Form 8A

State University of New York

Out-of-State and International Academic Program Proposal Form

(Full Form)

I. Policy

This form should be used by SUNY institutions required to obtain SUNY System Administration authorization to offer a credit-bearing academic program that leads to a degree or certificate at a location outside New York State. Such programs are not required to be registered by the New York State Board of Regents, but they are subject to approval by the SUNY Board of Trustees under Trustees' Resolution 2011-021.

Academic programs subject to Trustees' Resolution 2011-021 are those that:

1. Are credit-bearing;
2. Lead to a degree or certificate;
3. Enroll students in a location outside New York State; and
4. Reflect a registered program offered by the SUNY institution in New York State.

Board policy applies to academic programs that are stand-alone programs as well as programs offered through partnerships with other institutions, such as multi-institution programs, dual-degree programs, certain articulation agreements, and other partnership arrangements that deliver SUNY credit at a location outside NYS and result in the award of an academic degree or certificate. As a general rule, institutions should not expand internationally if the program is:

1. Seeking initial specialized/programmatic accreditation; or
2. Registered with restrictions or progress reports due to the New York State Education Department.

If the same out-of-state or international program is offered at multiple locations, each location is considered a separate program.

This form **does not** apply to study abroad programs that are already approved by SUNY, to articulation agreements where no SUNY credit is delivered at the out-of-state location, or to academic programs registered in New York State that are delivered entirely by distance education to individual students who are not enrolled as part of an out-of-state or international partnership agreement.

For programs involving an articulation agreement with an international partner whereby 50% or more of the total number of credits toward the degree or certificate are transferred to the SUNY institution from an overseas entity, the International Academic Program Proposal for Articulation Agreements with Partner Institutions (Short Form) and procedures described therein must be followed. (Articulation agreements with international partners involving less than 50% of the total number of credits transferred to the SUNY institution are not subject to review or approval.)

Version 2013-10-15

An out-of-state or international program must not be advertised or enroll students until SUNY has approved it, unless the program was offered prior to spring 2012 and is covered by the Policy Transition Plan.

II. Procedures

The institution's Chief Academic Officer submits a Program Announcement form (PA for undergraduate programs) or a Letter of Intent (LI for graduate programs) with a cover letter to: program.review@suny.edu and follows the same process that is used for new programs planned for New York State. Once the PA or LI process is completed, the Chief Academic Officer emails a completed version of this form, and all required attachments, to the same email address, along with a cover letter from the institution's Chief Academic Officer to the SUNY Provost for review and approval by the Provost's Office and the Office of International Programs. Part A, Item B-1, Part C and Part D of this form are required for all proposed programs. Items B-2 and B-3 are only required when a proposed location has not already received SUNY's approval. It is recommended that prior to submitting the PA/LI form, notice be provided to the SUNY Senior International Officers' listserv early in the program development stage to minimize duplication of effort.

Part A. Basic Program Information

ITEM	RESPONSE *(Type in requested information.)*
A-1. Program Type (check one)	__ General academic program __Program prepares teachers or educational leaders for certification in New York State _X_ Program prepares graduates for professional licensure in New York State
A-2. Home Institution Name and Address	Binghamton University 4400 Vestal Pkwy E Binghamton, NY 13902 (607) 777-2000
A-3. Program Title	Industrial and Systems Engineering
A-4. Program Award(s)	Bachelor of Science, Master of Science, Doctor of Philosophy
A-5. Total Number of Credits	127 credits for BS degrees 30 credits for MS degrees 24 credits of coursework for PhD degrees in addition to credits for research/dissertation
A-6. Registered Program at Home Institution *(The out-of-state program proposed in Items A-3 should be the same as this registered program.)*	a. Title: Industrial and Systems Engineering b. Award: Bachelor of Science, Master of Science, Doctor of Philosophy c. SED Program Code 21827, 82485, 32144 d. HEGIS Code 0913.00
A-7. Program Format	*Check all that apply.* [X]Day [ ]Evening [ ]Weekend [ ]Evening/Weekend [ ]Distance Education [X]Full-Time [ ]Upper Division
A-8. Program Mode	[X]Standard [ ]Independent Study [ ]Accelerated

	_Credit by Exam or Experience
A-9. Language(s) of Instruction (if other than English)	Not applicable.
A-10. Preferred Start Date	Fall 2018
A-11. Home Institution President or Chief Administrative Officer Approval *Signature affirms that the proposal has met all applicable campus administrative and shared governance procedures for consultation.*	Name: Harvey Stenger, Ph.D. Title: President Signature: Date:
A-12. Contact for This Proposal	Name: Peter J. Partell, Ph.D. Title: Associate Dean, Academic Affairs & Administration Telephone: 607-777-6212 E-mail: partell@binghamton.edu

Part B. Out-of-State or International Location
If this is the institution's first program submitted for this location, complete all items (B-1 through B-3) in Part B. If SUNY System Administration has previously approved a program at this location, skip Items B-2 and B-3 and go to Part C.

ITEM	RESPONSE (Type in requested information.)
B-1. Out-of-State Location Where Program Will Be Delivered	Street Address: SUNY Korea, 119 Songdo Moonwha-ro, Yeonsu-Gu City: Incheon State, Territory, Country: Korea 21985
B-2. Authorization(s) to Offer the Program in the Out-of-State Jurisdiction *(as applicable)*	(*The proposed location has already received SUNY's approval, and has been established*.)
B-3. Administrative and Governance Capacity	(*The proposed location has already received SUNY's approval*.)

