve educational opportunities that respond to the intellectual and professional needs of
the region; (d) to increase both faculty and student research that will address fundamental and regional problems, (e) to provide a variety of services that respond to the ongoing and emerging regional needs, and (f) to graduate students with the breadth and depth of knowledge and the intellectual and professional skills that prepare them for a productive life in an ever-changing world.

The new BSSE program will meet the needs of citizens, industries, and businesses in this region and the state by building upon and expanding the mission of the current Engineering Management Program. This foundation and support from regional industry makes the College of Engineering at UNC Charlotte an appropriate place to establish a B.S. program in SE.

The following table summarizes the proposed BSSE Study Plan:

<table>
<thead>
<tr>
<th>BSSE Curriculum and Study Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshman Year</strong></td>
</tr>
<tr>
<td>ENGR 1201 Intro to Engr I</td>
</tr>
<tr>
<td>CHEM 1251 Chemistry I</td>
</tr>
<tr>
<td>CHEM 1251L Chemistry I Lab</td>
</tr>
<tr>
<td>MATH 1341 Calculus I</td>
</tr>
<tr>
<td>ENGL 1101 English Composition</td>
</tr>
<tr>
<td>Liberal Studies Elective*</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
</tr>
<tr>
<td>PHYS 2102 Physics II</td>
</tr>
<tr>
<td>PHYS 2102L Physics II Lab</td>
</tr>
<tr>
<td>SEGR 2101 Systems Engr. Concepts</td>
</tr>
<tr>
<td>MATH 2241 Calculus III</td>
</tr>
<tr>
<td>ENGL 2118 Intro to Tech Comm (W)</td>
</tr>
<tr>
<td>SEGR 2106 Engr. Economic Analysis</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
</tr>
<tr>
<td>SEGR 3101 System Design and Deployment</td>
</tr>
<tr>
<td>SEGR 3105 Comp. Meth. for Sys Engr. II</td>
</tr>
<tr>
<td>OPRS 3111 Operations Res., Deterministic</td>
</tr>
<tr>
<td><em>Technical Elective</em></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
</tr>
<tr>
<td>SEGR 3290 Systems Design Project I (W)(O)</td>
</tr>
<tr>
<td>ENGR 3295 Prof. Development</td>
</tr>
<tr>
<td>Liberal Studies Elective*</td>
</tr>
<tr>
<td>SEGR 3107 Decision and Risk Analysis</td>
</tr>
<tr>
<td>SEGR 3111 Project Management (W)(O)</td>
</tr>
<tr>
<td>SEGR 3114 Production Control Systems</td>
</tr>
<tr>
<td><strong>Track Course</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>*Notes:</td>
</tr>
<tr>
<td>1. (W) indicates courses with emphasis on writing and (O) indicates courses with emphasis on oral communication</td>
</tr>
<tr>
<td>2. SEGR/ENGR 3295 Prof. Development can be taken in Fall or Spring during the senior year</td>
</tr>
<tr>
<td>3. See the list of available Liberal Studies Electives from the UNC Charlotte Undergraduate Catalog</td>
</tr>
<tr>
<td>4. See the list of Track courses available from the Systems Engineering and Engineering Management Department</td>
</tr>
<tr>
<td>5. See the list of Technical Electives available from the Systems Engineering and Engineering Management Department</td>
</tr>
</tbody>
</table>
Major highlights of the proposed BSSE curriculum are as follows:

Students pursuing a BSSE degree will be required to complete 123 credit hours, as outlined, in the general study plan above. Besides completing the SE core courses, each student will select one of the following two concentration areas by the end of their freshman year.

1. Systems Engineering Track
2. Engineering Management (EMGT) Track

EMGT track has required “track courses” (see Appendix I). Besides the track courses, students will be required to take additional technical and liberal studies electives (see Appendix II).

It is expected that the enrollment in the BSSE Program will grow to 150 students by the year 2012 and it is anticipated that 5-7 additional faculty will be needed to support this growth.

I.B. Proposed Catalog Copy of the BSSE Courses

SEGR 2101 Systems Engineering Concepts. (3) Prerequisite: ENGR1202. This course provides the foundation for systems engineering processes and practices. The contents cover the discussion of current systems issues, basic systems engineering processes, and the roles of systems engineering professionals in a global business environment. It also will cover the principles of mechanical drawing and computer aided design (CAD) for systems engineering applications.

SEGR 2105 Computational Methods for Systems Engineering I. (3) Prerequisite: SEGR2101. This course will introduce programming languages and computational tools that are often used by Systems Engineers. Programming in C and Matlab will be emphasized. Spreadsheet-based modeling will be introduced.

SEGR 2106 Engineering Economic Analysis. (3) Prerequisite: Sophomore standing and SEGR 2105 or consent of the department. Covers economic analysis of engineering alternatives, including time value of money, cash flow analysis, cost estimation, project evaluation, accounting and budgeting tools.

* (We intend to cross list this course with CEGR 2102 Engineering Economic Analysis and/or ETGR 3222 Engineering Economics)

SEGR 2111 Introduction to Engineering Management. (3) Prerequisite: ENGR1202. Focuses on the fundamentals in engineering management. It provides students the understanding of engineering management principles and practices and the roles of engineering management professionals in a global business environment.

SEGR 2121 Introduction to Logistics Systems and Supply Chains. (3) Prerequisite: ENGR1202. Focuses on the fundamentals in logistics systems and supply chain operations. It provides students the understanding of the operations in logistics systems and global
supply chains and the roles of logistics/supply chain professionals in global business environment.

**SEGR 3101 System Design and Deployment. (3)** Prerequisite: SEGR 2105 or consent of the department. Focuses on the basics of systems design, analysis, and implementation. It covers system design elements, system interface issues, system decomposition, and system integration. The emphasis is on the effective design and integration of system operations and successful deployment of systems design results.

**SEGR 3102 System Simulation, Modeling & Analysis. (3)** Prerequisite: STAT 3128. Focuses on the study of discrete-event simulation and its use in the analysis and design of systems. The emphasis is on using simulation software for simulation modeling and analysis with practical applications to design, analysis, and improvement of diverse systems.

**SEGR 3103 Human System Interface. (3)** Prerequisite: SEGR 2105 or consent of the department. Focuses on the interfacing issues between human, organization, and systems operations. The emphasis is on the influence of human and cultural factors related to the effectiveness of system operations in a global business environment.

**SEGR 3105 Computational Methods for Systems Engineering II. (3)** Prerequisite: SEGR 2105. This course covers numerical techniques for systems engineers such as Polynomial interpolation, Numerical differentiation and integration, Newton and simple gradient methods for nonlinear equations.

**SEGR 3107 Decision and Risk Analysis. (3)** Prerequisite: SEGR 2105 or consent of the department. This course aims to provide some useful tools for analyzing difficult decisions and making the right choice. After introducing components and challenges of decision making, the course will proceed with the discussion of structuring decisions using decision trees and influence diagrams. Decisions under conflicting objectives and multiple criteria will be covered as well as sensitivity and risk analysis.

**SEGR 3111 Project Management. (3)** Prerequisite: STAT 3128. Focuses on the study of various aspects of project management techniques and issues, and the use of conceptual, analytical, and systems approaches in managing engineering projects and activities. It includes the development and writing of project plans and reports for engineering and business operations.

**SEGR 3112 Value Engineering Management. (3)** Prerequisite: SEGR 2106 or consent of the department. Analyzes the requirements of a project to achieve the highest performance for essential functions at the lowest costs over the life of the project. The “best value” is achieved by a multidisciplinary team effort through the study of alternative design concepts, materials, and methods.
SEGR 3114 Production Control Systems. (3) Prerequisite: statistics. Principles, analysis and design of production and inventory planning and control systems. Demand forecasting, production scheduling and control systems and introduction to CPM. (On demand)

* (This course will be cross-listed with ETIN 3123 Production Control Systems)

SEGR 3122 Implementation of Logistics Systems and Supply Chains. (3) Prerequisite: SEGR 3121. This course reviews and analyzes real-life logistics and supply chain implementation cases. Different industry supply chains are compared and benchmarking is emphasized through review of industry best practices.

SEGR 3131 Computer Aided Design & Manufacturing. (3) Prerequisite: SEGR 2101 or consent of the department. Focuses on the basics of hardware and software implementation in the design and manufacturing processes. The emphasis is in making the design and manufacturing processes effective and efficient for global business competition.

SEGR 3132 Facilities Planning & Material Handling Systems. (3) Prerequisite: SEGR 2101 or consent of the department. Focuses on the basics in facility planning, plant layout design, material handling systems design and integration, and warehousing. The emphasis is on the effective design and integration of plant layout, material handling systems, and warehousing for supply chain operations.

SEGR 3290 Systems Design Project I. (1) Prerequisite: SE senior standing and corequisite SEGR 3111. First of a two-semester sequence leading to a major integrative system design experience in applying the principles of systems design and analysis and project management to the design of a system. Teamwork and communication skills are emphasized. It focuses on the development of the project plan and proposal for the capstone systems design project. Each student develops a complete systems design project plan and proposal and makes an oral presentation of the proposal to the faculty. It runs in conjunction with the project management course.

SEGR 3291 Systems Design Project II. (3) Prerequisite: SEGR 3290. A continuation of SEGR 3290 for the execution of the proposed systems design project. This course includes a mid-term written progress report with an oral presentation and a final written report plus the final oral presentation to demonstrate project results.

SEGR 4090 Special Topics. (1-6) Directed study of current topics of special interest. (On demand)

SEGR 4101 Network Modeling & Analysis. (3) Prerequisite: OPRS 3111 or SEGR 3106. This course covers formulation and solution of optimization problems using network flow algorithms. Topics include minimum flow problems, shortest path, maximum flow, transportation, assignment, minimum spanning trees. Efficient solution algorithms are investigated.
SEGR 4131 Product and Process Design. (3) Prerequisite: SEGR 2101 or consent of the department. Focuses on how to achieve a high-quality, customer-oriented product development process, from technology and product innovation, to design and development, leading up to production. Design for Six Sigma (DFSS) is the main technology discussed plus other product design approaches, such as design for cost, design for safety, and design for environment.

SEGR 4132 Automation & Systems Design. (3) Prerequisite: SEGR 3132. Focuses on the concepts of systems design, manufacturing systems design, manufacturing process control, shop floor control, and automation. The emphasis is on automation for economic and flexible manufacturing operations that can handle frequently changing global manufacturing requirements.

SEGR 4133 Lean Manufacturing Systems. (3) Prerequisite: SEGR 3132. Focuses on the fundamentals of how manufacturing operations work, and talk about the latest techniques to make your manufacturing organization successful. This course discusses how lean methodology can eliminate waste and increase the speed in manufacturing while reducing cycle times.

SEGR 4141 Engineering Experimental Design. (3) Prerequisite: STAT 3128. Focuses on how to achieve high-quality/low-cost systems based on Taguchi methods, design of experiments methods, and statistical analysis of data. Also includes introduction to response surface methods.

SEGR 4142 Reliability Management. (3) Prerequisite: STAT 3128. Focuses on measuring, evaluating, improving and managing reliability. Topics include basic reliability models, hazard rate functions, system reliability, and fault tree analysis.

SEGR 4952 Engineering System Optimization. (3) Prerequisite: Senior standing and OPRS 3111. 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.

These 4000 level courses will be cross-listed with future 5000 level EMGT courses.

II. Justification

II.A. BSSE Curriculum Design Framework

A strong curriculum needs to synthesize important perspectives: from industry, other SE programs and other UNC Charlotte departments, and comply with the UNC Charlotte Curriculum requirements. Figure 1 shows the BSSE curriculum design framework
As indicated in Figure 1, industry is the main driver and dictates the need for the skills gained through the completion of the BSSE degree program. The competitive analysis shows not only how the industry needs are addressed by academic institutions locally but also nationally. The input from other UNC Charlotte departments, especially within the College of Engineering provides benchmarking cases for the new BSSE curriculum. Other UNC Charlotte departments also provide courses that complement the core BSSE curriculum either as required or elective courses, as indicated in UNC Charlotte Undergraduate Requirements.

As shown above, the proposed B.S. in SE program and its curriculum takes into account several key perspectives including the industry needs and the competition. Based on our analysis, it is expected that the need for Systems Engineers and SE education will grow due to economic and population growth in the Charlotte region. Benchmarking against the major SE programs nationally indicates growing enrollment trends in the SE programs. Currently, in the state of North Carolina, there are no academic institutions offering a BSSE degree, and there are only a few programs at undergraduate and graduate levels that relate to SE. This picture indicates a shortage in the BSSE education in the state of North Carolina. Therefore, the proposed BSSE program will be timely and will also complement the existing Engineering Management (EMGT) Graduate Program.

Next, we will describe in more detail the Need Analysis, Competitive Analysis, Existing Programs at other UNC Charlotte Departments, as well as UNC Charlotte Curriculum Requirements.

II.B. Need Analysis

II.B.1. Systems Engineering Discipline

U.S. engineering/manufacturing companies are changing their engineering operations from in-house operations for design, production/manufacturing, logistics, sales, and services toward outsourcing some operations to various global locations in the current business environment. A major portion of engineers’ functions is to involve the integration of
engineering operations performed at multiple sites, often various international sites. With the shift of the business environment, the education of future engineers must reflect this changing trend and demand. The Systems Engineering (SE) discipline fills this critical educational need to handle the increasing demands of systems efficiency, effectiveness, and integration in engineering and business operations. Systems Engineering is critical if the State of North Carolina and the U.S. are to remain competitive and for engineering graduates in the twenty-first century to participate in global engineering operations. C. M. Vest in “Educating Engineers for 2020 and Beyond,” states “We need to establish a proper intellectual framework within which to study, understand, and develop large, complex engineered systems.” [2] To meet this demand, the College of Engineering at UNC Charlotte plans to establish a Bachelor of Science degree program in Systems Engineering (BSSE) beginning in spring 2008.

“Systems Engineering is an engineering discipline whose responsibility is creating and executing an interdisciplinary process to ensure that the customers’ and stakeholders’ needs are satisfied in a high quality, trustworthy, cost-efficient and schedule-compliant manner throughout a system’s entire life cycle. This process usually comprises the following seven tasks: State the problem, Investigate alternatives, Model the system, Integrate, Launch the system, Assess performance, and Re-evaluate. These functions can be summarized with the acronym SIMILAR: State, Investigate, Model, Integrate, Launch, Assess and Re-evaluate. It is important to note that the Systems Engineering Process is not sequential. The functions are performed in a parallel and iterative manner.” [3]

![Figure 2. SIMILAR Process [4].](image)

By following the SIMILAR process, Systems Engineers develop clear, concise, and comprehensive problem statements, resolve top-level system problems into simpler, solvable problems, and integrate the solutions to the simpler problems to solve the top-level problem [5]. Without loss of generality, SE concepts can be applied to any system including engineered (or human-made) systems and non-human-made systems or natural systems such as environmental systems (see e.g. [6]). As mentioned by Blanchard and Fabrycky (p.38, [7]):

“There are many categories of human-made systems, and there are many applications where the concepts and principles of systems engineering can be effectively implemented. Every time there is a newly identified need to accomplish some function, a new system requirement is established. In
each instance, there is a new design and development effort that must be accomplished at the system level.”

Some of the major SE application categories include [7]:

“1. Large scale systems with many components, such as a space-based system, an urban transportation system, or a hydroelectric power-generating system.
2. Small-scale systems with relatively few components, such as a local area communications system, a computer system, a hydraulic system, or a mechanical braking system.
3. Manufacturing or production systems where there are input-output relationships, processes, processors, control software, facilities and people.
4. Systems where a great deal of new design and development effort is required (e.g. in the introduction of advanced technologies).
5. Systems where the design is based on the use of existing commercial off-the-shelf equipment, commercial software, or existing facilities.
6. Systems that are highly equipment-, software-, facilities-, or data-intensive.
7. Systems where there are several suppliers involved in the design and development process at the national, and possibly, international level.
8. Systems being designed and developed for use in the defense, civilian, commercial, or private sectors separately or jointly.”

