Specific Format Required for a Complete Proposal

A complete proposal should contain the following information in this order and numbered this way:

1. New Program Proposal Form

Form NP

NEW PROGRAM PROPOSAL FORM

Sponsoring Institution(s): Southeast Missouri State University

Program Title: Industrial and Systems Engineering

Degree/Certificate: Bachelor of Science

Options: None

Delivery Site(s): Cape Girardeau, Missouri

CIP Classification (provide a CIP code): 14.2701

Implementation Date: Fall 2016

Cooperative Partners: None

Expected Date of First Graduation: Spring 2020

AUTHORIZATION

Dr. Gerald McDougall, Interim Provost — Signature — 12/17/15 — Date
Name/Title of Institutional Officer

Dr. Bradley Deken, Chair, Dept. of Polytechnic Studies — 573-651-2104
Person to Contact for More Information — Telephone

2. Need:

A. Student Demand:

i. Estimated enrollment each year for the first five years for full-time and part-time students

Form SE
STUDENT ENROLLMENT PROJECTIONS

Year	1	2	3	4	5
Full-Time	5	9	14	18	18
Part-Time	0	1	1	2	2
TOTAL*	5	10	15	20	20

* In each case, an average of 15 credit hours per student is projected.

ii. Will enrollment be capped in the future? *Response: No.*

B. Market Demand:

i. National, state, regional, or local assessment of labor need for citizens with these skills

Response: The field of industrial and systems engineering has long been recognized as a prime source of management talent. The U.S. Department of Labor, Bureau of Statistics, projects a total of 223,300 Industrial and Systems Engineering jobs by 2022 with average median pay of $78,860 per year. An October 19, 2014 search of indeed.com for Industrial & Systems Engineering jobs in Missouri provided ads for 416 different positions and about one third of those jobs were either in the St. Louis area or within 50 miles of there. Some members from the Polytechnic Studies Department advisory committee, representing industries of manufacturing, banking, transportation and logistics, and health care, also report a regional need for Industrial & Systems Engineering professionals.

C. Societal Need:

i. General needs which are not directly related to employment

Response: Industrial & Systems Engineers design, analyze, and control complex systems, such as manufacturing systems, global supply chain, and service systems. Different from other engineering disciplines that apply skills to the specific areas, Industrial Engineering is the only engineering discipline that focuses on optimizing systems for maximum efficiency, minimum cost, quality improvement, safety, and other interests to the stakeholders of the system. It saves time, money, materials, energy, and other resources for the companies, industries, and essentially for our society. The skills of Industrial & Systems Engineers can be applied in an extremely wide range of organizations and more and more organizations

have recognized the significance of the Industrial & Systems Engineering profession.

D. Methodology used to determine "B" and "C" above.
Response: 1) Discussions with government officials from U.S. Army Corps of Engineers, U.S. Coast Guard, and Homeland Security working in Industrial & Systems Engineering discipline. 2) Meeting with the new Southeast Polytechnic Studies Advisory Board on October 9, 2014 in Cape Girardeau. They are individuals representing interests of organizations in banking, health care, manufacturing, transportation, engineering, and law enforcement fields. 3) Discussions with other higher education professionals in Industrial & Systems Engineering discipline. 4) U.S. Bureau of Labor Statistics website (http://www.bls.gov). 5) Various prints and electronic articles.

3. Duplication and Collaboration: If similar programs currently exist in Missouri, what makes the proposed program necessary and/or distinct from the others at public institutions, area vocational technical schools, and private career schools?
Response:
The only similar program in Missouri is the Industrial & Manufacturing Systems Engineering program provided by University of Missouri. The proposed program exhibits significant differences from the existing one because of the following two reasons:
   1) *The existing program focuses on the manufacturing systems while the proposed program covers any system, thus providing the students with more opportunities and choices in career selection.*
   2) *The proposed program will well serve the demand in the St. Louis area and Southeast Missouri.*

In addition, the large number of future job positions in the industrial & systems engineering discipline also requires more than one university in Missouri to provide this program.

Does delivery of the program involve a collaborative effort with any external institution or organization?

Response: No. If yes, please complete Form CL.

4. Program Structure:

Form PS
PROGRAM STRUCTURE

A. Total credits required for graduation: 136 cr.

B. Residency requirements, if any: 30 cr. (General University Guidelines)

C. General education (total credits): 55 cr. (Univ. Studies req. w/1 five cr. course)

General education courses (specific courses OR distribution area and credits):
[See Appendix A for the names of all courses listed below.]