Part C. Partnership Entities

ITEM	RESPONSE (Type in requested information.)
C-1. Out-of-State Partner Entity *(Enter NONE for "Entity Name" if no partner is involved.)*	Entity Name: SUNY Korea Address: SUNY Korea, 119 Songdo Moonwha-ro, Yeonsu-Gu, Incheon, Korea 21985 Type of Institution: __ Public _X_ Private __ Proprietary __ Non-degree __ Other (describe)
C-2. Evidence of Partner Entity's Quality	SUNY Korea is approved and accredited by the Ministry of Education (MOE) by the Korean government. In addition, SUNY operations at the SUNY Korea campus have been approved by the SUNY Board of Trustees.
C-3. Agreements with Out-of-State Partner Entity *(All agreements must be in English. See NOTE with examples of issues to be covered in partnership agreements.)*	The SUNY Korea, LLC, has signed a general memorandum of understanding with Binghamton University.

NOTE: Examples of issues for inclusion in partnership agreements:

1. *Primary contacts for agreement*
2. *Signatures of both parties demonstrating agreement with the terms*
3. *Curriculum for this program with each partner's role in delivering coursework specified*
4. *Modifications to agreements*
5. *Responsibility for obtaining required authorizations and complying with legal requirements including taxes, employment visas and benefits, banking, etc.)*
6. *Responsibility for marketing and advertising*
7. *Guidelines for proper use of both the SUNY and the campus name, including logos and related identifiers.*
8. *Ownership and maintenance of equipment*
9. *Catalog or comparable information for students*
10. *Student admissions, orientation and advising*
11. *Student suspension, withdrawal, dismissal*
12. *Tuition and fees and all other student charges*
13. *Expected numbers of students*
14. *Language(s) of instruction and assessment of students' language proficiency*
15. *Student housing*
16. *Responsibility for transcripts and students' academic records*
17. *Immigration issues*
18. *Employment agreements (terms, conditions, taxes, benefits)*
19. *Monetary exchanges between partners (Be very specific about who pays for what.)*
20. *Facilities (purchase, lease) and all related issues (taxes, health and safety, etc.)*
21. *Liability, claim, loss, damage, suit, judgment arising from acts of employees and no right of liability regarding agreement itself*
22. *Insurance*
23. *Jurisdiction for dispute resolution*
24. *Non-discrimination*
25. *Time period of agreement and renewal*
26. *Emergency and evacuation plans*
27. *Exit strategy if plans do not materialize, including teach-out agreements for enrolled students*

Part D. Program Details

D-1. Program Description

a. Describe the program and its purpose, including its educational and career goals and objectives.

The Department of Systems Science and Industrial Engineering (SSIE) at Binghamton University is proposing to offer its Bachelor of Science, Master of Science, and Doctor of Philosophy degrees in Industrial and Systems Engineering alongside other previously established programs being offered on the campus of SUNY Korea.

Industrial and systems engineering gives practitioners the opportunity to work in a variety of businesses. Professionals working in this field manage the five M's – manpower, money, materials, methods, and machines. Industrial and systems engineers work to reduce waste and optimize processes in virtually any system. Regardless of industry, industrial and systems engineers improve quality through reduction of errors and increasing efficiencies. Industrial and systems engineers enable companies to adopt management philosophies of continuous productivity and quality improvement to survive in the increasingly competitive world market.

Industrial and systems engineers figure out how to do things better. They work to eliminate waste of time, money, materials, energy and other commodities. This is why many industrial and systems engineers end up being promoted into management positions. Industrial and systems engineering is not only about manufacturing. It also encompasses service industries, with many industrial and systems engineers employed in entertainment industries, shipping and logistics businesses, and healthcare organizations.

Industrial and systems engineers make processes better in the following ways:

- More efficient and more profitable business practices
- Better customer service and product quality
- Improved efficiency
- Increased ability to do more with less
- Making work safer, faster, easier, and more rewarding
- Helping companies produce more products quickly
- Making the world safer through better designed products
- Reducing costs associated with new technologies

The mission of the Department of Systems Science and Industrial Engineering is:

- *To educate students at the undergraduate and graduate levels in systems science, industrial engineering and systems engineering,*
- *To advance the state of scientific and technical knowledge through basic and applied research,*
- *To provide technical support for the economic development of the State of New York, and*
- *To provide service to the university, the public, and the professional community.*

The undergraduate Program Educational Objectives (or PEOs) of the industrial and

systems engineering program are designed to prepare our graduates in the following ways. Within a few years of graduation, graduates will accomplish the following objectives of:

1. designing, developing, and managing both deterministic and nondeterministic complex processes and systems involving people, information, equipment, and financial and material assets, with special emphasis on using probabilistic methods, design of experiments, and simulation.
2. joining and contributing to industrial, government, and service organizations, and to operate effectively with a high level of professional and ethical standards.
3. independent learning, acquiring professional certifications and/or advanced degrees in reputable graduate schools in manufacturing, service, and enterprise systems.
4. communicating and contributing effectively in a diverse team environment.

Undergraduate ISE Student Outcomes that students are expected to know and be able to do by the time of graduation include:

a. an ability to apply knowledge of mathematics, science, and engineering to Industrial and Systems Engineering problems.
b. an ability to design and conduct experiments, as well as to analyze and interpret data.
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 multi-disciplinary teams.
e. an ability to identify, formulate, and solve engineering problems.
f. an understanding of professional and ethical responsibility.
g. an ability to communicate effectively, both orally and in writing, and the ability to use multi-media tools.
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.

At the MS level, students are expected to embody the expectations listed above, as well as to apply ISE methods to advanced problems, conduct research, and effectively communicate their findings.

Students at the MS level will be expected to present evidence of the following Student Learning Outcomes (SLOs):

- SLO 1: Students will be able to apply engineering mathematics and fundamental SS/ISE methods. This is measured through:
    - Achievement of identified Primary Educational Objectives (PEOS) in core courses. Students' performance will be evaluated by key questions or projects related to PEOs.
    - Successful completion of core SS/ISE graduate coursework.
    - Post-MS defense self-assessment surveys.
- SLO 2: Students will be able to apply SS/ISE methods to advanced problems in

their area of specialization. This is measured through:
    - Acceptance of the MS thesis/project.
    - Post-MS defense self-assessment surveys.
- SLO 3: Students will be able to effectively communicate research findings. This is measured through:
    - Acceptance of the MS thesis/project.
    - Post-MS defense self-assessment surveys.