As implied from the above application categories and as illustrated in Figure 3, SE as an engineering field has very broad applications in a wide variety of industries including energy, telecommunications, construction, manufacturing, transportation and distribution, information technology, financial services, automotive, retail, healthcare and airlines, at all levels from an entry position to top management. This wide applicability, along with a very strong focus to model, analyze and manage complex engineered systems with proven tools and techniques, can be considered as the primary strengths of SE. As mentioned by Wymore (p.5, [5]), it can be concluded that practically every organization requires Systems Engineers...
to identify, characterize and solve the right problems and to eliminate inefficiencies and root-causes that generate these problems.

The Institute for Systems Research, at the University of Maryland [8] provides the following similarity and contrast between SE and other engineering disciplines:

“As other engineering disciplines, systems engineering involves central concepts; uses specific methodologies; includes both analysis and synthesis or design; relies on mathematics to express knowledge; and stimulates research for further engineering benefit. However, systems engineering is qualitatively different. While other engineering disciplines concentrate on using knowledge of the real world (e.g., electrical circuits, materials, robotics), systems engineering finds its focus in constructs of analysis and synthesis for problems involving multiple aspects of the real world.”

II.B.2. Industrial Evolution as a Main Driver for Systems Engineering

The need for Systems Engineers closely follows the industrial evolution and global trends as illustrated in Table 1 below comparing what used to be “then” in the first half of twentieth century and “now”. As shown in this table, increase in competition, shift in power from suppliers to customers, increase in the complexity of customer requirements, increase in products and number of industries, decentralization of organizations due to outsourcing and globalization, short product life cycles, technological advances, and advancements in computational techniques and decision support systems are some of the important changes that have been taking place globally over the past century. These are some of the major reasons why managing the complex supply chain system has become extremely vital to survive in the global market and why the need for SE have been increasing.

II.B.3. Economic Development in the Charlotte Region

As part of a strategic analysis, the UNC Charlotte Engineering Management Program identified that Charlotte area as the home to the headquarters of nine Fortune 500 companies including Bank of America, Wachovia Corp., Duke Energy, Nucor Corp., Sonic Automotive, SPX, Family Dollar, Goodrich Corp., and Lowe’s. In addition, 306 other Fortune 500 companies are represented in the Charlotte area covering a variety of industries in the manufacturing, transportation and distribution, and financial services as shown in Figure 4.
<table>
<thead>
<tr>
<th>Comparison Basis</th>
<th>Then</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>Few Companies</td>
<td>Many Companies</td>
</tr>
<tr>
<td></td>
<td>Monopoly</td>
<td>Competitive Marketplace</td>
</tr>
<tr>
<td>Shift in Power</td>
<td>Industry-driven</td>
<td>Customer-driven</td>
</tr>
<tr>
<td>Customer Requirements</td>
<td>Basic</td>
<td>Complex (price, quality, innovation, speed)</td>
</tr>
<tr>
<td>Industries</td>
<td>few (textiles, steel, etc.)</td>
<td>many</td>
</tr>
<tr>
<td>Organization Structure</td>
<td>Vertical integration</td>
<td>Outsourcing</td>
</tr>
<tr>
<td></td>
<td>Single enterprise owning the chain</td>
<td>Multiple integrated organizations</td>
</tr>
<tr>
<td></td>
<td>Centralized</td>
<td>De-centralized</td>
</tr>
<tr>
<td>Market Focus</td>
<td>Local</td>
<td>Globalization</td>
</tr>
<tr>
<td></td>
<td>Regional</td>
<td></td>
</tr>
<tr>
<td></td>
<td>National</td>
<td></td>
</tr>
<tr>
<td>Product Life Cycles</td>
<td>Long</td>
<td>short</td>
</tr>
<tr>
<td>Technology</td>
<td>Manual</td>
<td>Automation</td>
</tr>
<tr>
<td></td>
<td>Rudimentary computing</td>
<td>Digital computing</td>
</tr>
<tr>
<td></td>
<td>Low communication</td>
<td>Internet</td>
</tr>
<tr>
<td></td>
<td>Low information access</td>
<td>RFID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wireless</td>
</tr>
<tr>
<td>Computational Techniques</td>
<td>None to few</td>
<td>Numerous advanced OR techniques</td>
</tr>
<tr>
<td>Decision support &amp; Planning systems</td>
<td>None</td>
<td>Many including MRP, ERP, APS software</td>
</tr>
</tbody>
</table>

Table 1. Evolution of Industry [9]

![Figure 4. Local Industry Segmentation (based on [10])](http://www.charlottechamber.org/home.cfm)

According to the Charlotte Chamber of Commerce web site, Charlotte is the 3rd best business location in the U.S. and accommodates the 7th highest new and expanded business activities [10]. Due to this dynamic business environment, 11,761 new jobs were generated in 2005. According to economic forecasts, the business index continues to be positive as it has been in the past five years (shown in Figure 5). Because it also has one of the best real estate
markets in the country with a cost of living lower than the national average and an active airport that facilitates easy access, migration to this area has increased dramatically over the past several years. In fact, the population of Mecklenburg County is expected to increase 19.3% from about 880,000 in 2007 to 1,050,000 in 2012 (shown in Figure 6). Due to the ever-improving business opportunities and increasing population, this region is expected to have a growing need for educational services at both the undergraduate and graduate levels.

![Leading Index and Six Month Moving Average, 1/01-2/06 (1996=100)](image)

**Figure 5.** Business index for Charlotte (January 2001 – January 2006) [10].

![Estimated Population Growth](image)

**Figure 6.** Estimated population growth for Mecklenburg County (2007-2012) [10].

Since the SE graduates will be prepared to work in a wide variety of industries, local industry needs for the major industry sectors demonstrate that UNC Charlotte is an excellent location for the new BSSE program. Based on our analysis, the following areas capture the main SE skills required in industry in the Charlotte area, in North Carolina, in the U.S., and globally:

- Decision and Risk Analysis
- Systems Modeling and Optimization
- Systems Design, Planning and Analysis
Supply Chain and Logistics Engineering
Quality Engineering
Engineering Management
Communication and Presentation
Understanding of Global Business Dynamics

This shows that UNC Charlotte is a desired place to establish a program in SE. As shown in Appendix III, these skill needs were further mapped to different course requirements which helped us shape the final BSSE curriculum. This curriculum design begins from the building of a strong background in engineering fundamentals and in engineering science and then moves toward the enhancement of the concepts in systems design, systems engineering processes, and systems implementation based on a strong engineering science base.

II.B.4. The Educational Objectives of the BSSE Program

The educational objectives of the proposed B.S. program in Systems Engineering are as follows:

- Provide students with knowledge and educational opportunities in dealing with systems issues in the competitive global engineering and business environment.
- Produce engineers who will lead in (1) improving the understanding of global engineering issues and (2) developing effective approaches for engineering operations.
- Train engineers to possess the critical thinking, methodological, and communication skills required to advance and disseminate knowledge of systems engineering in supply chain operations.
- Provide educational opportunities to train the workforce needed to sustain the growth of global engineering operations/business in the state of North Carolina and the U.S.
- Enhance the educational experience in systems, management, and engineering for all undergraduate students at the institution.

We expect that the SE graduates can:

- Handle operational issues from a system perspective,
- Manage units with technical functions,
- Manage units with business and management functions,
- Handle interdisciplinary issues and problems,
- Make decisions at all levels of an organization from the top management problems, to strategic planning, product development and launching, production, marketing and sales, logistics support, and field services,
- Understand future trends in global markets and economy, and
- Manage multinational units, projects, and global supply chains.
The Systems Engineering program will be administered through the current Engineering Management (EMGT) Program and a planned new Department of Systems Engineering and Engineering Management (SEEM) in the future. The request to form a new department was submitted to the chancellor and is on hold until the degree program is functioning with adequate enrollment. Considerable program strengths exist in systems course offerings through the EMGT Program at the graduate level and through working with various industries in the region and in the nation. Such relations are necessary to build and sustain a strong undergraduate program in the rapidly emerging SE field that is vital to the economic prosperity of North Carolina and the nation. Faculty members from the EMGT Program/the new SEEM Department who are engaged in teaching and research in SE related fields will serve as program faculty. The program connects with existing engineering programs at the institution and is consistent with relevant national priorities. The focus of the BSSE program is to educate and train the engineers who will meet the needs of an increasingly global engineering and business environment and maintain the competitiveness of North Carolina and U.S. industry.

II.B.5. The Relationship of the BSSE Program to the Institutional Mission

UNC Charlotte’s Mission Statement, approved by the University’s Board of Trustees on September 27, 2002, states that:

With a broad institutional commitment to liberal education as the foundation for constructive citizenship, professional practice, and lifelong learning, UNC Charlotte is prepared to focus interdisciplinary resources to address seven broad areas of concern to the Charlotte region: 1) Liberal Education; 2) Business and Finance; 3) Urban and Regional Development; 4) Children, Families, and Schools; 5) Health Care and Health Policy; 6) International Understanding and Involvement; and 7) Applied Sciences and Technologies.

The proposed BSSE program has a strong connection to the highlighted items of 2, 3, 6, and 7. Therefore, the development of the Systems Engineering program strongly supports the mission of the University. It is also identified in the new program development plan of the UNC Charlotte 2004-2009 Institutional Plan and is part of the William States Lee College of Engineering’s strategic plan.

The proposed program is connected to a range of university goals including: (a) to provide services that impact positively the many challenges facing the region, state, and nation; (b) to train students who possess interdisciplinary skills and capacities that can be applied to a variety of situations and professions in an ever-changing global economy; (c) to improve educational opportunities that respond to the intellectual and professional needs of the region; (d) to increase both faculty and student research that will address fundamental and regional problems, (e) to provide a variety of services that respond to the ongoing and emerging regional needs, and (f) to graduate students with the breadth and depth of knowledge and the intellectual and professional skills that prepare them for a productive life in an ever-changing world.
II.B.6. The Need for the BSSE Program in North Carolina

The Directorate for Engineering of the National Science Foundation (NSF) released a conceptual document for reorganization in June 2005 [1]. In the document, one of the main emphases in the three major Engineering divisions, Division of Electrical, Communications and Cyber Systems; Division of Civil, Manufacturing, and Mechanical Innovation; and Division of Chemical, Biological, Environmental and Transport Systems; is on research dealing with the complexity in integrating systems that include engineering, engineered, and natural systems. Hence, the systems engineering discipline is playing an important role in current and future NSF research efforts.

For the Carolinas, with its growing business opportunities and increasing population in Charlotte and the surrounding areas, there is a need for educational services at undergraduate and graduate levels in managing systems and global supply chain operations. Systems engineering and engineering management are the essential and complementary disciplines that produce graduates with interdisciplinary engineering, management, and business skills that are highly valued by many companies that are competing in the global market.

Currently, there are no academic institutions offering BSSE degrees in the state of North Carolina. Among the 16 campuses of the UNC system, only four (4) offer systems engineering-related programs within their engineering program offerings. Among these four, only two are established departments (NC State and NC A&T), while the other two are either a graduate-level program (UNC Charlotte) or an undergraduate-level concentration area (ECU). These institutions and their programs are summarized in the following table. In addition, it is also noted that Duke University has a Master’s-level Engineering Management Program and does not have a similar B.S. degree program in the Systems Engineering area.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Program</th>
<th>Degrees Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina State University</td>
<td>Industrial &amp; Systems Engineering Department</td>
<td>B.S., M.S. and Ph.D. in Industrial Engineering</td>
</tr>
<tr>
<td>North Carolina A&amp;T State University</td>
<td>Industrial &amp; Systems Engineering Department</td>
<td>B.S., M.S. and Ph.D. in Industrial Engineering</td>
</tr>
<tr>
<td>UNC Charlotte</td>
<td>The Engineering Management Program</td>
<td>M.S. in Engineering Management</td>
</tr>
<tr>
<td>East Carolina University (ECU)</td>
<td>Separate Systems Engineering and Engineering Management</td>
<td>B.S. in Engineering Management</td>
</tr>
<tr>
<td></td>
<td>concentration areas under the undergraduate Engineering department that will be effective as of July 2006.</td>
<td></td>
</tr>
<tr>
<td>Duke University</td>
<td>The Engineering Management Program</td>
<td>Master of Engineering Management</td>
</tr>
</tbody>
</table>

Table 2. Systems Engineering-related programs within the state of North Carolina.
This indicates an opportunity for systems engineering education in the state of North Carolina. The new BSSE program plans to meet the needs of citizens, industries, and businesses in this region and the state by building upon and expanding the mission of the current Engineering Management Program.

Appendix VI includes support letters for the BSEE program from senior managers and executives from various industries.

II.C. Competitive Analysis

In order to perform benchmarking and competitive analysis, a list of SE academic programs was obtained from the International Council on Systems Engineering (INCOSE) web site [3].

From the exhaustive list of universities listed on the INCOSE web site, our analysis focused on the national universities that emphasized SE-related undergraduate studies. The following programs were analyzed to benchmark enrollment trends, SE course offerings and to identify concentration tracks:

1. Stanford University, Department of Management Science and Engineering
2. Virginia Polytechnic and State University, Grado Department of Industrial and Systems Engineering
3. University of Arizona, Department of Systems and Industrial Engineering
4. George Mason University, Department of Systems Engineering & Operations Research
5. Ohio State University, Department of Industrial, Welding and Systems Engineering
6. University of Virginia, Department of Systems and Information Engineering
7. University of Florida, Department of Industrial and Systems Engineering

As shown in Figure 7, analysis of enrollment trends from these schools in general shows an increase between 1998 and 2005. This trend can be considered as a direct indicator for the increased need for Systems Engineers in the industry.
Figure 7. Enrollment Trends in Major SE Programs.

(Notes on Figure 7:
1) Trend lines are computed based on actual enrollment data obtained from [11]
2) University of Arizona started posting Industrial Engineering, Systems Engineering and Engineering Management enrollment separately in 2005 but here all are added to make it comparable to previous years’ data
3) Ohio State started posting Industrial and Systems Engineering and Welding Engineering separately in 2005 but here all are added to make it comparable to previous years’ data.)

Based on the analysis of the curriculum and courses offered by each of these SE departments, the conclusions are as follows:

1. The number of courses and concentration tracks vary from university to university, but their entire core curriculum addresses the major required SE skill areas identified in Section II.B.3.
2. Some universities offer as many as five concentration tracks (e.g. Stanford and George Mason). Other universities (e.g. University of Arizona, Virginia Tech, and Ohio State) do not create specific concentration tracks, but allow their students to take elective courses to specialize in an area of their interest.
3. The “total required number of credits” for graduation varies. For example, while University of Arizona requires 128 credit hours, Virginia Tech requires 136 credit hours and George Mason requires 120 credit hours.

There are currently ten ABET accredited SE programs in the U.S. Systems Engineering programs are currently being accredited under the “Engineering: Other” category by ABET. ABET, Inc. is planning to establish a separated SE category for accreditation. We intend to pursue ABET accreditation in Systems Engineering for the proposed BSSE program.

II.D. Existing Programs at other UNC Charlotte Departments

In the BSSE program development, we also considered the relationship of the proposed new program to other existing programs at UNC Charlotte. Within The William States Lee College of Engineering, the proposed BSSE program will work closely with all the engineering departments including Civil and Environmental Engineering, Electrical and Computer Engineering, Engineering Technology, and Mechanical Engineering and Engineering Science. The students in the BSSE program will take courses from these departments as technical elective courses based on their interest in the types of systems that they wish to pursue. The SEGR courses developed for the program will also serve as technical elective courses to the students in the above-mentioned departments.