UI100	3	cr.	Literary Exp	3	cr.	Major Civ.	3	cr.
EN100	3	cr.	Oral Exp	3	cr.	UI3xx	3	cr.
CH185/085/005	5	cr.	Written Exp	3	cr.	UI400	3	cr.
MN220	3	cr.	Behav. Sys.	3	cr.	UI410 or UI450	3	cr.
SW207	3	cr.	Living Sys.	3	cr.	MA140	5	cr.
Artistic Exp	3	cr	Polit. Sys	3	cr.			

D. Major requirements (total credits): 81 cr.

MA145	4	cr.	MN324	3	cr.	EP100	1	cr.
MA244	4	cr.	MN412	3	cr.	MN260		cr.
MA345	3	cr.	EP240	4	cr.	or CS155	3	
MA350	3	cr.	EP261	3	cr.	or CS177		
MA523	3	cr.	EP361	3	cr.	EG201*	1	cr.
PH230/030	5	cr.	IM301	3	cr.	EG506*	3	cr.
PH231/031	5	cr.	IM313	3	cr.	EG492*	3	cr.
MN120	3	cr.	IM315	3	cr.	ET304	3	cr.
MN170	3	cr.	IM411	3	cr.			
MN203	3	cr.	IM417	3	cr.			

* It is proposed that there be a new subject code EG (for Industrial & Systems Engineering) with three new courses, as outlined in Appendix B.

E. Free elective credits (sum of C, D, & E should equal A): 0

F. Requirements for thesis, internship or other capstone experience: UI410 or UI450 3 cr., MN412 3 cr.

G. Any unique features such as interdepartmental cooperation: Department of Physics/Eng. Physics (21 cr.) Department of Mathematics (22 cr.)

6. Program Characteristics and Performance Goals: For collaborative programs, responsibility for program evaluation and assessment rests with the institution(s) granting the degree(s).

Form PG
PROGRAM CHARACTERISTICS AND PERFORMANCE GOALS

Institution Name: Southeast Missouri State University

Program Name: Bachelor of Science in Industrial & Systems Engineering

Date: Fall 2016

(Although all of the following guidelines may not be applicable to the proposed program, please carefully consider the elements in each area and respond as completely as possible in the format below. Quantification of performance goals should be included wherever possible.)

Student Preparation

- Any special admissions procedures or student qualifications required for this program which exceed regular university admissions, standards, e.g., ACT score, completion of core curriculum, portfolio, personal interview, etc. Please note if no special preparation will be required.
  Response: No special preparation will be required.

  Characteristics of a specific population to be served, if applicable
  Response: Individuals seeking formal education and training to pursue careers in Industrial & Systems Engineering.

Faculty Characteristics

- Any special requirements (degree status, training, etc.) for assignment of teaching for this degree/certificate.
  Response: In the Department of Polytechnic Studies, there are four faculty members (tenured or tenure track) with Ph.D. degrees from Industrial & Systems Engineering programs. The new EGxxx courses will be taught by these faculty members. Other faculty members in Polytechnic Studies, and the faculty members in Computer Science and Mathematics, have different levels of experience related to Industrial & Systems Engineering. They also have appropriate degrees and training in their respective areas of expertise in order to teach their respective supporting courses for this program.

- Estimated percentage of credit hours that will be assigned to full-time faculty. Please use the term "full-time faculty" (and not FTE) in your descriptions here.
  Response: It is anticipated that a majority of the courses in the major (i.e. more than 90%) will be taught by full-time faculty.

- Expectations for professional activities, special student contact, teaching/learning innovation.
  Response: As expected of all faculty members at Southeast, faculty teaching in the proposed program will have expectation for professional development activities to keep them current in their respective fields of expertise.

Enrollment Projections

- Student FTE majoring in program by the end of five years:
  Response: FTE=20

- Percent of full-time and part-time enrollment by the end of five years:
  Response: Full Time=90%; Part Time=10%.