Students at the PhD level share all the same expectations, but are also required to be able to identify a substantial open research problem in a specialized discipline within ISE, propose a sound methodology to address that problem, and effectively write and present any resulting technical documentation of their findings.

Students at the PhD level will be expected to present evidence of the following Student Learning Outcomes (SLOs):

- SLO 1: Students will be able to apply engineering mathematics and fundamental systems science/industrial and systems engineering concepts and methods. This is measured through:
    - Success of the PhD Qualifying Exam as evaluated by Dissertation Committee.
    - Students' underlying performance will be evaluated by SSIE Graduate Level GPA in relevant courses.
- SLO 2: Students will be able to apply specialized methods to advanced problems in their specialization. This is measured through:
    - Submitted PhD Prospectus.
    - Students' performance will be evaluated by Graduate Level GPA in specialized coursework.
- SLO 3: Students will be able to identify a substantial open research problem in the field and propose a sound research methodology to address that problem. This is measured through:
    - Success of the PhD Dissertation as evaluated by Dissertation Committee.
    - Post-Defense Assessment Surveys.
- SLO 4: Students can effectively write technical documents and make technical presentations. This is measured through:
    - Submitted PhD Dissertations & Defenses.
    - Post-Defense Assessment Surveys.

b. Provide a catalog description of each course required for completion of the program, and complete the Curriculum Chart (Table 1) at the end of this form to show, as applicable, general education courses (by category) and liberal arts and sciences courses, as well as external instruction, such as internships and clinical experiences. Note which courses, if any, will differ from those offered on the home campus and provide reasons for the differences.

The undergraduate and graduate courses offered in SUNY Korea will share the same catalog description and contents as offered by the home department. A curriculum chart for the BS-ISE program is provided in Table 1. Course descriptions of undergraduate courses offered at Binghamton University are provided in **Appendix I** at the end of this proposal. **Appendix II** provides MS and PhD requirements, along with course descriptions for all graduate courses.

Complete the Curriculum Chart (Table 1) at the end of this form.

D-2. Mission

a. Explain how this program contributes to the home institution's mission, strategic plan and reputation.

The establishment of this program is consistent with Binghamton University's strategic plan to achieve its goal of becoming the premier public university of the 21st century. Strategic priority IV in this plan is "Enhance the University's economic, social and cultural impact through engagement from the local to the global level." This program in Korea would establish a major global presence of the university.

Binghamton University's addition to this standing relationship currently maintained within SUNY is well-aligned with Binghamton University's Strategic Plan (or "Road Map"), which includes the following Strategic Priorities:

- **Engage in path-breaking graduate education, research, scholarship and creative activities that shape the world.**
- The premier public university of the 21st century will provide a transformative learning community that prepares students for advanced education, careers and purposeful living.
- Unite to foster a diverse and inclusive campus culture.
- **Enhance the University's economic, social and cultural impact through engagement from the local to the global level.**
- Optimize the acquisition and allocation of human, technological, financial and physical resources.

Expanding Binghamton University's existing program to offer availability in SUNY Korea, as well as building a bridge for cultural exchange between the universities through which students from either country may have access to study in the partner country, surely supports these strategic aims and fosters a more globally-informed education.

b. Explain how this program contributes to the State University of New York's mission, strategic plan and reputation.

The SUNY Korea program has been approved by SUNY, and is consistent with its missions, 2020 strategic plan, and promotion of its reputation overseas. The establishment of SUNY Korea was approved by SUNY Board of Trustees (BOT), led by the Stony Brook University (see Appendix III). As stated earlier, the offering of the aforementioned ISE degree programs at the SUNY Korea global campus is consistent with the SUNY 2020 plan, focusing on education and research, with a strategic plan outlined specifically to expand the presence of SUNY and Binghamton University and its degree programs overseas.

D-3. Market

a. **Need.** Provide evidence that there is a market for this program. Include descriptions of sources of evidence.

SUNY Korea, located in the Incheon Free Economic Zone (IFEZ), is at the center of Asian region and the Pacific Rim, both geometrically and economically. Within 3.5 hours of

Incheon by air, it encompasses a region in which 1/3 of the world's population lives. In addition to students in South Korea, many other students from the 3.5-hour region are prospective students of SUNY Korea. Furthermore, SUNY Korea is the first American university in South Korea, offering Stony Brook University degrees, and has attracted students from India, China, the United States, Chile, and Vietnam in addition to South Korea. Since Stony Brook University does not have an industrial and systems engineering program, they have approached the Department of Systems Science and Industrial Engineering at Binghamton University to participate in this effort to promote SUNY at the global level. According to market analysis, there is evidence of need for industrial and systems engineering programs at SUNY Korea.

b. **Coordination.** If other SUNY campuses offer similar programs in the same geographic region, please identify those campuses and programs, explain why you have concluded that this program is not duplicative or redundant, and attach letters of support demonstrating that the other campuses agree with your conclusion.

As stated in section D-3.a, this is not applicable as this will be the only industrial and systems engineering program available at SUNY Korea. Stony Brook University approached Binghamton University to offer industrial and systems engineering at SUNY Korea as industrial and systems engineering is not presently an offering within their programs. Furthermore, a memorandum of understanding was signed between Binghamton University and SUNY Korea to foster this arrangement on June 30, 2015, in a ceremony that was attended by representatives from Stony Brook University.

c. **Marketing and Advertising.** Explain how prospective students will learn about this program and its admissions and graduation requirements.