The program requirements will include fundamental math, physics, and chemistry courses in the associated science departments and courses in Liberal Studies from the College of Arts and Sciences. For some upper-division courses, SE students will take SE-relevant courses in mathematics, statistics, and operations research from the Department of Mathematics and Statistics; courses in GIS and location related topics from the Department of Geography and Earth Science; courses in information systems from the College of Information Technology; operations-related courses from the Department of Business Information Systems and Operations Management, and engineering related courses from Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical Engineering and Engineering Science Departments.

Existing programs in other UNC Charlotte departments within and outside of the College of Engineering were analyzed to:

1. Understand the curriculum structure of the other engineering departments and UNC Charlotte requirements for a BS degree in Engineering.
2. Understand the common Engineering Courses at the College of Engineering
3. Leverage the existing courses for SE electives (technical, sciences, and humanities).

Within the College of Engineering, curricula of the following programs were analyzed:

1. Civil Engineering
2. Mechanical Engineering
3. Electrical Engineering
It was seen from the other engineering departments that

1. Total required credit hours vary from 125 to 128 credit hours.
2. Each Engineering major is required to complete Introduction to Engineering I (ENGR 1201), Introduction to Engineering II (ENGR 1202), and Professional Development (ENGR 3295). While ENGR 1201 (Introduction to Engineering I) and ENGR 3295 (Professional Development) are taught or coordinated by the Office of Student Development and Success (OSDS), ENGR 1202 Introduction to Engineering II is taught by each department.
3. There are some courses such as CEGR Engineering Economic Analysis that can be cross-listed within the BSSE curriculum.
4. There are commonalities between fundamental math, physics, and chemistry courses, which are the courses that the SE students might be taking as well.
5. Based on UNC Charlotte General Education guidelines (see Section I.D), each of these departments enables students to take electives from other technical fields as well as from Liberal Studies.

Some SE-relevant engineering courses from Civil and Environmental Engineering, Electrical and Computer Engineering, and Mechanical Engineering and Engineering Science Departments were listed as technical electives.

Outside of the College of Engineering, courses offered by other departments were analyzed for selecting some core courses and technical electives. The following are the main actions resulted from this analysis:

1. Due to their direct relevance, we incorporated several courses from Math, Statistics and Operations Research Departments.
2. Other SE-relevant courses from Math, Statistics, Operations Research, Information Systems, Operations Management and Geography Departments were listed as technical electives.

**II.E. UNC Charlotte Curriculum Requirements**

UNC Charlotte baccalaureate degree and general education requirements are outlined in the UNC Charlotte Undergraduate Catalog 2007-2009. The following summarizes the main considerations to be taken into account in creating the BSSE curriculum:

1. Baccalaureate Degree Requirements
   
   - Credit Hours: 120-128 semester hours of credit.
   - Course Levels. Juniors and Seniors are required to have the consent of the major department to enroll in any course below the 3000 level not required in their degree program.
   - General Education. All baccalaureate degrees at UNC Charlotte include a common set of General Education requirements as described in the next paragraph.
2. General Education Program

- I. Development of Fundamental Skills of Inquiry (9-12 semester hours)
  - Basic writing courses: Students take two courses, ENGL 1101 and ENGL 1102. Entering freshmen who qualify for the accelerated course in writing and rhetoric may meet this requirement by completing one course, ENGL 1103.
  - Mathematical and logical reasoning: One course in mathematics (MATH) and a second course selected from mathematics (MATH), statistics (STAT), or deductive logic (PHIL 2105).
  - Basic skills of information technology: These skills which include the use of word processing, email, file management, internet searches, and library database searches are developed in English 1101 and 1103.

- II. Inquiry in the Sciences (10 semester hours)
  - Two courses, at least one of which must be taken with a laboratory, in the life sciences and/or the physical sciences.
  - One course in the social sciences.

- III. Themes of Liberal Education for Private and Public Life (12 semester hours)
  - Each student must take four of these courses as follows:
    - One course in the Arts and Society.
    - One course in the Western Tradition
    - One course in Global Understanding
    - One course in Dealing with Ethical Issues and Cultural Critique.

- IV. Communication Skills
  - Writing in the disciplines: Six (6) semester hours with writing (W) emphasis, including at least three (3) semester hours in the major.
  - Oral communication: at least one (1) course designated as an oral (O) communication course.
  - Foreign languages: There are no foreign language requirements.

Table 3 summarizes how the BSSE program satisfies the UNCC’s general education requirements. This table shows that the requirements in the BSSE program fulfill the general education requirements and include two more math, one more science, and one more writing intensive than are required.
<table>
<thead>
<tr>
<th>General Education Category:</th>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Development of Fundamental Skills of Inquiry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic writing skills</td>
<td>ENGL 1101 English I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENGL 1102 English II</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics and logical reasoning</td>
<td>MATH 1241 Calculus I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 1242 Calculus II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 2241 Calculus III</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 2164 Matrices &amp; Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>II. Inquiry in the Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life sciences and/or physical sciences</td>
<td>PHYS 2101 Physics I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PHYS 2101 Lab Physics I Lab</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>PHYS 2102 Physics II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PHYS 2102 Lab Physics II Lab</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CHEM 1251 Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CHEM 1251L Chemistry I Lab</td>
<td>1</td>
</tr>
<tr>
<td>Social Science</td>
<td>ECON 1101 Economics for Non-Majors</td>
<td>3</td>
</tr>
<tr>
<td>III. Themes of Liberal Education for Private and Public Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts and society</td>
<td>LBST 110X</td>
<td>3</td>
</tr>
<tr>
<td>Western culture</td>
<td>LBST 2101 Western Cultural and Historical Awareness</td>
<td>3</td>
</tr>
<tr>
<td>Global understanding</td>
<td>LBST 2102 Global and Intercultural Connections</td>
<td>3</td>
</tr>
<tr>
<td>Ethical and cultural critique</td>
<td>LBST 221X</td>
<td>3</td>
</tr>
<tr>
<td>IV. Communication Skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing in the discipline &amp; Oral Communications</td>
<td>SEGR 3111 Project Management (W)(O)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SEGR 3290 Systems Design Project I (W)(O)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>SEGR 3291 Systems Design Project II (W)(O)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENGL 2116 Intro to Tech Comm (W)</td>
<td>3</td>
</tr>
<tr>
<td>V. Foreign Language</td>
<td>None Required</td>
<td></td>
</tr>
</tbody>
</table>

| Total General Education Credit Hour Requirements | 55 |

Table 3. General Education Requirements for BSSE.

### III. Impact

#### III.A. Students Served

Undergraduate students majoring in BSSE will be primarily served with this proposal. Other engineering students might attend BSSE courses to fulfill their technical elective requirements.
III.B. Effect on Existing Curricula

III.B.1. Added Courses

Added courses will be taught on an annual basis commencing in 2007-08. A Freshman course will be taught beginning Spring 2008. Junior courses will be taught beginning 2008-2009, and Senior courses will be taught beginning 2009-2010.

III.B.2. Other Courses

The content and frequency of existing courses will not be affected.

III.B.3. Enrollment in Added Courses

It is expected that the BSEE program will attract 30 new undergraduate students initially, and in five years, the number of students in this BSEE program is estimated to be 150 students.

<table>
<thead>
<tr>
<th></th>
<th>2007-08</th>
<th>2008-09</th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Number of BSEE undergraduate students</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td>120</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 4. Expected Number of BSEE Students (2007-2012).

III.B.4. Enrollment in Other Courses

Enrollment in courses outside of the BSSE program is anticipated to increase based on the projected increase in enrollment in the BSSE program.

III.B.5. Special Topic Courses

EMGT Program currently offers special topic courses as general engineering courses coded as ENGR 4090 for undergraduate juniors and seniors. These courses will be coded as SEGR regular courses with the start of the BSSE program. The following are the special topic courses:

ENGR 4090-S01 Special Topics: Quality Management for Engineering Operations
ENGR 4090-001 Special Topics: Lean Manufacturing Systems

The new course names for these courses will be:

SEGR 3141 Quality Engineering
SEGR 4133 Lean Manufacturing Systems
III.B.6. Other Catalog Copy Changes

The following is the required addition to the UNC Charlotte Undergraduate Catalog:

SYSTEMS ENGINEERING AND ENGINEERING MANAGEMENT PROGRAM

Director: Professor Teng, Assistant Professors: Lim, Ozelkan, Sireli

The main objective of the undergraduate program in Systems Engineering is to equip the graduates with the essential Systems Engineering skills that are needed in industry and will enable the graduates to perform in a global engineering environment. These skills include:

- Decision and Risk Analysis
- Systems Modeling and Optimization
- Systems Design, Planning and Analysis
- Supply Chain and Logistics Engineering
- Quality Engineering
- Engineering Management
- Communication and Presentation
- Understanding of Global Business Dynamics

These objectives are accomplished through a flexible curriculum and through interactions with other departments and colleges of the University and with the professional community.

“Systems Engineering is an engineering discipline whose responsibility is creating and executing an interdisciplinary process to ensure that the customers’ and stakeholders’ needs are satisfied in a high quality, trustworthy, cost-efficient and schedule-compliant manner throughout a system's entire life cycle” (INCOSE, 2007). Systems Engineering as an engineering field has very broad applications in a wide variety of industries including energy, telecommunications, construction, manufacturing, transportation and distribution, information technology, financial services, automotive, retail, healthcare and airlines, at all levels from an entry position to top management. This wide applicability, along with a very strong focus to model, analyze and manage complex engineered systems with proven tools and techniques are the primary strengths of SE. Practically every organization requires Systems Engineers to identify, characterize and solve the right problems and to eliminate inefficiencies and root-causes that generate these problems.

The program offers a Bachelor of Science in Systems Engineering (B.S.S.E.) degree and a Master of Science in Engineering Management (M.S.E.M) degree. For information about the master's program, see the UNC Charlotte Graduate Catalog.

Concentration tracks, technical and liberal studies electives allow flexibility for study in specific areas. Each student may design a technical elective program with his or her advisor’s approval in order to achieve individual goals and follow a desired track.

Qualified students may apply for early-entry into the graduate program in Engineering Management during their junior or senior year. If accepted, students may take optional courses for graduate credit and begin work on their master's degree while completing their undergraduate degree.

Early-Entry to Master's Program in Engineering Management

1. A student may be accepted into the early-entry program at any time after completion of at least 75 semester hours of undergraduate work applicable to an appropriate degree. Admission must be approved by the Systems Engineering and Engineering Management program. Full admission to the graduate program is conditional pending the awarding of the undergraduate degree.
2. In order to be accepted into the program a student must have at least a 3.2 overall grade point average and a 3.2 grade point average in the student’s major. The successful applicant must have taken the appropriate standardized test and earned acceptable scores.

3. While in the early-entry program, a student must maintain a 3.0 overall grade point average through completion of the baccalaureate degree in order to remain in the graduate program.

4. Students accepted into the early-entry program will be subject to the same policies that pertain to other matriculated graduate students. Early-entry students must finish their undergraduate degree before they complete 15 hours of graduate work.

BACHELOR OF SCIENCE IN SYSTEMS ENGINEERING (B.S.S.E.)

A major in Systems Engineering leading to the B.S.S.E. degree consists of 123 credit hours. Specific requirements are:

<table>
<thead>
<tr>
<th>Category</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>English</td>
<td>9</td>
</tr>
<tr>
<td>General Engineering</td>
<td>5</td>
</tr>
<tr>
<td>Humanities and Social Science Electives</td>
<td>15</td>
</tr>
<tr>
<td>Mathematics</td>
<td>15</td>
</tr>
<tr>
<td>Open Technical Electives</td>
<td>9</td>
</tr>
<tr>
<td>Operations Research Courses</td>
<td>6</td>
</tr>
<tr>
<td>Physics</td>
<td>8</td>
</tr>
<tr>
<td>Systems Engineering Core Courses</td>
<td>43</td>
</tr>
<tr>
<td>Systems Engineering Track Courses</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total BSSE Credit Hours</strong></td>
<td><strong>123</strong></td>
</tr>
</tbody>
</table>

Social science and humanities electives must be chosen both to satisfy University General Education requirements and to meet the objectives of a broad education consistent with the educational goals of the profession. To avoid taking “extra” humanities/social science electives, students must select their electives carefully after consulting with their faculty advisor.

The science electives must be chosen from an approved list of physical, life, or earth sciences and must complement the student’s overall educational plan.

Each BSSE student needs to select one of the following concentration areas by the end of their freshman year.

1. Systems Engineering Track
2. Engineering Management

The courses that are marked as “track courses” in the study plan are determined on the basis of the concentration area as described.

General Track: Students enrolled in the general track can take any three of the SE technical elective courses to fulfill their BSSE degree requirements.

Engineering Management Track: The following track courses should be taken by each student specializing in Engineering Management:
CURRICULUM OUTLINE: B.S.S.E. DEGREE

Freshman Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 1201 Intro to Engr I</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 1251 Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1251L Chemistry I Lab</td>
<td>1</td>
</tr>
<tr>
<td>MATH 1241 Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 1101 English Composition</td>
<td>3</td>
</tr>
<tr>
<td>Liberal Studies Elective*</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 1202 Intro to Engr II</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 2101 Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2101L Physics I Lab</td>
<td>1</td>
</tr>
<tr>
<td>MATH 1242 Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 1102 Writing in Academic Community</td>
<td>3</td>
</tr>
<tr>
<td>ECON 1101 Economics for Non-Majors</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 2102 Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2102L Physics II Lab</td>
<td>1</td>
</tr>
<tr>
<td>SEGR 2101 Systems Engr. Concepts</td>
<td>3</td>
</tr>
<tr>
<td>MATH 2241 Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 2116 Intro to Tech Comm (W)</td>
<td>3</td>
</tr>
<tr>
<td>SEGR 2106 Engr. Economic Analysis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEGR 2101 System Design and Deployment</td>
<td>3</td>
</tr>
<tr>
<td>SEGR 3105 Comp. Meth. for Sys Engr. II</td>
<td>3</td>
</tr>
<tr>
<td>OPER 3100 Operations Management</td>
<td>3</td>
</tr>
<tr>
<td>OPRS 3111 Operations Res.-Deterministic</td>
<td>3</td>
</tr>
<tr>
<td>Technical Elective*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEGR 3102 Sys. Simul., Modeling &amp; Anal</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 3670 Total Quality Systems</td>
<td>3</td>
</tr>
<tr>
<td>OPRS 3113 Operations Res.-Probabilistic</td>
<td>3</td>
</tr>
<tr>
<td>Track Course*</td>
<td>3</td>
</tr>
<tr>
<td>Technical Elective*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

Total Required Hours 123

Note: (W) indicates a writing intensive course; (O) indicates an oral communication course

*Contact the Program office for more information about the optional courses and their use for an undergraduate concentration or for the early-entry Master's program.
IV. Resource Required to Support Proposal

IV.A. Personnel

The BSSE Program will share faculty resources with the existing EMGT Graduate Program. As of Fall of 2006, four full-time and one part-time faculty members deliver the EMGT Program. As identified in the EMGT Program Strategic Plan [12], addition of the BSSE Program will require five to seven additional faculty members within the first five years of the BSSE Program to support the anticipated enrollment increase and new course offerings as shown in Table 5. The college of engineering strives to maintain a 20:1 student faculty ratio in order to provide the highest quality hands-on engineering education and to remain competitive with regional engineering schools.

<table>
<thead>
<tr>
<th></th>
<th>2007-08</th>
<th>2008-09</th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new faculty</td>
<td>0</td>
<td>1</td>
<td>1-2</td>
<td>1-2</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Table 5. Staffing Plan for the BSSE Program (2007-2012).

IV.B. Physical Facility

The BSSE Program will be housed in the Kennedy Building along with the EMGT Graduate Program within the allocated space for the new Systems Engineering and Engineering Management (SEEM) Program. This allocated space for the SEEM Program includes Kennedy Rooms 300, 301, 302 and 332. Long range plans relocate the program to the uptown center to make the program more accessible to industry.

IV.C. Equipment and Supplies

Current EMGT Program copier and printer will be used to support the BSSE Program. An additional department printer is already purchased and will be used to support the BSSE Program as well.