Student and Program Outcomes

- Number of graduates per annum at three and five years after implementation:
  Response: 3 Yr. = 1
  5 Yr. = 5

- Special skills specific to the program:
  The student outcomes of the Industrial & Systems Engineering program is that upon graduation students will be able to have:
  (a) an ability to apply knowledge of mathematics, science, and engineering.
  (b) an ability to design and conduct experiments, as well as to analyze and interpret data within the industrial & systems engineering domain.
  (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
  (d) an ability to function on multidisciplinary teams.
  (e) an ability to identify, formulate, and solve engineering problems within the industrial & systems engineering domain.
  (f) an understanding of professional and ethical responsibility as an Industrial & Systems Engineering professional.
  (g) an ability to communicate effectively.
  (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
  (i) a recognition of the need for, and an ability to engage in, life-long learning.
  (j) a knowledge of contemporary issues.
  (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

- Proportion of students who will achieve licensing, certification, or registration:
  Response: N/A

- Performance on national and/or local assessments, e.g., percent of students scoring above the 50th percentile on normed tests; percent of students achieving minimal cut-scores on criterion-referenced tests. Include expected results on assessments of general education and on exit assessments in a particular discipline as well as the name of any nationally recognized assessments used.
  Response: N/A

- Placement rates in related fields, in other fields, unemployed:
  Response: Related Field=95% and Other Fields=5%

- Transfer rates, continuous study
  Response: N/A

Program Accreditation

- Institutional plans for accreditation, if applicable, including accrediting agency and timeline. If there are no plans to seek specialized accreditation, please provide reasons.
  Response: The program will seek accreditation from ABET (the Accreditation Board for Engineering and Technology) that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that the program meets the quality standards established by the profession for which the program prepares its students. Since the ABET evaluation criteria cover graduation requirements, career advice, etc., Southeast will apply for accreditation after the first graduation, which is expected in Fall 2019.

Alumni and Employer Survey

- Expected satisfaction rates for alumni, including timing and method of surveys
  Response: Surveys will be conducted on graduates within three months of graduation from the fall and spring terms, requesting their input, among other things, on their satisfaction with the quality of the program. This will be followed up by an every three year survey of these graduates to assess the effectiveness of the program in preparing them for their careers.

- Expected satisfaction rates for employers, including timing and method of surveys.
  Response: Surveys will be conducted on employers of graduates every three years requesting their input on quality of the program and its graduates. The Southeast Polytechnic Studies Advisory Committee that meets twice per year will also provide input during the meetings.

7. Accreditation: If accreditation is not a goal for this program, provide a brief rationale for your decision. If the institution is seeking program accreditation, provide any additional information that supports your program.
Response: The program will seek accreditation from ABET (the Accreditation Board for Engineering and Technology) that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. The program will demonstrate that it satisfies the following General Criteria for Baccalaureate Level Programs: Students, Program Educational Objectives, Student Outcomes, Continuous Improvement, Curriculum, Faculty, Facilities, and Institutional Support.

8. Institutional Characteristics: Please describe succinctly why your institution is particularly well equipped or well suited to support the proposed program.
Response: The Department of Polytechnic Studies is well suited to provide the Bachelor of Science in Industrial & Systems Engineering degree because of the excellent faculty and facilities associated with the department, as well as faculty and facilities in the collaborating departments. In addition to this, the majority of the courses associated with the proposed program (except for the three new additional courses) are currently available and being offered at the university.

9. Any Other Relevant Information:
Response: None

Appendix A

Program Requirements with Course Names

Department of Polytechnic Studies
Program Proposal for
BS DEGREE IN INDUSTRIAL & SYSTEMS ENGINEERING

University Studies (55 Credit Hours)

UI100 First Year Seminar	3
EN100 English Composition	3
CH185/085/005 General Chemistry	5
MN220 Engineering Economic Analysis	3
SW207 Social Systems	3
Artistic Expression	3
Literary Expression	3
Oral Expression	3
Written Expression	3
Behavioral Systems	3
Living Systems	3
Political Systems	3
Development of a Major Civilization	3
UI3xx	3
UI400 Business and Ethics	3
UI410 IET Senior Capstone	3
MA140 Analytic Geometry and Calculus I	5

Major Courses (81 Credit Hours)