SUNY Korea conducts recruitment in various countries in Asia, Africa, South America, the United States, and other regions, and also promotes the new campus jointly with Binghamton University, which has an excellent worldwide reputation for its research, education and academic programs. The web site (www.sunykorea.ac.kr) is available to all. Information sessions held in Seoul, Korea, attract parents and students to promote its degree programs and excellent facilities. Students learn of the programs, admissions and graduation requirements through its websites and recruitment meetings, as well as through personal inquires via email or telephone. The admissions and graduation requirements are the same as those at the Binghamton University. Students are admitted by Binghamton University admissions staff/faculty (undergraduate level) or Graduate School (graduate level) in consultation with the faculty (undergraduate and graduate directors) of the home department. In addition, the global campus at Songdo and IFEZ are also promoting the global universities in Songdo, including SUNY Korea.

d. **Projected Enrollment.** In the table below, provide projected enrollment (number of headcount students) for both full-time and part-time students and explain how the projections were determined.

Projections in the table below are based off the trajectory of growth seen in previously established programs on the SUNY Korea campus, as well as reported demand for ISE and inquiries for such programs received by SUNY Korea personnel. It is anticipated, given the success of other programs and the amount of regional interest received by SUNY Korea recruiters, that growth of the ISE programs will be at least equivalent to the other program offerings at SUNY Korea.

Projected Number of Out-of-State or International Students		
Number of Students	**When the program begins**	**After five years**
Full-time UG students:	80	320
Part-time UG students:	--	--
Full-time GD students:	10	35
Part-time GD students:	--	--
Total students:	90	355

e. **Risk Analysis.** Explain factors that could reduce demand for this program and describe plans for responding to below-expected enrollment, including teach-outs of enrolled students if the program proves to be unsustainable.

It is expected that the BS degree will take 4 years to complete, whereas the MS degree will require 1.5-2 years, and the PhD will require 3-4 years or more with completion of the prior degrees. One risk is not being able to reach the target enrollment. SUNY Korea and Binghamton University will collaborate closely in recruiting and advertising to attract students to apply for admission. Based on the experience of the Technology and Society Management Bachelor's degree program, which started in March 2013, and Mechanical Engineering and Computer Science programs of Stony Brook University, which started in August 2014 and February 2015 respectively, we believe the risk of the new ISE programs' failure to be minimal. In addition, the Technology and Society Management undergraduate degree program has been able to admit students of higher quality on average, compared to the department at Stony Brook University in 2013-2014. The Computer Science and Mechanical Engineering degree programs of Stony Brook University, which are also being offered at SUNY Korea, are experiencing similar growth in enrollment. As SUNY Korea's name becomes better known, we expect to be able to attract high-quality students with sufficient numbers to fill the roster. The growth in enrollment of the existing programs at SUNY Korea is consistent with the initial projections. Preliminary market analysis causes us to expect similar results for enrollment in industrial and systems engineering through Binghamton University.

If there comes a point when the degree programs are not sustainable financially, liability for the venture (enrollments, tenure, etc.) ultimately resides with the SUNY Korea, LLC. This structure has been approved by the SUNY Korea Board of Trustees. However, in protection of the students in the case that the ISE program in SUNY Korea ever be discontinued, all students in the degree programs will be eligible to change campuses to attend Binghamton University's Department of Systems Science and Industrial Systems Engineering in Binghamton, N.Y., to finish their degrees. Students not wishing to physically travel to the United States could also be supported via the department's distance education program. Since the SUNY Korea students have been admitted by Undergraduate/Graduate Admissions on the home campus with the same standards and qualifications, such transfer to Binghamton University will not be an issue. If they are not willing to transfer to the US campus, our faculty and staff at SUNY Korea will help them, to their best ability while abiding by the policy of the Ministry of Education (MoE) and NYS, to transfer to other institutions in South Korea and the US.

D-4. Quality

a. **Faculty Responsibility.** Describe the home campus faculty's role in planning for this program at this location.

The proposal is prepared by the Department of Systems Science and Industrial Engineering in collaboration with the Thomas J. Watson School of Engineering and Applied Science on the home campus, with approval of the faculty body in the department. Such action toward approval followed lengthy discussion and multiple visits by senior faculty of the department and Watson School to the host campus at SUNY Korea. The submission of this proposal was also vetted through the process of approval by the University Faculty Senate and the Graduate Council. A program chair, residing in Songdo-Incheon, will be dispatched from the home department to be in charge of the degree programs, ensuring the quality of research, education and courses taught by faculty, as well as the integrity of the Binghamton University degrees. Faculty at SUNY Korea will include those from the home department in the US and qualified faculty recruited specifically for this program.

b. **Admissions.** Describe the admissions requirements and procedures for this program and how they differ, if at all, from requirements at the home campus. Explain how prospective students will be assessed for proficiency in the language(s) of instruction, including, as applicable, language proficiency exams and cut scores that will be used, and how they will be used.

The admission decisions are done by the Undergraduate/Graduate Admissions office/faculty in the home campus at Binghamton University with the same standards for quality and requirements for proficiency in English. This process is identical to the current practice of undergraduate/graduate admissions at Binghamton University.

c. **Academic and Student Support Services.** Describe the academic and student support services available to help students succeed in this program, and how these services will be made available to all students enrolled at this location.

SUNY Korea has established an infrastructure for academic affairs, advising, student affairs, and other student services to help students succeed in the academic programs. The chairperson and faculty in SUNY Korea will provide appropriate academic guidance for students to progress in the program and graduate. During the one year when the undergraduate students are at Binghamton University in New York or graduate students may attend campus for research or coursework, the Academic Advising Staff at the Thomas J. Watson School of Engineering and Applied Science, and faculty advisors in the home department, including the Department Chair and Undergraduate/Graduate Program Directors, will provide appropriate academic guidance and advising.

d. **Library Resources.** Describe the library resources for this program and how these resources will be made available to all students enrolled at this location.