IV.D. Computer and Software

Kennedy 302E is hosting the new Systems Engineering Computational Lab. This lab will host twenty Mosaic Dell SFF workstations and two HP Printers which are already installed.

The available software applications will be adequate to support the BSSE program. Future requirements will be assessed on an ongoing basis based on the Engineering College Policies.

IV.E. Audio-Visual

The Systems Engineering Computational Lab will have an instruction podium which is already purchased. Besides this, there are no additional audio and/or visual equipment or media production services required. Existing facilities are adequate.
IV.F. Other Resources

The preparation, printing, and mailing of marketing materials such as pamphlets, brochures, posters, etc, will be required to promote the new BSSE program and to recruit new students. Approximately $3,500 will be required to support the initial recruitment activities.

IV.G. Funding

Funding for the new and/or additional resources will be provided by the College of Engineering, state-appropriated funds, and enrollment increase funds.

V. Consultation with the Library and Other Departments or Units

V.A. Originating Unit

This proposal has been originated by the EMGT Graduate Program. All EMGT faculty have unanimously approved this proposal in August 2007.

V.B. Library Consultation

Present library holdings are adequate to support the proposed program. The needs for this program area are very similar to the needs of the Engineering Management graduate program. The Library owns or has electronic access to sufficient journals and electronic resources specific to the Engineering Management area and this area. In addition, the library has approximately 40 electronic databases, many with links to full text articles.

No additional library support, other than the ongoing purchases for materials in this and the interrelated Engineering and Engineering Management programs, is necessary to support the program. Holdings are current and adequate to support this new degree program.

A copy of the library support letter is attached in Appendix VI Letters-of-Support section.

V.C. Consultation with Other Units

The following departments/units which are involved in the delivery of the courses included in the BSSE curriculum were notified and/or consulted through the College of Engineering:

- Dean for General Education
- Department of Chemistry
- Department of Physics and Optical Sciences
- Department of Mathematics and Statistics
- Department of English
- Department of Geography and Earth Sciences
- Department of Accounting
- Department of Business Information System & Operation Management
- Department of Economics
- Department of Finance
- Department of Management
- Department of Marketing

The following departments/units within the College of Engineering are notified and/or consulted:

- Department of Civil and Environmental Engineering
- Department of Electrical and Computer Engineering
- Department of Mechanical Engineering and Engineering Science
- Department of Engineering Technology
- College of Engineering Office of Student Development & Success (Freshman Engineering)

References


Appendices:

Appendix I: BSSE Concentration Tracks
Appendix II: Electives
Appendix III: Industry Requirements Analysis
Appendix IV: Faculty Curriculum Vitas
Appendix V: SEGR Course Outlines
Appendix VI: Letters of Support
Appendix I

BSSE Concentration Tracks
Appendix I.A. General SE Track

Students enrolled in the Systems Engineering track can take any three of the SE technical elective courses (see Appendix II) to fulfill their BSSE degree requirements.

Appendix I.B. Engineering Management (EMGT) Track

The following track courses should be taken by each student specializing in Engineering Management:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEGR 2111</td>
<td>Introduction to Engineering Management</td>
</tr>
<tr>
<td>SEGR 3112</td>
<td>Value Engineering Management</td>
</tr>
<tr>
<td>OPER 3204</td>
<td>Management of Service Operations</td>
</tr>
</tbody>
</table>
Appendix II

Electives
Appendix II.A. Technical Electives

Each SE student will need to take three (3) technical electives. These technical electives can be selected from other SE courses given in Table 5 or, alternatively, can be selected from other department courses given in Table 6. Courses not appearing on this list require advisor's approval prior to registering for the course and should be explained in the students' files. **NOTE that each technical elective may have multiple prerequisites to enroll. Each SE student will be required to take the prerequisite course(s) first in the selected technical elective course subject area. Please check the UNC Charlotte course catalog on the prerequisites.**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEGR 2111</td>
<td>Introduction to Engineering Management</td>
</tr>
<tr>
<td>SEGR 2121</td>
<td>Intro to Logistics Systems and Supply Chains</td>
</tr>
<tr>
<td>SEGR 3103</td>
<td>Human Systems Interface</td>
</tr>
<tr>
<td>SEGR 3112</td>
<td>Value Engineering Management</td>
</tr>
<tr>
<td>SEGR 3122</td>
<td>Implementation of Logistics Systems and Supply Chains</td>
</tr>
<tr>
<td>SEGR 3131</td>
<td>Computer Aided Design &amp; Manufacturing</td>
</tr>
<tr>
<td>SEGR 3132</td>
<td>Facilities Planning &amp; Material Handling Systems</td>
</tr>
<tr>
<td>SEGR 4131</td>
<td>Product and Process Design</td>
</tr>
<tr>
<td>SEGR 4132</td>
<td>Automation &amp; Systems Design</td>
</tr>
<tr>
<td>SEGR 4133</td>
<td>Lean Manufacturing Systems</td>
</tr>
<tr>
<td>SEGR 4142</td>
<td>Reliability Management</td>
</tr>
<tr>
<td>SEGR 4952</td>
<td>Engineering System Optimization</td>
</tr>
</tbody>
</table>

**Table 5. SE Technical Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCT 2121</td>
<td>Principles of Accounting I</td>
</tr>
<tr>
<td>ACCT 2122</td>
<td>Principles of Accounting II</td>
</tr>
<tr>
<td>CEGR 3122</td>
<td>Structural Analysis</td>
</tr>
<tr>
<td>CEGR 3141</td>
<td>Introduction to Environmental Engineering</td>
</tr>
<tr>
<td>CEGR 3153</td>
<td>Transportation Laboratory</td>
</tr>
<tr>
<td>CEGR 3155</td>
<td>Environmental Laboratory</td>
</tr>
<tr>
<td>CEGR 3161</td>
<td>Transportation Engineering I</td>
</tr>
<tr>
<td>CEGR 4108</td>
<td>Finite Element Analysis and Applications</td>
</tr>
<tr>
<td>CEGR 4161</td>
<td>Advanced Traffic Engineering</td>
</tr>
<tr>
<td>CEGR 4162</td>
<td>Transportation Planning</td>
</tr>
<tr>
<td>CEGR 4171</td>
<td>Urban Public Transportation</td>
</tr>
<tr>
<td>CEGR 4181</td>
<td>Human Factors in Traffic Engineering</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>CEGR 4262</td>
<td>Traffic Engineering</td>
</tr>
<tr>
<td>ECG 2111</td>
<td>Network Theory I</td>
</tr>
<tr>
<td>ECGR 2112</td>
<td>Network Theory II</td>
</tr>
<tr>
<td>ECGR 2155</td>
<td>Logic and Networks Laboratory</td>
</tr>
<tr>
<td>ECGR 2156</td>
<td>Instrumentation and Networks Laboratory</td>
</tr>
<tr>
<td>ECGR 2161</td>
<td>Basic Electrical Engineering</td>
</tr>
<tr>
<td>ECGR 2181</td>
<td>Logic System Design I</td>
</tr>
<tr>
<td>ECGR 3123</td>
<td>Data Communications and Networking</td>
</tr>
<tr>
<td>ECGR 3131</td>
<td>Fundamentals of Electronics and Semiconductors</td>
</tr>
<tr>
<td>ECON 2102</td>
<td>Principles of Economics-Micro</td>
</tr>
<tr>
<td>ECON 3125</td>
<td>Managerial Economics</td>
</tr>
<tr>
<td>ECON 4181</td>
<td>Energy and Environmental Economics</td>
</tr>
<tr>
<td>FINN 3120</td>
<td>Financial Management</td>
</tr>
<tr>
<td>FINN 3220</td>
<td>Financial Analysis</td>
</tr>
<tr>
<td>FINN 3223</td>
<td>International Financial Management</td>
</tr>
<tr>
<td>FINN 3271</td>
<td>Principles of Risk Management and Insurance</td>
</tr>
<tr>
<td>FINN 3275</td>
<td>Advanced Risk Management</td>
</tr>
<tr>
<td>GEOG 4103</td>
<td>Computer Mapping</td>
</tr>
<tr>
<td>GEOG 4120</td>
<td>Introduction to Geographic Information Systems</td>
</tr>
<tr>
<td>GEOG 4130</td>
<td>Advanced Geographic Information Systems</td>
</tr>
<tr>
<td>GEOG 4140</td>
<td>Geographic Information Techniques for Community Planning</td>
</tr>
<tr>
<td>GEOG 4155</td>
<td>Retail Location</td>
</tr>
<tr>
<td>GEOG 4210</td>
<td>Urban Planning Methods</td>
</tr>
<tr>
<td>GEOG 4255</td>
<td>Applied Population Analysis</td>
</tr>
<tr>
<td>GEOG 4260</td>
<td>Transportation Policy Formulation</td>
</tr>
<tr>
<td>GEOG 4265</td>
<td>Transportation Analysis Methods</td>
</tr>
<tr>
<td>GEOL 3180</td>
<td>Environmental Impact Analysis</td>
</tr>
<tr>
<td>INFO 2130</td>
<td>Intro to Bus. Computing</td>
</tr>
<tr>
<td>INFO 2231</td>
<td>Intro to Bus. Programming</td>
</tr>
<tr>
<td>INFO 3130</td>
<td>Management Information Systems</td>
</tr>
<tr>
<td>INFO 3223</td>
<td>Business Database Systems</td>
</tr>
<tr>
<td>INFO 3232</td>
<td>International Info. Sys. Mgmt</td>
</tr>
<tr>
<td>MATH 2171</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>MATH 2342</td>
<td>Data Analysis and Probability</td>
</tr>
<tr>
<td>MATH 3116</td>
<td>Graph Theory</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>MATH 3128</td>
<td>Actuarial Science I.</td>
</tr>
<tr>
<td>MATH 3129</td>
<td>Actuarial Science II.</td>
</tr>
<tr>
<td>MATH 3176</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td>MATH 4128</td>
<td>Risk Theory</td>
</tr>
<tr>
<td>MEGR 2141</td>
<td>Engineering Mechanics I</td>
</tr>
<tr>
<td>MEGR 2144</td>
<td>Introduction to Solid Mechanics</td>
</tr>
<tr>
<td>MEGR 2180</td>
<td>Manufacturing Systems</td>
</tr>
<tr>
<td>MEGR 3111</td>
<td>Thermodynamics I</td>
</tr>
<tr>
<td>MEGR 3112</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>MEGR 3116</td>
<td>Introduction to Heat Transfer</td>
</tr>
<tr>
<td>MEGR 3121</td>
<td>Dynamics Systems I</td>
</tr>
<tr>
<td>MEGR 3122</td>
<td>Dynamic Systems II</td>
</tr>
<tr>
<td>MEGR 3161</td>
<td>Introduction to Engineering Materials</td>
</tr>
<tr>
<td>MEGR 3162</td>
<td>Mechanical Behavior and Strengthening of Solids</td>
</tr>
<tr>
<td>MEGR 3171</td>
<td>Introduction to Measurements and Instrumentation</td>
</tr>
<tr>
<td>MEGR 3171L</td>
<td>Instrumentation Laboratory</td>
</tr>
<tr>
<td>MEGR 3225</td>
<td>Introduction to Finite Element Analysis</td>
</tr>
<tr>
<td>MEGR 3281</td>
<td>Numerical Control of Manufacturing Processes</td>
</tr>
<tr>
<td>MEGR 3282</td>
<td>Statistical Process Control and Metrology</td>
</tr>
<tr>
<td>MEGR 4127</td>
<td>Introduction to Robotics</td>
</tr>
<tr>
<td>MEGR 4162</td>
<td>Materials Production and Process</td>
</tr>
<tr>
<td>MEGR 4165</td>
<td>Introduction to Nondestructive Evaluation Methods</td>
</tr>
<tr>
<td>MGMT 3140</td>
<td>Management Concepts and Practice</td>
</tr>
<tr>
<td>MGMT 3241</td>
<td>Human Resource Management</td>
</tr>
<tr>
<td>MGMT 3260</td>
<td>Managerial Communication</td>
</tr>
<tr>
<td>MGMT 3274</td>
<td>International Business Processes and Problems</td>
</tr>
<tr>
<td>MKTG 3110</td>
<td>Marketing Concepts</td>
</tr>
<tr>
<td>MKTG 3215</td>
<td>Global Marketing Management</td>
</tr>
<tr>
<td>OPER 3206</td>
<td>Managing for Quality</td>
</tr>
<tr>
<td>OPER 3208</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>OPRS 4113</td>
<td>Game Theory</td>
</tr>
<tr>
<td>OPRS 4114</td>
<td>Dynamic Programming</td>
</tr>
</tbody>
</table>

Table 6. Technical Elective Courses from Other Departments
Appendix II.B. Liberal Studies (LBST) Electives

Each SE student will need to take four (4) Liberal Studies (LBST) elective courses as follows:

<table>
<thead>
<tr>
<th>One course in the arts and society:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LBST 1101  The Arts and Society: Dance</td>
<td></td>
</tr>
<tr>
<td>LBST 1102  The Arts and Society: Film</td>
<td></td>
</tr>
<tr>
<td>LBST 1103  The Arts and Society: Music</td>
<td></td>
</tr>
<tr>
<td>LBST 1104  The Arts and Society: Theater</td>
<td></td>
</tr>
<tr>
<td>LBST 1105  The Arts and Society: Visual Arts</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One course in the western tradition:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LBST 2101  Western Cultural and Historical Awareness</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One course in global understanding:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LBST 2102  Global and Intercultural Connections</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One course dealing with ethical issues and cultural critique:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LBST 2211  Ethical Issues in Personal, and Public Life</td>
<td></td>
</tr>
<tr>
<td>LBST 2212  Literature and Culture</td>
<td></td>
</tr>
<tr>
<td>LBST 2213  Science, Technology, and Society</td>
<td></td>
</tr>
<tr>
<td>LBST 2214  Issues of Health and Quality of Life</td>
<td></td>
</tr>
<tr>
<td>LBST 2215  Citizenship</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. LBST Elective Courses
<table>
<thead>
<tr>
<th>No.</th>
<th>Skills</th>
<th>Financial</th>
<th>Transportation &amp; Distribution</th>
<th>Manufacturing</th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Network Design</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Network Modeling &amp; Analysis</td>
</tr>
<tr>
<td>2</td>
<td>Facility Layout Design</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Facilities Design &amp; Planning</td>
</tr>
<tr>
<td>3</td>
<td>Quality Control</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Quality Engineering</td>
</tr>
<tr>
<td>4</td>
<td>Project Management</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Project Management</td>
</tr>
<tr>
<td>5</td>
<td>Risk Management</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Engr. Decision Analysis</td>
</tr>
<tr>
<td>6</td>
<td>Decision Analysis</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Engr. Decision Analysis</td>
</tr>
<tr>
<td>7</td>
<td>Costing and financial analysis</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Engr. Economic Analysis</td>
</tr>
<tr>
<td>8</td>
<td>Modeling</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Operations Res.-Deterministic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operations Res.-Probabilistic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Comp. Meth. for Sys Engr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Comp. Meth. for Sys Engr. II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculus I, II, III</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Matrices &amp; Linear Algebra</td>
</tr>
<tr>
<td>10</td>
<td>Optimization</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Operations Res.-Deterministic</td>
</tr>
<tr>
<td>11</td>
<td>Communication and Presentation</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Intro to Tech Comm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>English I, II</td>
</tr>
<tr>
<td>12</td>
<td>Problem Solving</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Engr. Decision Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Engr. Systems Optimization</td>
</tr>
<tr>
<td>13</td>
<td>People Management</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Project Management</td>
</tr>
<tr>
<td>14</td>
<td>Ergonomics and Safety</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Human System Interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Engr. Exper. Design</td>
</tr>
<tr>
<td>16</td>
<td>Six-Sigma Quality</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Quality Engineering</td>
</tr>
<tr>
<td>17</td>
<td>Implementation Experience</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Systems Design Project I, II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prof. Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Systems Engr. Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intro to Engr I, II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Industrial Capstone Project</td>
</tr>
<tr>
<td>18</td>
<td>Programming</td>
<td>√</td>
<td>√</td>
<td></td>
<td>Comp. Meth. for Sys Engr. I, II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Programming for Systems Engineers</td>
</tr>
<tr>
<td>19</td>
<td>Spreadsheet Modeling</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Comp. Meth. for Sys Engr. I, II</td>
</tr>
<tr>
<td>20</td>
<td>Value and performance measurement &amp; tracking</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>Value Engineering</td>
</tr>
<tr>
<td>Course ID</td>
<td>Course Description</td>
<td>Requirements</td>
<td>Related Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Demand Planning</td>
<td>√</td>
<td>Operations Management, Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Supply Planning</td>
<td></td>
<td>Operations Management, Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Transportation Planning &amp; Scheduling</td>
<td>√</td>
<td>Product Planning and Inventory Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Factory Planning &amp; Scheduling</td>
<td></td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Inventory Planning and Control</td>
<td></td>
<td>Production Planning and Inventory Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Product Design</td>
<td>√</td>
<td>Product &amp; Process Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Service Planning</td>
<td></td>
<td>Service Operations Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Spare Parts Planning</td>
<td></td>
<td>Product Planning and Inventory Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Computer Aided Design</td>
<td></td>
<td>Computer Aided Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Capacity Planning</td>
<td>√</td>
<td>Production Planning and Inventory Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Strategic Planning</td>
<td></td>
<td>Operations Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Supplier Relationship Management</td>
<td>√</td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Customer Relationship Management</td>
<td></td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Global Business Dynamics</td>
<td></td>
<td>Introduction to Global Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Intercultural Relations</td>
<td>√</td>
<td>Global &amp; Intercultural Connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>International Trade Laws</td>
<td></td>
<td>Introduction to Global Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Business Laws</td>
<td></td>
<td>Introduction to Global Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Business Ethics</td>
<td></td>
<td>Ethical Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Purchasing</td>
<td></td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Contract Management</td>
<td>√</td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Reverse Logistics</td>
<td>√</td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Recycling and Green Supply Chains</td>
<td>√</td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Lean System Design</td>
<td>√</td>
<td>Lean Mfg Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Pricing, Rebates and Revenue Management</td>
<td>√</td>
<td>Pricing Optimization and Game Theory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Benchmarking</td>
<td>√</td>
<td>Supply Chain Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Product Lifecycle Management</td>
<td>√</td>
<td>Product &amp; Process Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Material Handling Systems</td>
<td></td>
<td>Automation &amp; Material Handling Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Enterprise Resource Planning Systems</td>
<td></td>
<td>Information and Decision Support Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>e-Business Techniques</td>
<td></td>
<td>Electronic and Technology Enabled Business</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table lists major skills required by SE students in their career. BSSE students will acquire some of these skills by taking courses not only from the SE department and the engineering college but also from other departments and colleges at UNCC. BSSE students will obtain enough knowledge foundation to pursue all skills when they graduate. The course names listed here do not necessarily correspond to an existing course but rather indicate a topic area. The exact names of the courses are provided under the Technical and Liberal Studies Electives sections.
Appendix IV