MA145	Analytic Geometry and Calculus II	4
MA244	Analytic Geometry and Calculus III	4
MA345	Linear Algebra	3
MA350	Differential Equations I	3
MA523	Probability and Statistics I	3
PH230/030	General Physics I	5
PH231/031	General Physics II	5
MN120	Fundamentals of Engineering Design Processes	3
MN170	Engineering Materials and Testing	3
MN203	Engineering Materials and Processes I	3
MN324	Mechanical Design Processes	3
MN412	Advanced Manufacturing Systems	3
EP240	Circuit Analysis	4
EP261	Engineering Mechanics Dynamics	3
EP361	Thermal Analysis	3
IM301	Industrial Safety and Supervision	3
IM313	Facilities Planning	3
IM315	Work Measurement and Ergonomics	3
IM411	Statistical Quality Control	3
IM417	Manufacturing Resources Analysis	3
MN260	Technical Computer Programming Applications	
or CS155	or Computer Science I	3
or CS177	or Programming for Scientists and Engineers	
EP100	Physics and Engineering Concepts	1
EG506	Operations Research	3
EG201	Systems Engineering	1
EG492	Modeling and Simulation (co-listed with IM692)	3
ET304	Fundamentals of Programmable Logic Controllers	3
	Sub-total of core hours	**81**

Appendix B

New Industrial & Systems Engineering Courses

Industrial & Systems Engineering Core Courses

October 24, 2014

On the pages that follow there are outlines for three proposed new courses:

EG506	Operations Research
EG201	Systems Engineering
EG492	Modeling and Simulation

[Note: The registrar has said that the EG prefix has not been used to date and can be used here.] Also included is a table mapping these courses to the Industrial & Systems Engineering education outcomes.

Among the steps involved in developing those courses and the rest of the proposed Industrial & Systems Engineering curriculum:

- Research into existing undergraduate industrial & systems engineering programs
- Phone conversations and email exchanges with several of the "Top 10" universities in preparing Industrial & Systems Engineering professionals
- Meeting with Southeast's new Polytechnic Studies Advisory Board on October 9, 2014

Specific References:

- Institute of Industrial Engineering (IIE) Training Center Classroom Courses (http://www.iienet2.org/IIETrainingCenter/details.aspx?id=36324)
- *Optimization in Operations Research.* Rardin, R. L. (1998). New Jersey: Prentice Hall.
- Email with University of Arkansas Industrial Engineering faculty – October 1, 2014
- Rough draft of notes from Polytechnic Studies Advisory Board meeting – October 9, 2014

Program Student Outcomes

The program educational outcome of the Industrial & Systems Engineering program is that upon graduation students will be able to have:

(a) an ability to apply knowledge of mathematics, science, and engineering.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data within the industrial & systems engineering domain.
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
(d) an ability to function on multidisciplinary teams.
(e) an ability to identify, formulate, and solve engineering problems within the industrial & systems engineering domain.
(f) an understanding of professional and ethical responsibility as an Industrial & Systems Engineering professional.
(g) an ability to communicate effectively.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
(i) a recognition of the need for, and an ability to engage in, life-long learning.
(j) a knowledge of contemporary issues.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Map of Industrial & Systems Engineering New Courses to Program Educational Outcomes

Industrial & Systems Engineering Program Educational Outcome	a	b	c	d	e	f	g	h	i	j	k
EG506 Operations Research	X	X	X		X			X	X		X
EG201 Systems Engineering	X	X	X	X		X	X	X	X	X	X
EG492 Modeling and Simulation	X	X	X		X		X	X		X	X

Program Educational Objectives

The objectives of the Industrial and Systems Engineering program are to produce graduates who (3-5 years after graduation) :

- Are recognized as significant contributors in their companies or post-undergraduate institutions.
- Continue to pursue advanced professional degrees, engineering certification, and/or other educational experiences.
- Are expected to meet the challenges of the contemporary professional practices as managers and leaders in industrial engineering organizations, society, and their communities.

EG201 Systems Engineering

Department: Polytechnic Studies **Course No.:** EG201
Title of Course: Systems Engineering **Revision:** New

Catalog Description and Credit Hours of Course:
This course is intended to introduce the students to the systems engineering process used to create multidisciplinary solutions to complex problems which have multiple, often conflicting objectives. The course will provide an overview of systems thinking process in the context of large-scale systems, with examples taken from a wide range of application areas. (1 credit hours)

Prerequisites: MN220

Proposed Introduction Date: Fall 2015

Purposes of the Course:
Upon completion of this course, the student should be able to:

1. Understand systems engineering as an interdisciplinary process.
2. Develop a systems engineering plan for a realistic project.
3. Demonstrate the value of systems concepts in the development of products, processes, and services.
4. Describe the key areas and activities in systems engineering process and management.
5. Apply systems engineering tools to realistic problems.
6. Know how to proactively design for and manage system lifecycle targets.
7. Formulate an effective plan for gathering and using data.
8. Understand system engineers' role and responsibilities.