SUNY Korea students have access to the online library resources at Binghamton University. A plan is in progress for the Incheon Global Campus Foundation (IGCF) and IFEZ to make local e-library subscription for all global universities, including SUNY Korea.

e. **Facilities.** Describe the instructional and related facilities, as well as equipment, that will be used for this program to ensure its success.

Korean government, through the Ministry of Trade, Industry and Economy (MOTIE), IFEZ,

the City of Incheon, and IGCF, as well as SUNY Korea, provide resources for equipment and maintenance of the campus facility.

While students are in residence at Binghamton University in New York, they will have access to facilities and equipment on the home campus, including but not limited to instructional and research labs, library resources, study spaces and common areas.

f. **Program Accountability, Assessment and Accreditation.** List the student learning outcomes for this program at this location and describe how they will be assessed as an integral part of the home campus's program review and evaluation process, which must meet the standards of SUNY policy and the Middle States Commission on Higher Education (MSCHE) for assessment of general education and the disciplines. If the registered program at the home campus is accredited by a specialized or programmatic accreditation agency, indicate when that accreditation is expected to apply to this location.

Since the same curriculum and degree programs are offered, the program accountability, assessment and accreditation follow those at Binghamton University.

MSCHE conducted a site visit in May 2011 and subsequently approved SUNY Korea as an "additional location" of Stony Brook University. SUNY Korea was then included in the MSCHE accreditation visit of Stony Brook University in 2014. As addition of an industrial and systems engineering program will constitute a substantive change to MSCHE, another site visit will be scheduled to allow review of the program.

The steps above were pursuant to the greater SUNY system authorizing Stony Brook University the ability to take necessary actions to institute their academic programs at SUNY Korea, per the enclosed letter and SUNY Board of Trustees Resolution 075 dated May 12, 2009 (**Appendix III**). Binghamton University has been invited by Stony Brook University to join operations at SUNY Korea and will continue to collaborate in preparation for the offering of ISE programs. Binghamton University will work with Stony Brook University to schedule a site visit with the Middle States accrediting agency regarding Binghamton University's intent to offer ISE degree programs at the SUNY Korea campus.

The Industrial and Systems Engineering BS degree program is accredited by the Engineering Accreditation Commission (EAC) of ABET, Inc. The program is accredited through September 2019.

After consulting with ABET, we have decided that we will pursue separate ABET accreditation for the BS program offered at SUNY Korea. This means that the ABET accreditation for Binghamton University's BS ISE program in SUNY Korea will undergo a site visit and self-study report that is separate from any site visits or self-study reports pertaining to the main campus, although the primary educational objectives and student learning outcomes will be the same. In keeping with ABET requirements, we will pursue this accreditation after the first class graduates from SUNY Korea circa 2023.

The Watson School will keep close contact with ABET regarding the process of accreditation to ensure compliance with ABET policy and regulation. Specific to the undergraduate program, The Watson School will coordinate with the ABET accrediting agency to ensure continued compliance.

Program Objectives and Student Outcomes:

The Department of Systems Science and Industrial Engineering (SSIE) at Binghamton University is proposing to offer its Bachelor of Science, Master of Science, and Doctor of Philosophy degrees in Industrial and Systems Engineering degree with the same primary educational objectives and student outcomes at SUNY Korea.

The undergraduate Program Educational Objectives (or PEOs) of the industrial and systems engineering program are designed to prepare our graduates in the following ways. Within a few years of graduation, graduates will accomplish the following objectives of:

1. designing, developing, and managing both deterministic and nondeterministic complex processes and systems involving people, information, equipment, and financial and material assets, with special emphasis on using probabilistic methods, design of experiments, and simulation.
2. joining and contributing to industrial, government, and service organizations, and to operate effectively with a high level of professional and ethical standards.
3. independent learning, acquiring professional certifications and/or advanced degrees in reputable graduate schools in manufacturing, service, and enterprise systems.
4. communicating and contributing effectively in a diverse team environment.

Undergraduate ISE Student Outcomes that students are expected to know and be able to do by the time of graduation include:

l. an ability to apply knowledge of mathematics, science, and engineering to Industrial and Systems Engineering problems.
m. an ability to design and conduct experiments, as well as to analyze and interpret data.
n. 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.
o. an ability to function on multi-disciplinary teams.
p. an ability to identify, formulate, and solve engineering problems.
q. an understanding of professional and ethical responsibility.
r. an ability to communicate effectively, both orally and in writing, and the ability to use multi-media tools.
s. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
t. a recognition of the need for, and an ability to engage in, life-long learning.
u. a knowledge of contemporary issues.
v. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

At the MS level, students are expected to embody the expectations listed above, as well as to apply ISE methods to advanced problems, conduct research, and effectively communicate their findings.

Students at the MS level will be expected to present evidence of the following Student Learning Outcomes (SLOs):

- SLO 1: Students will be able to apply engineering mathematics and fundamental

SS/ISE methods. This is measured through:
    - Achievement of identified Primary Educational Objectives (PEOS) in core courses. Students' performance will be evaluated by key questions or projects related to PEOs.
    - Successful completion of core SS/ISE graduate coursework.
    - Post-MS defense self-assessment surveys.
- SLO 2: Students will be able to apply SS/ISE methods to advanced problems in their area of specialization. This is measured through:
    - Acceptance of the MS thesis/project.
    - Post-MS defense self-assessment surveys.
- SLO 3: Students will be able to effectively communicate research findings. This is measured through:
    - Acceptance of the MS thesis/project.
    - Post-MS defense self-assessment surveys.

Students at the PhD level share all the same expectations, but are also required to be able to identify a substantial open research problem in a specialized discipline within ISE, propose a sound methodology to address that problem, and effectively write and present any resulting technical documentation of their findings.