Faculty Curriculum Vitae
CHURLZU LIM

Degrees & Professional Registrations
- Ph.D. in Industrial and Systems Engineering, Virginia Tech, 2004
- M.S. in Management Engineering, Korea Advanced Institute of Science and Technology, 1997
- B.S. in Management Science, Korea Advanced Institute of Science and Technology, 1995

Number of years service on this faculty, including date of original appointment and dates of advancement in rank
5 months, Engineering Management Program
Original Appointment August 2006 at the rank of Assistant Professor

Related Teaching and Other Work Experience
- University of Florida, Department of Industrial and Systems Engineering, Adjunct Assistant Professor, 2006
- University of Arizona, Department of Systems and Industrial Engineering, Research Associate, 2004-2006
- Virginia Tech, Department of Industrial and Systems Engineering, Research Assistant, 2001-2004
- Virginia Tech, Department of Industrial and Systems Engineering, Teaching Assistant, 2001, 2003-2004
- Korea Air Force Academy, Department of Industrial Engineering, Lecturer, 1997-2000

Active Membership in Professional and Scientific Societies
- Institute for Operations Research and the Management Sciences
- Institute of Industrial Engineers
- American Society for Engineering Education

Honors / Awards / Recognition
- IIE Pritsker Doctoral Dissertation Award, 2nd Place, 2005
- Grado Graduate Fellowship, 2001-2004
- Selected Doctoral Colloquium Participant, INFORMS, Atlanta, GA, 2003

Selected Recent Publications / Presentations / Grant Awards
- Presentation: Variable Target Value Techniques for Solving Large-Scale Nondifferentiable Optimization Problems, Seminar Series, Industrial and Systems Engineering, University of Florida, September, 2005
- Presentation: Discrete and Continuous Multicommodity Flow Network Interdiction, Complementarity Duality Global Optimization Conference, Blacksburg, Virginia, August, 2005
- Presentation: A Network Design Problem with Continuous Enemy Interdiction, IFORS, Honolulu, Hawaii, July, 2005
- Presentation: Nondifferentiable Optimization for Lagrangian Duals of Linear Programs, Department Seminar Series, Systems and Industrial Engineering, The University of Arizona, October, 2004
- Presentation: Solving Nondifferentiable Lagrangian Duals of LPs by Obviating Nondifferentiability, Virginia Tech INFORMS Student Chapter Seminar Series, Virginia Polytechnic Institute and State University, March, 2004
• Presentation: *Variable Target Value Methods for Solving Lagrangian Duals of Linear Programs*, Virginia Tech INFORMS Student Chapter Seminar Series, Virginia Polytechnic Institute and State University, November, 2003

**Institutional and Professional Service (last five years)**
• Session Chair, Applications of Global Optimization, IIE Annual Conference, Nashville, TN, 2007
• Vice President, Virginia Tech INFORMS Student Chapter, 2003-2004
• M.S. Thesis Committee Member, F. Sudargho, University of Arizona, 2005
• Refereed Journal Papers for *IIE Transactions, Networks, Journal of Global Optimization, Journal of Industrial and Management Optimization*

**Professional Development Activities (last five years)**
• Attended INFORMS Annual Meeting, Pittsburgh, PA, 2006
• Attended INFORMS Annual Meeting, San Francisco, CA, 2005
• Attended CDGO Conference, Blacksburg, VA, 2005
• Attended IFORS Conference, Honolulu, HI, 2005
• Attended IIE Annual Conference, Atlanta, GA, 2005
• Attended INFORMS Annual Meeting, Denver, CO, 2004
• Attended INFORMS Annual Meeting, Atlanta, GA, 2003
ERTUNGA C. OZELKAN

Degrees & Professional Registrations
- Ph.D., Systems and Industrial Engineering, The University of Arizona, 1997
- M.S., Systems Engineering, The University of Arizona, 1994
- B.S., Civil Engineering, The Bogazici University, Istanbul, Turkey, 1991

Number of years service on this faculty, including date of original appointment and dates of advancement in rank:
3 years, Engineering Management Program
Original appointment January 2004 at the rank of Assistant Professor

Related Teaching and Other Work Experience
- University of Texas at Dallas, Department of Information Systems and Operations Management, Visiting Assistant Professor, Fall 2002 – Fall 2003
- i2 Technologies, Applications Engineer, 1998 - 1999
- Tefen Ltd., Project Manager, 1997 - 1998
- Tefen Ltd., Consultant, 1996 - 1997

Active Membership in Professional and Scientific Societies
- Institute for Operations Research and the Management Sciences (INFORMS)
- Production and Operations Management Society (POMS)
- Institute for Industrial Engineers (IIE)
- American Society for Engineering Education (ASEE)

Honors / Awards / Recognitions
- IIE Lean Division Excellence in Teaching Award, Institute for Industrial Engineers, 2006, for the nominated EMGT 6090 O03 Lean Supply Networks course.
- Outstanding Teaching Award, Center for Intelligent Supply Networks (C4ISN)-University of Texas at Dallas, Fall 2004, for contributions in the Professional Supply Chain Management Program
- Top Gun Award, i2 Technologies Education Services, 2000, One of the three employees to receive the award for outstanding performance
- Joint Development Award, Compaq Computers, 1999, for meeting Compaq’s supply chain software development needs.
- Tucson Mayor’s Award - Honorary Citizen of Tucson, Mayor of Tucson, Arizona, 1996, for contributions in cultural exchange.
- Fellowship / Tuition/Graduate Scholarship, The University of Arizona, 1995-1997, Limited awards to students with superior academic record.
- Scholarship, Von Karman Institute for Fluid Dynamics, Brussels, Belgium, 1990, Limited awards to students for scientific research and training.
- Scholarship, TUBITAK: The Scientific & Technologic Research Council of Turkey, 1985, one of the three students selected from the Tarsus American Highschool for the Mathematics Olympics summer preparation courses in Gokceada, Turkey.

Selected Recent Publications / Presentations / Grant Awards
- Ozelkan, E. C. and L. Duckstein, 2000, Multi-objective fuzzy regression: a general framework, Computers and Operations Research, Special Issue on Artificial Intelligence and Decision Support with Multiple Criteria 27(7-8), 635-652

Institutional and Professional Service (last five years)
• Associate Director of Center for Lean Logistics and Engineered Systems-CLLES, Spring 2005 - Present
• Chair of the Curriculum Committee for the EMGT Program, 2005-present
• EMGT Program Representative for the Col. of Eng. Computing Facilities Advisory Committee (CFAC), 2006- present
• Program Coordinator for the Supply Chain Management (SCM) Professional Certificate Program
• Web Administrator for the EMGT Program and CLLES, 2004-present
• EMGT Program Faculty Search Committee Member – Spring 2006
• EMGT Program Strategic Planning Committee Member – Summer 2006
• Organized EMGT Program Information Sessions (Dec 6, 2004; Mar 14, 2005)
• Chair of the Member Selection Committee for the EMGT Program, Spring 2005.
• Collaborated with American Society for Quality (ASQ), Pass & Seymour/legrand and Johnson Lean Enterprise Consultancy to jointly complete a “Lean Case Study and Simulation Project”, Spring 2006.
• Conducted the “Lean Day and Social” event on campus in collaboration with the Society of Manufacturing Engineers (SME) and other UNCC faculty.
• Delivered short courses for UNCC Intercultural Programs on for international students from KNU University, South Korea during July 2005 and January 2006.
• Secretary for the ASEE Engineering Management Division, 2006-2007
• Member of the Editorial Review Board of the International Journal of Information Systems and Supply Chain Management 2007-2009

Professional Development Activities (last five years)
Attended numerous presentations during the following conferences
• INFORMS Conference, Pittsburgh, PA, November 5-8, 2006
• ASEE Annual Conference & Exposition, Chicago, IL, June 18-21, 2006.
• IIE Annual Research Conference, Atlanta, May 14-18, 2005.
• Second World Conference on POM and 15th Annual POM Conference, Cancun, Mexico, April 30 - May 3, 2004.
• POM Conference - Production and Operation Management in Service Economy, Savannah, Georgia, April 4-7, 2003.
• INFORMS Conference – San Jose, November 16-20, 2002.

Attended several grant development workshops at UNCC.
A. YESIM SIRELI

Degrees
- Ph.D. in Engineering Management, Old Dominion University, 2003.
- B.S. in Electrical Engineering, Istanbul Technical University, 1990.

Number of years service on this faculty, including date of original appointment and dates of advancement in rank
3.5 years, Engineering Management Program.
Original appointment July 2003 at the rank of Assistant Professor; reappointed 2006.

Related Teaching and other Work Experience
- Old Dominion University, Norfolk, Va., Department of Engineering Management & Systems Engineering, Graduate Research and Teaching Assistant, January 1999 – July 2003.

Active Membership in Professional and Scientific Societies
- IEEE Engineering Management Society, Member and Reviewer for the IEEE Transactions on Engineering Management
- Decision Sciences Institute (DSI), Member
- American Society for Engineering Education (ASEE), Member and Peer Reviewer for National Conferences
- Marketing Science Institute (MSI), Member
- American Society for Engineering Management (ASEM), Reviewer, National Conference 2005
- The Honor Society of Phi Kappa Phi, Member
- Internet Society (ISOC), Member

Honors / Awards / Recognitions
- Invited membership to the Honor Society of Phi Kappa Phi
- Invited membership to the American Society for Engineering Management (ASEM) Honor Society

Selected Recent Publications / Presentations / Grant Awards in chronological order
- E. Ozelkan (PI), Y. Sireli and G. Teng (Co-PIs), Supply Chain Management Certification Workshop, Grant supported by Tyco/Scott Health & Safety, Monroe, 05/2006 – 08/2006.

• Y. Sireli (PI at UNCC), in collaboration with East Carolina University, Longitudinal Study of the Market Penetration of Cockpit Weather Information Systems – Phase 2, Grant supported by NASA Langley Research Center, 01/2005 – 01/2006.


• Y. Sireli (PI at UNCC), in collaboration with East Carolina University, Longitudinal Study of the Market Penetration of Cockpit Weather Information Systems – Phase 1, Grant supported by NASA Langley Research Center, 10/2003 – 01/2005.


**Institutional and Professional Service (last 3.5 years)**

**University Service:**

• Member of the Minority Faculty Recruitment and Retention Planning Committee, Fall 2003 - Spring 2006.
• Director of the Systems Engineering Department Planning Committee, Fall 2004 – present.
  o Organizer of new EMGT information sessions that will focus on the needs of graduate students of other engineering departments (first session will be held in Spring 2007 for ECE grad students).
  o Writer of the following Department of Systems Engineering & Engineering Management (SEEM) documents: Five-year Strategic Plan and Promotion and Tenure Policy, Fall 2005 - Spring 2006.
  o Contributor to the curriculum development of the future SEEM Department.
  o EMGT Program liaison to the Office of International Admissions for promoting the program overseas, Spring 2004 – present.
  o Presenter and facilitator at the EMGT Program information sessions, Spring 2004 – present.
• Co-founder of the Alpha Eta Chapter of Epsilon Mu Eta, the Engineering Management Honor Society, Spring 2004 – present.
• Member of the EMGT Program new faculty search committee, Fall 2005 – Spring 2006.
• Mechanical Engineering Department coordinator of the Arts and Science Council Campaign, 2004 - 2005.
• Graduate and Professional Schools Fair coordinator, Fall 2003.

Advising, Mentoring, and Additional Teaching:
• Instructor of individual studies for engineering management master’s students, Spring 2006 – present.
• Mentor to an EMGT master’s student (NC-LSAMP Bridge to the Doctorate program), Spring 2005 - Spring 2006.
• Faculty advisor in an Electrical Engineering Ph.D. committee, Spring 2004 – present.
• Faculty advisor in a Mechanical Engineering master’s thesis committee, Fall 2005.
• Advisor to EMGT master’s students / research assistants, Spring 2004, Fall 2005.
• Faculty advisor in an EMGT master’s thesis committee, Fall 2003.

Professional Services:
• Reviewer for the IEEE Transactions on Engineering Management, and for ASEE and ASEM Annual Conferences.
• Session chair at several conferences.