Student Learning Outcomes:

1. Students will be able to describe the components of the systems engineering concepts.
2. Students will be able to demonstrate the application of systems engineering to practical problems.
3. Students will be able to describe the system life-cycle process and the major techniques in that process.

Course Content or Outline:

Topic	Hours
Course Intro / Systems Engineering and the World of Modern Systems	2
Systems Engineering Landscape	1
Structure of Complex Systems	1
The System Development Process	1
Systems Engineering Management	1
Needs Analysis	1
Concept Exploration	1
Concept Definition	1
Decision Analysis and Support	1
Advanced Development	1
Software Systems Engineering	1
Engineering Design	1
Integration and Evaluation	1
Production, Operation and Support	1

Textbook(s) and/or Other Required Materials or Equipment:
Alexander Kossiakoff, William N. Sweet, Sam Seymour and Steven M. Biemer. *Systems Engineering Principles and Practice (2nd Edition)*. Published by John Wiley and Sons, 2011. ISBN 9780470405482

EG506 Operations Research

Department: Polytechnic Studies
Title of Course: Operations Research

Course No.: EG506
Revision: New

Catalog Description and Credit Hours of Course:
This course provides Operations Research (OR) methods to formulate, analyze, and solve mathematical models that represent real-world problems. Being able to solve the real life problems and obtaining the right solution requires understanding and modeling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. (3 credit hours)

Prerequisites: MA 345& MN 260 & MA 523

Proposed Introduction Date: Fall 2015

Purposes of the Course:
Upon completion of this course, the student should be able to:

1. Formulate a real-world problem as a mathematical programming model.
2. Implement and solve the model in EXCEL and LINDO.
3. Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
4. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness.
5. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
6. Solve specialized linear programming problems such as the transportation and assignment problems.
7. Solve network models such as the shortest path, minimum spanning tree, and maximum flow problem.

Student Learning Outcomes:

1. Students will be able to identify opportunities for optimization and formulate the mathematical model.
2. Students will be able to use the appropriate method to solve the optimization model and interpret the results.
3. Students will be able to identify the basic mathematical logic underlying programming techniques.

Course Content or Outline:

Topic	Hours
Introduction to Linear Programming	5
Simplex Method for Linear Programming	5
Interior Point Method for Linear Programming	4
Duality Theory and Sensitivity Analysis	6
The Transportation and Assignment Problems	5
Network Optimization Models	5
Integer Programming	5
Decision Analysis	5
Queueing Theory	5

Textbook(s) and/or Other Required Materials or Equipment:
"Introduction to Operations Research," by Fredrick S. Hiller and Gerald J. Lieberman 9th edition, Copyright 2010 (ISBN 0073376299, publisher: McGraw-Hill).

EG492 Modeling and Simulation

Department: Polytechnic Studies
Course No.: EG492
Title of Course: Modeling and Simulation
Revision: New

Catalog Description
This course emphasizes the development of modeling and simulation concepts and analysis skills necessary to design, program, implement, and use computers to solve complex systems/products analysis problems. (3 credit hours)

Prerequisites: MA523

Objectives of the Course:
1. To introduce the development of computer simulation and modeling systems using commercially viable software to support and automate business decision making.
2. To enable students to acquire an understanding of the basic concepts and skills associated with computer simulation and modeling, decision theory and modeling of business decisions.

Students Learning Outcomes:
Students will:
1. Apply probabilistic models in modeling real world systems.
2. Implement a simulation of a real world model using commercially viable software.
3. Analyze probabilistic distribution of data generated from the simulation model and correlate it to real world data.

Course Content or Outline:

Topic		Hours
1.	Review of Probability and Statistics	3
2.	Queuing Theory	3
3.	Random Numbers and random number generation	5
4.	Queuing models	6
5.	Statistical Models	3
6.	Input Modeling	6
7.	Simulation Software	6
8.	Verification and Validation of Simulation Models	4
9.	Output Data Analysis	6
10.	Optimization of Simulation Models	3
11.	Manufacturing System Simulation	5

Textbook and Other Required Materials or Equipment:
Simulation Modeling and Analysis with Arena, By Tayfur Altiok (Author), Benjamin Melamed (Author)
Simulation Modeling and Analysis, By Averill M Law (Author), W David Kelton (Author)