Students at the PhD level will be expected to present evidence of the following Student Learning Outcomes (SLOs):

- SLO 1: Students will be able to apply engineering mathematics and fundamental systems science/industrial and systems engineering concepts and methods. This is measured through:
    - Success of the PhD Qualifying Exam as evaluated by Dissertation Committee.
    - Students' underlying performance will be evaluated by SSIE Graduate Level GPA in relevant courses.
- SLO 2: Students will be able to apply specialized methods to advanced problems in their specialization. This is measured through:
    - Submitted PhD Prospectus.
    - Students' performance will be evaluated by Graduate Level GPA in specialized coursework.
- SLO 3: Students will be able to identify a substantial open research problem in the field and propose a sound research methodology to address that problem. This is measured through:
    - Success of the PhD Dissertation as evaluated by Dissertation Committee.
    - Post-Defense Assessment Surveys.
- SLO 4: Students can effectively write technical documents and make technical presentations. This is measured through:
    - Submitted PhD Dissertations & Defenses.
    - Post-Defense Assessment Surveys.

g. **Financial Resources.** Explain how revenues will be adequate to cover the expenses of this program so that the program is self-sustaining. New York State funds must not be used to support academic programs conducted outside of New York State. Then complete Table 2 (expenses), Table 3 (revenue), and Table 3a (tuition rates

and fees) to summarize your analysis. Attach a spreadsheet with itemized details for Table 2.

The financial resources come from the tuition revenue generated by the academic offerings at SUNY Korea. NYS funds will not be used to support academic programs in SUNY Korea. Refer also to Tables 2 and 3.
Complete Tables 2, 3 and 3a at the end of this form.

h. **Faculty Qualifications.** Describe how faculty at this location will be hired and supervised. In addition, complete Table 4 to identify all faculty who will be teaching in this program. Part A is for faculty employed at the home institution; Part B is for faculty employed by a partner entity.

Dr. Nagen Nagarur (Professor of Systems Science and Industrial Engineering at Binghamton University) will be appointed as program chair by the home department to reside in SUNY Korea. He will be in charge of the academic operations, the academic degree program in SUNY Korea, and work with the home department on the admissions, degree auditing, academic advising, and budget planning. All faculty hired and supervised for SUNY Korea will have to go through the same recruiting process with a faculty committee at the home department to ensure the quality of the faculty hired to conduct research and to teach at SUNY Korea. The tenure process for SUNY Korea faculty has been carefully considered and discussed at the home campus, including within the Faculty Senate Executive Committee and other governing bodies. Although tenure for SUNY Korea faculty will be with SUNY Korea (not Binghamton University), the initiating personnel committee (IPC) for each tenure case will be formed by the home department at Binghamton University. The primary difference in case processing for SUNY Korea will be that the finalized case and recommendations will proceed from the Watson Dean's Office to the SUNY Korea President and Board of Managers of the SUNY Korea, LLC, consisting of the SUNY Chancellor designee, Provost of Stony Brook University, and deans of relevant academic units (as opposed to the BU UPC and BU Provost). Final decisions on tenure reside with the SUNY Korean President and the SUNY Korea, LLC.
Complete Table 4 at the end of this form.

Attach CVs for all faculty to be employed by the partner institution. CVs must be provided in English.

Table 1 – Curriculum Chart for the Out-of-State Program (BS Industrial and Systems Engineering Program)

FALL 1										SPRING 1									
Course Offering	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**	**Course Offering**	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**
MATH	224/225	4	M	X	X					MATH	226/227	4	M	X	X				
ISE	211	4			X					ISE	212	4			X				
WTSN	111	2			X					WTSN	112	2			X				
WTSN	103	2	BC	X	X					WTSN	104	2	BC	X	X				
PHYS	131	4	NS	X	X					ME	273	3			X				
Body/Wellness	(Y,S,B)	1	X			X													
	Total Credits	**17**									**Total Credits**	**15**							

FALL 2										SPRING 2									
Course Offering	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**	**Course Offering**	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**
Gen Ed Elective	(G,P A,N,H)	4	AH	X						Gen Ed Elective	(G,P,A,N,H)	4	H	X					
Gen Ed Elective	(G,P,A,N,H)	4	SS	X						Gen Ed Elective	(G,P,A,N,H)	4	AR	X					
PHYS	132	4	NS	X	X					Gen Ed Elective	(G,P,A,N,H)	4	OW	X					
MATH	324	4	M	X	X					CHEM or BIO		4	NS	X	X				
ISE	295	1			X					Body/Wellness	(Y,S,B)	1	X			X			
	Total Credits	**17**									**Total Credits**	**17**							

FALL 3										SPRING 3									
Course Offering	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**	**Course Offering**	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**
ISE	311	4			X					ISE	314	4			X				
MATH	304	4	M	X	X					ISE	362	4		X	X				
ISE	231	4			X					ISE	321	4			X				
ISE	261	4		X	X					ISE	320	4			X				
	Total Credits	**16**									**Total Credits**	**16**							

FALL 4										SPRING 4									
Course Offering	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**	**Course Offering**	**Course Number**	**Cr**	**GE**	**LA**	**M**	**RE**	**E**	**N/R**	**Instructor**
ISE	370	4			X					Tech Elec #1**	(ISE,ME,EECE,CS,BE)	3				X			
ISE	420	4			X					Tech Elec #2**	(ISE,ME,EECE,CS,BE)	3				X			
ISE	391	4			X					Tech Elec #3**	(ISE,ME,EECE,CS,BE)	3				X			
ISE	363	4			X					ISE	492	4			X				
	Total Credits	**16**									**Total Credits**	**13**							

CREDIT SUMMARY (*for undergraduate programs only)

General Education*	54
Liberal Arts and Sciences	60
Major or Concentration	109
Required Electives/Electives	11
Upper Division*	57
Total	**127**