Professional Development Activities (last 3.5 years)
• Published several journal and conference articles, a selection of which is referenced above.
• Presented / will present at the conferences referenced above.
• Written and co-written several grant proposals, some of which are pending.
• Presented NASA-funded work to various audiences related to decision support systems in aviation.
• Attended the National Effective Teaching Institute workshop by ASEE, Salt Lake City, UT, 06/17-19/2004.
S. GARY TENG

Degrees & Professional Registrations
- Ph.D., Industrial Engineering, Auburn University, 1989
- M.S.I.E., Texas Tech University, 1983
- B.E., Industrial Engineering, Chung Yuan University, 1979
- Registered Professional Engineer (State of Wisconsin, since 1991)
- American Society for Quality Certified Reliability Engineer (since 1993) and Certified Quality Engineer (since 1993)

Number of years service on this faculty, including date of original appointment and dates of advancement in rank:
6.5 years, Engineering Management Program
Original appointment July 2000 at the rank of Associate Professor

Related Teaching and Other Work Experience
- Western New England College, Department of Industrial & Manufacturing Engineering, Associate Professor, 1996 – 2000
- North Carolina A&T State University, Department of Manufacturing Systems, Associate Professor, 1995 - 1996
- University of Wisconsin-Milwaukee, Department of Industrial & Manufacturing Engineering, Assistant Professor, 1989 – 1995
- Auburn University, Advanced Manufacturing Technology Center, Research & Teaching Assistant, 1985 - 1989
- Formosa Plastics Group, Industrial Engineer, 1981 - 1982
- Army (Taiwan), Platoon Leader and Acting Deputy Company Commander, 1979 - 1981

Active Membership in Professional and Scientific Societies
- Alpha Pi Mu (Industrial Engineering Honor Society)
- Sigma Xi (The Scientific Research Society)
- Epsilon Mu Eta (Engineering Management Honor Society)
- American Society for Engineering Education
- American Society for Engineering Management
- American Society for Quality
- Institute of Industrial Engineers
- Institute for Supply Management
- Institute for Operations Research and the Management Sciences

Honors / Awards / Recognitions
- Army Commander-In-Chief Award (Taiwan, 1981)
- Outstanding Faculty Advisor Award (Society of Manufacturing Engineers, 1993)
- UWM Faculty International Travel Award (1994)
- IIE Chapter Recognition Silver Award (Faculty Advisor, 1999 & 2000)

Selected Recent Publications / Presentations / Grant Awards
Institutional and Professional Service (last five years)


**Institutional and Professional Service (last five years)**

- Director, Engineering Management Program, 2000 - 2007
- Director, Center for Lean Logistics and Engineered Systems, 2005 - 2007
- Member of the task force (2002-2003) and Program Committee (2003-2007) for Infrastructure and Environmental Systems Ph.D. Program, College of Engineering
- Member of the task force for Construction Management Institute, College of Engineering, 2003-2005
- Chair of Ad Hoc Committee to develop processes for promotion and tenure review for faculty participating in college-wide programs (2003-2005) and Chair of Systems Engineering and Engineering Management Department Planning Committee (2001-2002), College of Engineering
- Member of the University Hearing Committee (2001-2002) and Faculty Executive Committee (2005-2007), UNCC.
- Division Chair (2006-2007), Program Chair (2005-2006), Secretary/Treasurer (2004-2005), and Newsletter Editor (2003-2004), Engineering Management Division, ASEE
- Chair, Student Section Development Committee, American Society for Engineering Management, 2004-2007
- Membership Chair (2002-2003) and Publicity Chair (2001-2002), ASQ Charlotte Section
- Proposal Review Panelist for NSF, 2005
- Proposal Reviewer, Louisiana State Board of Regents, 2007
- Paper Reviewer for 12 research journals, 2001 - 2007
Appendix V

SEGR Course Outlines
SEGR 2101 – SYSTEMS ENGINEERING CONCEPTS

Proposed Catalog Description:

SEGR 2101 Systems Engineering Concepts. (3) Prerequisite: ENGR 1202. This course provides the foundation for systems engineering processes and practices. The contents cover the discussion of current systems issues, basic systems engineering processes, and the roles of systems engineering professionals in a global business environment. It also will cover the principles of mechanical drawing and computer aided design (CAD) for systems engineering applications. (Fall)

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Systems Engineering
Week 2: Methodological Frameworks
Week 3: Methodological Frameworks
Week 4: Systems Engineering Processes
Week 5: Systems Engineering Processes
Week 6: Design in Systems Engineering Processes
Week 7: CAD for Systems Engineering Applications
Week 8: CAD for Systems Engineering Applications
Week 9: CAD for Systems Engineering Applications
Week 10: Formulation of Issues
Week 11: Formulation of Issues
Week 12: Analysis of Alternatives
Week 13: Trade-off Analysis
Week 14: Selection of Alternatives
Week 15: System Decision Making
SEGR 2105 – COMPUTATIONAL METHODS FOR SYSTEMS ENGINEERING I

Proposed Catalog Description:

SEGR 2105 Computational Methods for Systems Engineering I. (3) Prerequisite: SEGR 2101. This course will introduce programming languages and computational tools that are often used by Systems Engineers. Programming in C and Matlab will be emphasized. Spreadsheet-based modeling will be introduced. (Spring)

Proposed Text:


Or


Proposed Course Outline:

Week 1: Introduction to Computer Languages
Week 2: Basics of C++
Week 3: C++ Statements and Control Structures
Week 4: Arrays
Week 5: Pointers
Week 6: Dynamic Memory Allocation
Week 7: Characters and Strings
Week 8: Functions
Week 9: File Input/Output in C++
Week 10: Object Oriented Programming
Week 11: Basics of MATLAB
Week 12: MATLAB Built-In Functions
Week 13: Graphic Functions in MATLAB
Week 14: Basics of Excel
Week 15: Functions in Excel
SEGR 2106 - ENGINEERING ECONOMIC ANALYSIS

Proposed Catalog Description:

SEGR 2106 Engineering Economic Analysis. (3) Prerequisite: Sophomore standing and SEGR 2105 or consent of the department. Covers economic analysis of engineering alternatives, including time value of money, cash flow analysis, cost estimation, project evaluation, accounting and budgeting tools.

Proposed Text:

Or

Proposed Course Outline:

Week 1: Introduction to Engineering Economy
Week 2: Value Creation and Financial Accounting
Week 3: Cost Concepts
Week 4: Activity-Based Costing
Week 5: Computations Involving Interest
Week 6: Equivalent Worth Methods
Week 7: Rate of Return Methods
Week 8: Depreciation and Income Taxes
Week 9: Dealing with Price Changes in Capital Investment Analysis (Inflation)
Week 10: Analyses for Government and Public Utilities (Benefit-Cost Ratio)
Week 11: Replacement Analysis
Week 12: Estimating for Economic Analyses
Week 13: Introduction to Risk and Uncertainty
Week 14: Sensitivity Analysis
Week 15: Decision Tree Analysis
SEGR 2111 - INTRODUCTION TO ENGINEERING MANAGEMENT

Proposed Catalog Description:

SEGR 2111 Introduction to Engineering Management. (3) Prerequisite: ENGR 1202. Focuses on the fundamentals in engineering management. It provides students the understanding of engineering management principles and practices and the roles of engineering management professionals in a global business environment.

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Management Challenges
Week 2: Functions of Engineering Management
Week 3: Planning & Organizing
Week 4: Leading & Controlling
Week 5: Business Fundamentals for Engineering Manager
Week 6: Cost Accounting for Engineering Managers
Week 7: Financial Accounting and Analysis for Engineering Managers
Week 8: Managerial Finance for Engineering Managers
Week 9: Marketing Management for Engineering Managers
Week 10: Engineering Leadership
Week 11: Ethics in Engineering/Business Management
Week 12: Web-Based Applications
Week 13: Globalization
Week 14: Management Issues in Global Engineering Environment
Week 15: Engineering Management for Global Operations
SEGR 2121 - INTRODUCTION TO LOGISTICS SYSTEMS
AND SUPPLY CHAINS

Proposed Catalog Description:

SEGR 2121 Introduction to Logistics Systems and Supply Chains. (3) Prerequisite: ENGR 1202. Focuses on the fundamentals in logistics systems and supply chain operations. It provides students the understanding of the operations in logistics systems and global supply chains and the roles of logistics/supply chain professionals in global business environment.

Proposed Text:


Or/and

Lecture Notes/Course-pack

Proposed Course Outline:

Week 1: Characterizing a Supply Chain (5Ps)
Week 2: Supply Chain Management Processes (SCM Process Map)
Week 3,4: Supply Chain Design
Week 5,6: Supply Chain Planning
Week 7,8: Supply Chain Execution
Week 9: Logistics Systems Requirements
Week 10: Roles and Decisions of Supply Chain Professionals
Week 11: Value of Information in Supply Chains
Week 12: Collaborative Planning, Forecasting and Replenishment
Week 13: Constraint-based Thinking in Supply Chains
Week 14: Benchmarking
Week 15: Technology and Decision Support Systems in Supply Chains
SEGR 3101 SYSTEM DESIGN AND DEPLOYMENT

Proposed Catalog Description:

SEGR 3101 System Design and Deployment. (3) Prerequisite: SEGR 2105 or consent of the department. Focuses on the basics of systems design, analysis, and implementation. It covers system design elements, system interface issues, system decomposition, and system integration. The emphasis is on the effective design and integration of system operations and successful deployment of systems design results. (Fall)

Proposed Text:


Proposed Course Outline:

Week 1: Introduction & System Definitions and Concepts
Week 2: System Life-cycle Analysis
Week 3: Customer Requirements
Week 4: QFD
Week 5: System Design Process
Week 6: Preliminary System Design
Week 7: Detailed Design & Development
Week 8: Concurrent Engineering Applications
Week 9: Lean Systems
Week 10: Lean Systems
Week 11: System Cost and Benefit Analysis
Week 12: Systems Management
Week 13: Systems Management
Week 14: Systems Integration
Week 15: Systems Integration
SEGR 3102 – SYSTEM SIMULATION, MODELING & ANALYSIS

Proposed Catalog Description:

SEGR 3102 System Simulation, Modeling & Analysis. (3) Prerequisite: STAT 3128. Focuses on the study of discrete-event simulation and its use in the analysis and design of systems. The emphasis is on using simulation software for simulation modeling and analysis with practical applications to design, analysis, and improvement of diverse systems. (Spring)

Proposed Text:


Or


Proposed Course Outline:

Week 1: Course Overview & Review of Probability and Statistics
Week 2: Static Simulation
Week 3: Dynamic Simulation Models: Spreadsheet Simulation
Week 4: Introduction to Arena Software
Week 5: Input Modeling Basics
Week 6: Modules in Arena
Week 7: Advanced Process in Arena
Week 8: Animation in Arena
Week 9: Statistical Analysis of Simulation Output
Week 10: Output Analysis in Arena
Week 11: Term Project Proposal
Week 12: Introduction to Crystal Ball
Week 13: Random Number Generators
Week 14: Project Presentations
Week 15: Project Presentations
SEGR 3103 – HUMAN SYSTEM INTERFACE

Proposed Catalog Description:

SEGR 3103 Human System Interface. (3) Prerequisite: SEGR 2105 or consent of the department. Focuses on the interfacing issues between human, organization, and systems operations. The emphasis is on the influence of human and cultural factors related to the effectiveness of system operations in a global business environment. (Spring)

Proposed Text:

And
Material from Books and Articles.

Proposed Course Outline:

Week 1: Course Overview: Human Factors and Systems
Week 2: Interactive System Definition and Concept
Week 3: Cognitive Modeling
Week 4: Perception and Representation
Week 5: Data Collection and Analysis Techniques
Week 6: Attention and Memory Constraints
Week 7: Human Motion Analysis
Week 8: Human Error
Week 9: Interaction Styles
Week 10: Cultural, Environmental, and Social Considerations
Week 11: Input/Output Techniques
Week 12: Methods of User-Centered Design
Week 13: Formal Methods for Usability Test
Week 14: Prototyping and Evaluation
Week 15: Design of Interactive System
SEGR 3105 – COMPUTATIONAL METHODS FOR SYSTEMS ENGINEERING II

Proposed Catalog Description:

SEGR 3105 Computational Methods for Systems Engineering II. (3) Prerequisite: SEGR 2105. This course covers numerical techniques for systems engineers such as Polynomial interpolation, Numerical differentiation and integration, Newton and simple gradient methods for nonlinear equations. (Fall)

Proposed Text:


Or


Proposed Course Outline:

Week 1: Overview of Computational Methods
Week 2: Linear Equations: Norms and Condition Numbers
Week 3: Gaussian Elimination and LU Factorization
Week 4: Least Squares: Models and Curve-Fitting
Week 5: QR Factorization
Week 6: Eigenvalues and Eigenvectors
Week 7: QR Algorithm
Week 8: Least Squares: Singular Value Decomposition
Week 9: Polynomial Interpolation
Week 10: Piecewise-Linear Interpolation
Week 11: Nonlinear Equations
Week 12: Newton’s Method
Week 13: Numerical Integration
Week 14: Numerical Differentiation
Week 15: Random Number Generators
SEGR 3107 DECISION AND RISK ANALYSIS

Proposed Catalog Description:

SEGR 3107 Decision and Risk Analysis. (3) Prerequisite: SEGR 2105 or consent of the department. This course aims to provide some useful tools for analyzing difficult decisions and making the right choice. After introducing components and challenges of decision making, the course will proceed with the discussion of structuring decisions using decision trees and influence diagrams. Decisions under conflicting objectives and multiple criteria will be covered as well as sensitivity and risk analysis. (Fall)

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Decision Making
Week 2: Structuring Decisions
Week 3: Making Decisions
Week 4: Making Decisions - Without Probabilities
Week 5: Multi-criteria - Analytic Hierarchy Process
Week 6,7: Sensitivity Analysis
Week 7,8: Probability Basics, Subjective Probability
Week 8,9: Theoretical Probability, Using Data
Week 10,11: Risk Analysis using Monte Carlo Simulations
Week 12,13: Value of Information
Week 13,14: Modeling Risk Preferences-Utility
Week 14,15: Multi Attribute Utility
SEGR 3111 PROJECT MANAGEMENT

Proposed Catalog Description:

SEGR 3111 Project Management. (3) Prerequisite: STAT 3128. Focuses on the study of various aspects of project management techniques and issues, and the use of conceptual, analytical, and systems approaches in managing engineering projects and activities. It includes the development and writing of project plans and reports for engineering and business operations. (Fall)

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Project Management
Week 2: Development and Writing Project Plans
Week 3: Project Management Software
Week 4: Project Proposals
Week 5: Project Scopes
Week 6: Work Breakdown Structures
Week 7: Network Diagrams for Project Management
Week 8: Network Diagrams for Project Management
Week 9: Project Schedule & Control
Week 10: Project Schedule & Control
Week 11: People Related Issues in Project Management
Week 12: Project Communication
Week 13: Project Presentations
Week 14: Project Documentation
Week 15: Project Implementation
SEGR 3112 - VALUE ENGINEERING MANAGEMENT

Proposed Catalog Description:

SEGR 3112 Value Engineering Management. (3) Prerequisite: SEGR 2106 or consent of the department. Analyzes the requirements of a project to achieve the highest performance for essential functions at the lowest costs over the life of the project. The “best value” is achieved by a multidisciplinary team effort through the study of alternative design concepts, materials, and methods.

Proposed Text:

And/Or

Proposed Course Outline:

Week 1: Introduction to the Value Methodology
Week 2: Management of Systems
Week 3: Cost Concepts and Target Costing
Week 4: Basic Cost Analysis Techniques
Week 5: Types of Functions
Week 6: Measuring Value
Week 7: Value Project Management
Week 8: Quality as a Major Component of Value
Week 9: Communications Models
Week 10: Teams and Teamwork
Week 11: Creative Brainstorming and Concept Development
Week 12: Value Project Analysis and Evaluation Techniques
Week 13: Value Engineering as a System
Week 14: Organization and Implementation
Week 15: Value Engineering Case Studies
SEGR 3114 PRODUCTION CONTROL SYSTEMS

Proposed Catalog Description: (This course will be cross-listed with ETIN 3123 Production Control Systems, the below description is the catalog Description for ETIN 2123)

SEGR 3114 Production Control Systems (3) Prerequisite: statistics. Principles, analysis and design of production and inventory planning and control systems. Demand forecasting, production scheduling and control systems and introduction to CPM. (On demand)

Proposed Text:


Or


Proposed Course Outline:

Week 1: Introduction to Production and Operations Planning
Week 2: Constraint-based Thinking / Theory of Constraints
Week 3-4 Demand Forecasting
Week 5-6: Inventory Planning
Week 7-8: Aggregate Planning
Week 9: Materials Requirements Planning
Week 10: Production Scheduling
Week 11-12: Lean Production Planning
Week 13: Facility Layout Design
Week 14-15: Production Quality Control
Week 16: Production Operations Project Management (as time permitted)
SEGR 3122 IMPLEMENTATION OF LOGISTICS SYSTEMS
AND SUPPLY CHAINS

Proposed Catalog Description:

SEGR 3122 Implementation of Logistics Systems and Supply Chains (3) Prerequisite: SEGR 3121. This course reviews and analyzes real-life logistics and supply chain implementation cases. Different industry supply chains are compared and benchmarking is emphasized through review of industry best practices.

Proposed Text:

Course-pack with Harvard Business School case studies from http://harvardbusinessonline.hbsp.harvard.edu

Proposed Course Outline:

Week 1: Introduction to Supply Chain Execution
Week 2: Benchmarking
Week 3: Measuring and Controlling Supply Chain Performance
Week 4: Benchmarking Company Analysis: Wall-mart
Week 5: Benchmarking Company Analysis: Dell
Week 6: Benchmarking Company Analysis: Cisco
Week 7: Benchmarking Company Analysis: Levi’s
Week 8: Benchmarking Company Analysis: Nike
Week 9: Benchmarking Company Analysis: Toyota
Week 10: Benchmarking Company Analysis: Ford
Week 11: Benchmarking Company Analysis: SAP
Week 12: Benchmarking Company Analysis: IBM
Week 13: Benchmarking Company Analysis: Nokia
Week 14: Benchmarking Company Analysis: Ikea
Week 15: Benchmarking Company Analysis: UPS
SEGR 3131 – COMPUTER AIDED DESIGN & MANUFACTURING

Proposed Catalog Description:

SEGR 3131 Computer Aided Design & Manufacturing. (3) Prerequisite: SEGR 2101 or consent of the department. Focuses on the basics of hardware and software implementation in the design and manufacturing processes. The emphasis is in making the design and manufacturing processes effective and efficient for global business competition.

Proposed Text:


Or


Proposed Course Outline:

Week 1: Overview of CAD/CAM
Week 2: CAD/CAM Hardware
Week 3: Geometric Modeling Concepts
Week 4: Coordinate Systems and Transformations
Week 5: Lines, Circles, and Polygons
Week 6: Curves
Week 7: Surfaces
Week 8: Solids
Week 9: Graphics Aids/Manipulations
Week 10: Animation
Week 11: Mechanical Assembly
Week 12: Interactive Computer Programming
Week 13: Finite Element Analysis
Week 14: Computer Numerical Control
Week 15: CNC Programming
SEGR 3132 – FACILITIES PLANNING & MATERIAL HANDLING SYSTEMS

Proposed Catalog Description:

SEGR 3132 Facilities Planning & Material Handling Systems. (3) Prerequisite: SEGR 2101 or consent of the department. Focuses on the basics in facility planning, plant layout design, material handling systems design and integration, and warehousing. The emphasis is on the effective design and integration of plant layout, material handling systems, and warehousing for supply chain operations.

Proposed Text:

Or

Proposed Course Outline:

Week 1: Time Study
Week 2: Flow Analysis Techniques
Week 3: Plant Layout Problems
Week 4: Layout Procedures
Week 5: Space Requirements
Week 6: Warehousing Layout Models
Week 7: Computer-aided Layout
Week 8: Single Facility Location Problems
Week 9: Multifacility Location Problems
Week 10: Network Location Problems
Week 11: Linear Location Models
Week 12: Discrete Location Models
Week 13: Material Handling Problems
Week 14: Material Handling System Design
Week 15: Material Handling Equipments
SEGR 3290 SYSTEMS DESIGN PROJECT I

Proposed Catalog Description:

SEGR 3290 Systems Design Project I. (1) Prerequisite: SE senior standing and corequisite SEGR 3111. First of a two-semester sequence leading to a major integrative system design experience in applying the principles of systems design and analysis and project management to the design of a system. Teamwork and communication skills are emphasized. It focuses on the development of the project plan and proposal for the capstone systems design project. Each student develops a complete systems design project plan and proposal and makes an oral presentation of the proposal to the faculty. It runs in conjunction with the project management course. (Fall)

Proposed Text:

None.

Proposed Course Outline:

Students in this project course work concurrently on their work in SEGR 3111 to develop their proposal for the systems design project during the semester.

Topics covered in the project work:

1. Logbook Documentation for Project Work
2. Systems Project Planning
3. Development of System Design Requirements
4. Literature Review Process
5. Oral Communications
6. Written Communications
SEGR 3291 SYSTEMS DESIGN PROJECT II

Proposed Catalog Description:

**SEGR 3291 Systems Design Project II.** (3) Prerequisite: SEGR 3290. A continuation of SEGR 3290 for the execution of the proposed systems design project. This course includes a mid-term written progress report with an oral presentation and a final written report plus the final oral presentation to demonstrate project results. *(Spring)*

Proposed Text:

None.

Proposed Course Outline:

Students in this project course continue their work on their system design project based on the proposal they have developed in SEGR 3290. In this course, students need to submit a project progress report and do a progress report presentation in mid-term and then submit a final report as well as a final presentation at the end of semester.

Topics covered in the project work:

1. Logbook Documentation for Project Work
2. Project scheduling
3. System Design and Problem Solving
4. Realistic Constraints Issues
5. Systems Project Result Implementation
6. Oral Communications
7. Written Communications
SEGR 4101 – NETWORK MODELING & ANALYSIS

Proposed Catalog Description:

SEGR 4101 Network Modeling & Analysis. (3) Prerequisite: OPRS 3111 or SEGR 3106. This course covers formulation and solution of optimization problems using network flow algorithms. Topics include minimum flow problems, shortest path, maximum flow, transportation, assignment, minimum spanning trees. Efficient solution algorithms are investigated. (Spring)

Proposed Text:


Or


Proposed Course Outline:

Week 1: Basics of Network Problem
Week 2: Applications of Network Problems
Week 3: Minimum Spanning Tree
Week 4: Shortest Path Problem: Label-Correcting Algorithm
Week 5: Dijkstra’s Algorithm
Week 6: Maximum Flow Problem
Week 7: Max-Cut Min-Flow Theorem
Week 8: Minimum Cost Flows
Week 9: Network Simplex Algorithm
Week 10: Transportation Problem
Week 11: Assignment/Matching Problem
Week 12: Multicommodity Flow Problem
Week 13: Traveling Salesman Problem
Week 14: Complexity Issues
Week 15: Other Topics in Network Flows
Proposed Catalog Description:

**SEGR 4131 Product and Process Design. (3)** Prerequisite: SEGR 2101 or consent of the department. Focuses on how to achieve a high-quality, customer-oriented product development process, from technology and product innovation, to design and development, leading up to production. Design for Six Sigma (DFSS) is the main technology discussed plus other product design approaches, such as design for cost, design for safety, and design for environment.

Proposed Text:


*And/Or*


Proposed Course Outline:

Week 1: Introduction to Product and Process Design
Week 2: Six Sigma Concepts
Week 3: Management of Product Development Cycle Time and Technology Development by DFSS
Week 4: Product Design by DFSS
Week 5: Critical Parameter Management (CPM)
Week 6: The Process of CPM in Product Development
Week 7: Metrics for Engineering and Project Management within CPM
Week 8: Gathering and Processing Voice of the Customer
Week 9: Quality Function Deployment (QFD)
Week 10: Multi-level QFD
Week 11: Concept Generation, Evaluation and Selection
Week 12: Selected DFx Methods
Week 13: Design of Experiments (DOE)
Week 14: Statistical Process Control (SPC)
Week 15: The Role of Executive and Management Leadership in Product and Process Design
SEGR 4132 AUTOMATION & SYSTEMS DESIGN

Proposed Catalog Description:

SEGR 4132 Automation & Systems Design. (3) Prerequisite: SEGR 3132. Focuses on the concepts of systems design, manufacturing systems design, manufacturing process control, shop floor control, and automation. The emphasis is on automation for economic and flexible manufacturing operations that can handle frequently changing global manufacturing requirements.

Proposed Text:


Proposed Course Outline:

Week 1: Automation in Production Systems
Week 2: Product/Production Relationships
Week 3: Lean Production
Week 4: Manufacturing Costs
Week 5: Elements of an Automated System
Week 6: Advanced Automation Functions
Week 7: Hardware Components for Automation and Process Control
Week 8: Numerical Control
Week 9: Material Transport Systems
Week 10: Storage Systems
Week 11: Automatic Identification and Data Capture Methods
Week 12: Manufacturing Systems Design
Week 13: Automated Production Lines
Week 14: Cellular Manufacturing
Week 15: Implementation of Toyota Production System
SEGR 4133 LEAN MANUFACTURING SYSTEMS

Proposed Catalog Description:

SEGR 4133 Lean Manufacturing Systems. (3) Prerequisite: SEGR 3132. Focuses on the fundamentals of how manufacturing operations work, and talk about the latest techniques to make your manufacturing organization successful. This course discusses how lean methodology can eliminate waste and increase the speed in manufacturing while reducing cycle times.

Proposed Text:


And/or
Lecture Notes/Course-pack

Proposed Course Outline:

Week 1: Introduction: Lean Production Game
Week 2: Origins of Lean
Week 3: Lean Process
Week 4: Specify Value: Customer Segmentation, QFD, Kano Model
Week 5: Identify Value Stream: Value Stream Mapping, 7 Wastes of Lean
Week 6: Make it Flow: Takt Time, Resource Requirements, 5S, TOC
Week 7: Make it Flow: Layout Design, Line Balancing, Setup Reduction (SMED)
Week 8: Pull: Kanban, Level Loading (Heijunka)
Week 9: Perfection: Kaizen, FMEA
Week 10: Perfection: Statistical Process Control
Week 11: Perfection: Process Capability
Week 12: Lean versus Six-Sigma
Week 13: Factory Dynamics: Little’s Law
Week 14: Factory Dynamics: Impact of Variability on Factory Performance
Week 15: Extending Lean to Supply Chains
SEGR 4141 - ENGINEERING EXPERIMENTAL DESIGN

Proposed Catalog Description:

SEGR 4141 Engineering Experimental Design. (3) Prerequisite: STAT 3128. Focuses on how to achieve high-quality/low-cost systems based on Taguchi methods, design of experiments methods, and statistical analysis of data. Also includes introduction to response surface methods. (Spring)

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Design of Experiments
Week 2: Simple Comparative Experiments
Week 3: Experiments with a Single Factor
Week 4: Analysis of Variance
Week 5: Introduction to Factorial Designs
Week 6: $2^k$ Factorial Designs
Week 7: Confounding in $2^k$ Factorial Designs
Week 8: Two-level Fractional Factorial Designs
Week 9: Three-level Fractional Factorial Designs
Week 10: Simple Linear Regression Models
Week 11: Multiple Linear Regression Models
Week 12: Response Surface Methods
Week 13: Robust Design
Week 14: Experiments with Random Factors
Week 15: Other Design and Analysis Topics
SEGR 4142 - RELIABILITY MANAGEMENT

Proposed Catalog Description:

SEGR 4142 Reliability Management. (3) Prerequisite: STAT 3128. Focuses on measuring, evaluating, improving and managing reliability. Topics include basic reliability models, hazard rate functions, system reliability, and fault tree analysis.

Proposed Text:


Or


Proposed Course Outline:

Week 1: Introduction, Definitions, Relationships
Week 2: The Role of Management in Reliability
Week 3: Managing the Reliability Process
Week 4: Economics of Reliability
Week 5: Design for Reliability
Week 6: FMEA and FTA Analyses
Week 7: Reliability Specifications and Goal Setting
Week 8: Concurrent Engineering
Week 9: Human-Centered Design
Week 10: Reliability Information Collection and Analysis
Week 11: Designing Experiments to Measure and Improve Reliability
Week 12: Accelerated Testing
Week 13: Failure Analysis System
Week 14: Maintainability and Reliability
Week 15: System Reliability
SEGR 4952 ENGINEERING SYSTEM OPTIMIZATION

Proposed Catalog Description:

SEGR 4952 Engineering System Optimization. (3) Prerequisite: Senior standing and OPRS 3111. 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.

Proposed Text:


Proposed Course Outline:

Week 1: Introduction to Systems Approach (System Lifecycle, SIMILAR Process)
Week 2-3: Linear Modeling (Formulation, Assumptions, Examples)
Week 4: Solving Linear Models (Graphical, Spreadsheet)
Week 5-6: Solving Linear Models (Simplex)
Week 6-7: Special cases & Sensitivity
Mathematical modeling using commercial software (e.g. AMPL, CPLEX, MAPLE, GAMMS, etc.)
Week 8-9:
Week 10-11: Integer Modeling (Formulation, Assumptions, Examples)
Week 11-12: Transportation and Assignment Problems
Week 12-13: Network Flows (Shortest Path, Minimum Spanning Tree)
Week 14: Non-linear Modeling (One-dimensional)
Week 14-15: Non-linear Modeling (Multi-dimensional)
Appendix VI

Letters of Support
Consultation on Library Holdings

To: Dr. Gary Teng  
College of Engineering Management Program & 
Center for Lean Logistics & Engineered Systems

From: Joanne S. Klein  
Reference Librarian, Engineering and Information Technology

Date: January 31, 2007

Subject: New Undergraduate Program in Systems Engineering

Summary of Librarian’s Evaluation of Holdings:

Evaluator: Joanne S. Klein  Date: 1/31/07

Check One:  
1. Holdings are superior  
2. Holdings are adequate (Please see comments)  YES  
3. Holdings are adequate only if Dept. purchases additional items.  
4. Holdings are inadequate

Comments:  
A search of the Atkins Library online catalog reveals the following holdings in support of this program. See the table that follows. A search in the areas of Systems Engineering and related subjects retrieved 6347 pertinent items. Of this total, 1038 have been acquired since 2000, so this is a current and relevant collection. Because there is some overlap of subject headings, the actual total number of titles will be less than this, but the collection, especially if bolstered by ongoing purchases, is quite adequate to support this program. The Library owns or has electronic access to 126 journals and 753 other electronic resources that support this program. In addition, the library has approximately 10 electronic databases, many with links to full text articles, supporting the overall Engineering Management program.

Joanne S. Klein  
Evaluator’s Signature  

January 31, 2007  
Date
Atkins Library Holdings in Areas Related to
Systems Engineering
1/31/07

<table>
<thead>
<tr>
<th>Subject Heading</th>
<th>All Books</th>
<th>Post 2000</th>
<th>Journals</th>
<th>Electronic Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automation</td>
<td>1351</td>
<td>132</td>
<td>41</td>
<td>122</td>
</tr>
<tr>
<td>CAD/CAM Systems</td>
<td>71</td>
<td>9</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Computer Aided Design</td>
<td>292</td>
<td>40</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Decision Support Systems</td>
<td>67</td>
<td>15</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Engineering Management</td>
<td>91</td>
<td>7</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Facility Management</td>
<td>20</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>109</td>
<td>7</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Inventory Control</td>
<td>273</td>
<td>51</td>
<td>6</td>
<td>57</td>
</tr>
<tr>
<td>Logistics</td>
<td>167</td>
<td>30</td>
<td>3</td>
<td>42</td>
</tr>
<tr>
<td>Manufacturing Processes</td>
<td>86</td>
<td>15</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Materials Handling</td>
<td>59</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Mathematical Model*</td>
<td>84</td>
<td>8</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Numerical Analysis</td>
<td>500</td>
<td>31</td>
<td>17</td>
<td>42</td>
</tr>
<tr>
<td>Process Control</td>
<td>154</td>
<td>18</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Product Management</td>
<td>132</td>
<td>32</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Production Management</td>
<td>393</td>
<td>81</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td>Project Management</td>
<td>408</td>
<td>174</td>
<td>0</td>
<td>63</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>148</td>
<td>21</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Quality Control</td>
<td>1055</td>
<td>209</td>
<td>13</td>
<td>135</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>108</td>
<td>89</td>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>Simulation Methods</td>
<td>506</td>
<td>40</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>Systems Engineering</td>
<td>221</td>
<td>15</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Value Analysis</td>
<td>52</td>
<td>6</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>6347</strong></td>
<td><strong>1038</strong></td>
<td><strong>126</strong></td>
<td><strong>753</strong></td>
</tr>
</tbody>
</table>
November 3, 2006

S. Gary Teng, Ph.D., P.E.
Professor and Director
Engineering Management Program &
Center for Lean Logistics & Engineered Systems
The University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC  28223

Dear Dr. Teng:

GDATP strongly supports the development of a systems engineering program at the College of Engineering at The University of North Carolina at Charlotte. The success of our business depends on our ability to meet the product and service needs of the United States Department of Defense. Systems engineering plays a critical role in defining our customers' needs and required functionality. System engineering concepts, processes, methods, and tools enable our engineers and managers to manage the ever increasing array of technologies employed in today’s defense products and services.