****All Technical Electives are from courses that are 300-level or above in the specified majors.**

Key to Table 1

Cr = Credits (insert # of credits),

GE = General Education

- insert abbreviation indicating SUNY-GER category as follows: Mathematics (M), Natural Sciences (NS), Social Science (SS), American History (AH), Western Civilization (WC), Other World Civilizations (OW), Humanities (H), The Arts (AR), Foreign Language (FL), Basic Communication (BC)
- insert "x" for any courses that satisfy a campus-based general education requirement that does not count toward the SUNY-GER

LA = Liberal Arts & Science offering (insert "x" for any course that is deemed to be a liberal arts and science offering)

M = Major (insert "x" for any course that is required as part of the major program)

RE = Required Elective (insert "x" for any elective which, though not considered part of the major program, is required of students seeking to complete the major)

E = Elective (insert "x" for any elective course that would count toward graduation but not toward the major or general education)

N/R = New or Significantly Revised (insert "x" for any major or required elective courses that are new or have been significantly revised in connection with the proposed program). **All new or significantly revised courses must be approved at the home institution before being included in an out-of-state program.**

Table 2 – Projected Expenses for the Out-of-State or International Program

Complete Table 2 to show all expenses related to the program.

As stated earlier, the financial resources to support the program come from the tuition revenue generated by the academic offerings at SUNY Korea. NYS funds will not be used to support academic programs at SUNY Korea. The following table shows the projected expenses specifically for the Industrial and Systems engineering programs at SUNY Korea.

Table 2 – Projected Program Expenses (in US Dollars)			
Projected Expenses	**Start-up**	**When the program begins**	**After five years**
Personnel *(Include all personnel related expenses, such as salaries, fringe benefits and other related costs such as taxes, retirement contributions, workers' compensation insurance, and unemployment insurance.)*	$100,000	TBD in consultation with SUNY Korea	TBD in consultation with SUNY Korea
Library	$20,000	$5,000	$2,000
Equipment and Laboratories	$550,000	$25,000	$25,000
Facilities *(Include all facilities-related expenses, such as capital investments, debt repayment, leases, upkeep and maintenance, and liability insurance.)*	0	0	0
Other Operating Expenses *(Include all other expenses here, including travel and home campus administration.)*	TBD in consultation with SUNY Korea	TBD in consultation with SUNY Korea	TBD in consultation with SUNY Korea
TOTAL:	TBD	TBD	TBD

Attach a spreadsheet that itemizes each expense item included in Table 2.

Table 3 and Table 3a - Projected Revenue/Resources and Tuition/Fee Rates for the Out-of-State Program

In Table 3, list all sources of revenue for the program. New York State funds shall not be used for out-of-state programs.

SUNY Korea has provided the following Financial Plan Summary for all programs.

Financial Plan Summary

SUNY Korea 2017~2026

(Version: 4--21- -2016; Update of existing degrees with the new BS--BE--MS--PhD degrees)

Academic Year -> Projected Revenue & Expense	2017		2018		2019		2020		2021	
Revenues:										
Tuition (Graduate MS&PhD)		2,563,680		3,501,893		4,473,730		4,372,123		4,118,107
Tuition (Undergraduate/BS&BE)		4,894,240		8,541,390		15,793,807		21,587,834		22,820,335
SUNY Korea Language Institute		500,000		550,000		550,000		605,000		605,000
SUNY Korea Other Programs		200,000		220,000		242,000		266,200		292,820
SUNY Korea Donation/Advancement		250,000		275,000		302,500		332,750		420,000
Total Revenues		**8,407,920**		**13,088,283**		**21,362,036**		**27,163,907**		**28,256,263**
Expenses:										
Salaries Expense										
Faculty	4,416,268		6,730,687		9,402,734		10,461,366		10,836,919	
Administration	985,264		1,055,640		1,256,446		1,353,096		1,543,013	
Total Salaries Expense		5,401,532		7,786,327		10,659,180		11,814,462		12,379,932
Supplies Expense										
Educational Supplies*	70,000		70,000		120,000		120,000		150,000	
Office Supplies	20,000		20,000		60,000		60,000		80,000	
Telephone	20,000		20,000		80,000		80,000		90,000	
Postage	15,000		15,000		60,000		60,000		80,000	
Total Supplies Expense		125,000		125,000		320,000		320,000		400,000
Travel Expense		100,000		100,000		200,000		225,000		225,000
Recruiting & Marketing		120,000		100,000		150,000		150,000		175,000
SGUF Rent and Fee (per capita) Δ		0		0		0		460,031		477,367
SGUF Maintenance Fee (per capita) ΔΔ		0		0		0		442,217		458,882
Scholarship & Student Assistantship		671,213		722,597		2,432,104		3,115,195		4,848,920
Operation & Administrative Expenses										
Legal Fees & Operational Insurance**	174,579		220,433		302,675		359,600		369,384	
Less due to student exchange ***	293,654		722,597		1,216,052		1,557,597		1,616,307	
Programs & adm. increased duty§	1,021,469		1,575,720		2,569,818		3,257,884		3,376,158	
LLC Corporate Insurance	50,000		50,000		50,000		50,000		50,000	
Total Ops/Adm expenses		1,539,702		2,568,750		4,138,546		5,225,081		5,411,849
US Academic Expense										
Faculty & Staff at Stony Brook and Binghamton	1,516,078		1,465,418		1,577,937		1,602,652		1,729,190	
IT & Other capital	30,000		30,000		30,000		80,000		80,000	
Training/travel	30,000		30,000		45,000		65,000		80,000	
Total US Academic Expense		1,576,078		1,525,418		1,652,937		1,747,652		1,889,190
SUNY Korea Language Institute Ops expenses	297,500		280,000		350,000		385,000		385,000	
SUNY Korea Other Programs Ops expenses	50,000		55,000		60,500		66,550		73,205	
Total Ops/Adm expenses (IEC + Other Programs)		347,500		335,000		410,500		451,550		458,205
Total Expenses		9,881,025		13,263,092		19,963,268		23,951,187		26,724,344
Net Income		-1,473,105		-174,809		1,398,769		3,212,720		1,531,919
Other deficit (e.g., interest-free loan)										
Add: Korean Government Support		0		0		0		0		0
Net Surplus/Loss		**-1,473,105**		**-174,809**		**1,398,769**		**3,212,720**		**1,531,919**