Our organization depends on an educated workforce prepared to solve complex problems. The inter-disciplinary education and training of systems engineering develops individuals ready to meet the challenges of global competition. System engineering is an urgent need and critical element of our strategy. A system engineering program at the University will provide the technical expertise vital to our company.

Sincerely,

Steve Elgin
Sr. Director, Detection Systems Operations
General Dynamics Armament and Technical Products
William H. Bath Jr.
3410 Twelve Oaks Place
Charlotte, NC 28270
704.302.6800
billbath@hotmail.com

26 October 2006

S. Gary Teng, Ph.D., P.E.
Professor & Director
Engineering Management Program & CLLES
The University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC 28223

Dear Dr. Teng,

Recently, at our semi-annual UNCC EMTG Advisory Board meeting, the Board had a chance to review the proposed Bachelor of Science in Systems Engineering (BSSE) goals and curriculum outline. The Systems Engineering and the Engineering Management Department and Degree Programs are critical to the future success of UNCC.

Good supply chain design (inventory minimization while maximizing fill rates and customer satisfaction, for example) does not happen by chance. The abilities to understand complex supply chains and to design system solutions are valuable skills that many companies and industries are in need of today. When put in real-world situations, graduates from this program will be able to align multiple functions across entire businesses – from customers through multiple tiers in the supply base. The ability to comprehend the extended enterprise’s supply chain will position students to manage financial and decision risk – the most critical skill needed in business today.

The future of manufacturing and order fulfillment in the US relies on flexibility and the ability for companies to deliver customized product in a compressed timeframe. These degree programs will help them develop a broader understanding of business beyond the traditional silo functions of companies today (i.e. purchasing, planning, manufacturing, etc.) These programs will teach the tools for UNCC students to design efficient and effective supply chains and to become business leaders for the future.

I fully endorse the creation of the Systems Engineering and the Engineering Management Department and Degree Programs at the University of North Carolina at Charlotte.

Best Regards,

[Signature]

William H. Bath Jr.
Independent Management Consultant
Member, UNCC EMGT Advisory Board
Member, Monroe Economic Development Commission
October 20, 2006

S. Gary Teng, Ph.D., P.E.
Professor & Director, Engineering Management Program &
Center for Lean Logistics & Engineered Systems
The University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC 28223

Dear Dr. Teng:

On behalf of the Material Handling Industry of America (MHIA) trade association and its national/international membership, I am pleased to endorse the University of North Carolina at Charlotte’s proposal to establish a B.S. in Systems Engineering degree program, particularly one with an application and research concentration on logistics systems.

Given the rate of expansion of warehousing, distribution and logistics services in Charlotte and the surrounding region, the Systems Engineering program will be a valuable addition to the area, the state of North Carolina and the Southeast. The techniques that are learned and utilized in such programs are also widely applicable to many other engineering and business issues faced by our member companies.

The proposals for the BSSE degree program and the Systems Engineering and Engineering Management Department contain a mix of courses and experiences that closely match what we feel are the key components for understanding how to solve real world systems problems while setting a firm foundation for advanced graduate and research work.

Since our association is based in Charlotte, this degree program and department would serve as a valuable local resource. Our association pledges its support to work with the new degree program as a strong resource for interesting industry applications. We look forward to many valuable interactions with the program and department.

Sincerely,

Michael Ogle, Ph.D.
Managing Director, College Industry Council on Material Handling Education
Senior Director of Technical & Engineering Services, Material Handling Industry of America
Dear Dr. Teng,

This letter is to express my support for the establishment of the B.S. in Systems Engineering degree program and the new Systems Engineering and Engineering Management Department. The need for this BSSE program in industry, in the US, the State of NC, and the Charlotte region is evident and required in order to enhance the education of our workforce, promote the economic attractiveness to new industry of the region and to work in concert with existing industry to firm up and help sustain a competitive advantage in the global marketplace. UNCC is strategically located in the largest metropolitan and fastest growing area in the Carolinas. The engineering school provides a much needed venue to provide a platform for this new and significantly needed curriculum and BSEE program. I appreciate your great leadership, consideration and support of this effort.

Sincerely,
Barbara B. Orr, P.E.
VP Duke Energy Power Delivery (retired)
November 21, 2006

To whom it may concern:

Dr. Gary Teng’s positive energy and organizational thought to create an engineering program for students to have a working body of knowledge from operational issues, technical and administrative functions and the important role they play within systems engineering and managing across multinational lines of supply and communication is what businesses will require from the engineering community in the immediate future. Engineers who graduate with the full compliment of interdisciplinary and technical skills will be better prepared to meet the challenges facing any business today.

Businesses whether they are in medical, automotive, transportation, construction, or environmental, areas will require the engineer to have the skills necessary to problem solve, work in group settings, handle change effortlessly, and communicate the issues. The Systems Engineering and Engineering Management degree program that will be offered by UNCC will be on the leading edge of tomorrow’s engineering programs across the country.

I have been associated for over thirty years with steel, automotive and consumer goods industries and recognize how critical the engineering function is to an organization. I personally believe that the investment in UNCC Systems Engineering and Engineering Management degree program will further advance the engineering student to be better prepared for any business environment chosen.

I support Dr. Teng’s effort at the UNCC for this type of Engineering initiative.

With kind regards,

Debra L. Shumar
President and Founder
December 4, 2006

Dr. S. Gary Teng, PhD, PE
Engineering Management Program, Center for Lean Logistics & Engr. Systems
The University of North Carolina
9201 University City Boulevard
Charlotte, NC  28223

Dear Dr. Teng:

ArvinMeritor strongly supports the development of a systems engineering program at the University of North Carolina. The success of ArvinMeritor depends on our ability to realize successful systems validation, define customer needs, and document all required functionality early in the developmental cycle while taking into consideration the automotive industry standards.

ArvinMeritor depends on an educated workforce to manage the decision-making and problem-solving process. System engineering is a critical element of our organizational needs, and provides the technical expertise vital to our company and this industry.

If I can be of any further assistance, please contact me.

Sincerely,

Joe Muscedere,
Vice President of Quality
Commercial Vehicle Systems
December 12, 2006

Dr. S. Gary Teng  
Professor & Director  
Engineering Management Program &  
Center for Lean Logistics & Engineered Systems  
The University of North Carolina at Charlotte  
9201 University City Blvd.  
Charlotte, NC 28223

Dr. Teng,

I wanted to take this opportunity to show my support for the proposed Systems Engineering program at The University of North Carolina at Charlotte. This is an academic function that is not represented at all in the metropolitan Charlotte area, and is sorely needed. With this region being the headquarters for a number of Fortune 500 companies as well as numerous manufacturing and service organizations, there is clearly a need.

In addition to this proposed department being able to provide the academic foundation in Systems and Industrial Engineering, it should also be used as a building block to forging stronger ties between the University and local / regional industry. Having graduate programs in Systems Engineering will also allow for the development of working engineers in this area to continue their professional development while not having to necessarily quit working – truly a win/win situation for both the University and their employer.

Please let me know if there is anything that I can do to further help in this endeavor.

Sincerely,

Bill Rhyne  
Director of Supply Chain and Labor Management
S. Gary Teng, Ph.D., P.E.
Professor & Director
Engineering Management Program &
Center for Lean Logistics & Engineered Systems
The University of North Carolina at Charlotte
9201 University City Blvd.
Charlotte, NC 28223

Dear Dr. Teng:

As a major employer in Cabarrus County, Philip Morris USA has a vested interest in the education and economic health of the greater Charlotte region. To that end, we support UNC-Charlotte’s (UNCC) decision to develop programs aimed at readying tomorrow’s workforce, and believe that offering degree programs in Systems Engineering and establishing a Systems Engineering & Engineering Management Department at UNCC will contribute to the economic success of the entire region and ensure that its residents are able to meet the demands of tomorrow’s changing economy.

We value UNCC’s commitment toward improving secondary education in the Charlotte region, and we support your efforts to provide greater economic and employment opportunities for the people in the entire state.

We believe that there is a need in North Carolina for more systems engineering graduates to effectively transition from the agricultural and textile businesses to more technological and service oriented industries. At the same time, there is a need for more creative and talented systems engineers who can develop innovative products and processes that will make companies more efficient, cost effective and competitive in today’s dynamic global market place.
UNCC's ability to recognize the need to develop a Systems Engineering & Engineering Management Department to meet society's need for additional systems engineers is a credit to your University's vision.

We hope that UNCC is successful in its endeavors.

Sincerely,

[Signature]

GRR/vp
October 23, 2007

Dr. Gary Teng, Professor and Director  
Engineering Management

Dear Gary:

This letter is to confirm the enthusiastic support of the entire Office of Student Development and Success (OSDS) for the new Bachelor of Science in Systems Engineering (BSSE) degree. Based on our experiences with recruiting, advising, and teaching freshmen, it is clear that offering a BSSE degree is exactly what our college needs to meet the demands and interests of our changing student population and to grow the college.

We frequently get inquiries about systems engineering programs when we host recruiting events, advise students, and teach our freshman classes. Students are always interested about the opportunities afforded by a BSSE degree. In the past, they either transferred to another institution or chose to pursue their second choice of a civil, computer, electrical, or mechanical engineering degree. Females in particular are attracted to systems engineering. I am convinced that a BSSE degree will help us achieve our college goal of increasing the enrollment and retention of underrepresented minority students.

The OSDS staff is very excited about recruiting, advising, and teaching freshman systems engineering students – despite the additional workload. We are also excited about having your students participate in our residential Freshman Learning Community and the MAPS (Maximizing Academic and Professional Success) Program. Both programs are recognized nationally for their contribution to student academic performance and retention.

Once again, we enthusiastically support the Bachelor of Science in Systems Engineering degree. We believe this program, which is long overdue, will bring new opportunities for our college and, more importantly, for our students. We wish you the best, and if there is anything we can do to help make this happen, please let me know.

Sincerely,

Patricia Tolley

Patricia A. Tolley, Assistant Dean

cc: Dean Robert Johnson
Gary Teng

From: Ingalls, Jerry
Sent: Saturday, October 20, 2007 10:06 AM
To: Teng, Gary Teng
Subject: Re: Consultation for BS in Systems Engineering Curriculum Proposal

Gary,

I have studied your proposal and commend you and your faculty and staff for a well crafted document. This is a strong proposal that appears to address a significant campus and regional need. The faculty of the Department of Geography and Earth Sciences welcome the opportunity to serve the needs of your students for outside electives. As we alter our GIScience program, I believe the resulting courses will provide even stronger electives for your students in that critical area.

The Department of Geography and Earth Sciences supports your efforts to establish this new program. Please let us know if there is anything we can do to help you in your efforts.

Jerry Ingalls
Chair, Department of Geography and Earth Sciences
University of North Carolina Charlotte
Charlotte, NC 28223
McEniry 340
Phone: 704-687-5979 Office
Fax: 704-687-5906 Fax
To: Professor S. Gary Teng
From: Lee W. Casperson, Chair
Department of Electrical and Computer Engineering
Date: 30 October 2007
Subject: B.S. in Systems Engineering

I have learned of the proposal to establish a Bachelor of Science degree program in Systems Engineering within the College of Engineering here at UNC Charlotte, and I am happy to be able to comment on this proposal. Our College of Engineering has been growing rapidly in size and reputation, and it is appropriate for us to always be alert for new and better ways to serve our constituents. A key element in this development is the addition of new programs, and a B.S. program in Systems Engineering will be a timely and very significant enhancement of our capabilities. Charlotte is the home to an increasing number of modern industries and associations, and the skills that will be taught and facilitated by the Systems Engineering program should be a valuable resource for all of them. Also, within the College of Engineering, systems engineering is a component of our other departmental engineering activities, and collaboration and access to the new courses being developed will benefit students and faculty in all of our disciplines. On behalf of the Department of Electrical and Computer Engineering, I am pleased to congratulate you on this proposal and to offer my strongest endorsement.
Dear Professor Teng,

Thank you for sending me the proposal for the new program in Systems Engineering. I am writing to extend the support of the department of Mathematics and Statistics for the creation of this degree. I think it is a good proposal. I note with approval the range of MATH, STAT and OPRS courses in the program, and I can confirm the department's intention of offering these courses on a regular basis and are pleased that they can be used in support of your degree program.

Sincerely,
Alan Dow
Memorandum

TO: S. Gary Teng, Director
Engineering Management Program

FROM: Anthony L. Brizendine, Chair
Department of Engineering Technology

DATE: February 8, 2008

SUBJECT: Support of BS in Systems Engineering

The Department of Engineering Technology is pleased to offer its support for your proposal to establish the BS in Systems Engineering degree program at UNC Charlotte.
February 8, 2008

Dear Gary:

This letter is to offer the strong support of your proposal for the curriculum design of the new B.S. in Systems Engineering program. The new Systems Engineering courses will be beneficial to all Engineering students. The Mechanical Engineering Department is glad to support the technical elective courses in the ME areas. We believe that this curriculum design fits the needs of industry in the area. The collaborations between the Systems Engineering program, Engineering departments, other departments, and Charlotte area industry will be a great success for UNC Charlotte.

On behalf of the Department of Mechanical Engineering and Engineering Science, I offer my strongest endorsement to this BSSE curriculum proposal.

Jay Raja, Ph.D.
Chair, Department of Mechanical Engineering and Engineering Science
The College of Business finds the revisions incorporated into the B.S. in Systems Engineering Course and Curriculum Proposal to meet the recommendations and suggested changes we outlined last November. We therefore support the proposal with the following stipulations:

1. All students wishing to register for courses in Accounting, Economics, Finance, Management Information Systems, Marketing, and Management must satisfy all the prerequisite requirements listed for these courses. We exclude OPER 3100, 3204, and 3208 and leave them open to your students after completing MATH 1242, ECON 1101, and STAT 3128, all courses listed in your proposal as Freshman and Sophomore year courses.

2. In the BSSE Study Plan, ECON 1101 is scheduled to be taken during the Spring semester of the Freshman year. It would be better from an enrollment management point-of-view to have roughly half of the students in this program take ECON 1101 in the Fall semester and the other half take it in the Spring semester. This can easily be accomplished by the former group taking their Liberal Studies Elective in the Spring term. Please also note that ECON 1101 is regularly offered in one or both Summer sessions.
MEMORANDUM

TO: Dr. Gary Teng, Director
   Engineering Management Master’s Program

FROM: Dr. David T. Young, Chairman CEE Department

DATE: February 11, 2008

SUBJECT: New undergraduate program in Systems Engineering

Over the past few months, it has been a pleasure meeting with you and several others to discuss your plans for a new undergraduate program in Systems Engineering (SE) in the Lee College of Engineering. The Department of Civil and Environmental Engineering (CEE) supports your development and offering of the SE program through a Bachelor of Science in Systems Engineering (BSSE) curriculum. We look forward to collaborating with faculty and students in the BSSE program in areas of mutual interest.

Kindest Regards.