** Educational materials for classrooms and consumables for teaching laboratories*

*** This includes attorney fee & an insurace requested by the Korean law. The premium is negotiated with an insurance company. It is an expense item in the "Operation & Administrative Expenses".*

**** An estimate based on the number of students who want to study (exchange) on home campus for one semester during their MS degree program; PhD students are required to go to home campus for at least one year.*

§ Adjustment for degree programs and administrative overload including: Graduate School, Registrar, TLT, DoIT, Library

Δ SGUF Rent and Fee is calculated at $833.33 per capita of student enrolled in SUNY Korea, starting in 2019

ΔΔ SGUF Maintenace Fee is calculated at $801.59 per capita of student enrolled in SUNY Korea with annual inflation of 2%, starting in 2019

In Table 3A, indicate the tuition and fee rates used to calculate tuition revenue above. Tuition rates should correspond to those adopted by the SUNY Board of Trustees, unless SUNY has approved a discounted tuition rate for part-time, non-matriculated, out-of-state students according to University policy at http://www.suny.edu/sunypp/documents.cfm?doc_id=391 (and in Memorandum to Presidents 98-01).

SUNY Korea tuition rates are set by SUNY Korea, LLC in keeping with SUNY Board of Trustees policies. SUNY Korea students pay the equivalent of SUNY Non-resident Tuition. New York State residents enrolling at SUNY Korea pay SUNY Resident Tuition.

Table 4 – Faculty

Provide information on all faculty members who will be teaching in the program. Part A is for faculty employed by the home institution; Part B is for faculty employed by a partner entity. If a faculty member is "To Be Hired" indicate "TBH" under the "Faculty Member Name" column and provide the rank and qualifications for the hire. Out-of-state and international faculty degrees must be comparable to degrees for faculty in New York State. Insert additional rows as needed.

Part A. Faculty Employed by the Home Institution					
Faculty Member Name, Rank, Title *(Include and identify Program Director with *)*	**Full-time (FT) or Part-Time (PT)**	**Program Courses to be Taught**	**Percent Time Dedicated to the Program**	**Highest and Other Applicable Earned Degrees & Disciplines** *(Include the conferring college or university.)*	**Additional Qualifications:** List related certifications/ licenses, occupational experience, scholarly contributions, etc.
Nagendra Nagarur*	FT	ISE 311 Enterprise Systems ISE 320 Optimization & Operations Research ISE 363 Quality Engineering ISE 370 Industrial Automation ISE 391 Systems Engineering Design ISE 492 Systems Design Project SSIE 510 Enterprise Systems	100%	Ph.D., Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University, Blacksburg, U.S.A., 1988. M.S., Industrial Engineering, Wichita State University, U.S.A.,1980. B.TECH., Chemical Engineering, Regional Engineering College, Warangal, India,1976.	Lean Six Sigma Green and Black Belt Instructor
Mohammad Khasawneh	PT	ISE 211 Engineering Economics ISE 231 Human Factors	15%	Ph.D., Industrial Engineering, Clemson University, 2003 M.S., Mechanical Engineering, Jordan	Chancellor's Award for Excellence in Teaching (2010-2011) Outstanding Graduate Director (2014-2015)

				University of Science & Technology, 2000 B.S., Mechanical Engineering, Jordan University of Science & Technology, 1998	
Mark Poliks	PT	ISE 261 Probabilistic Systems I ISE 295 Engineering Seminar ISE 362 Probabilistic Systems II & DOE	20%	Ph.D., Materials Science & Engineering / Polymer Science, The University of Connecticut, 1987 M.S., Polymer Chemistry, University of Massachusetts, 1983 B.S., Chemistry and Mathematics (both with honors), University of Massachusetts, 1982	
Daryl Santos	PT	ISE 420 Optimization & Operations Research II SSIE 505 Applied Probability & Statistics SSIE 553 Operations Research SSIE 561 Quality Assurance for Engineers	20%	PhD, Industrial Engineering, University of Houston, 1993 MS, Industrial Engineering, University of Houston, 1990 BS, Operations Research & Industrial Engineering, Cornell University, 1987	Vice Provost for Diversity Chancellor's Award for Excellence in Scholarship and Creative Activities (2011) Chancellor's Award for Excellence in Teaching (2005)
Sang Won Yoon	PT	ISE 212 Engineering Computing ISE 314 Computer Program for Engineers ISE 321 Modeling and Simulation SSIE 520 Modeling and Simulation	20%	Ph.D., Industrial Engineering, Production, Robotics, and Integration Software for Manufacturing & Management (PRISM) Center, Purdue University, 2009	

				M.S., Operation & Management Engineering. Artificial Intelligence & Statistics Lab, Korea University, 2001 Bachelor in Industrial Engineering, Chonbuk National University, 1998	
Part B. Faculty Employed by a Partner Institution (as applicable)					
Name of Partner Institution:					
Faculty Member Name, Rank, Title *(Include and identify Program Director with *)*	**Full-time (FT) or Part-Time (PT)**	**Program Courses to be Taught**	**Percent Time Dedicated to the Program**	**Highest and Other Applicable Earned Degrees & Disciplines** *(Include the conferring college or university.)*	**Additional Qualifications:** List related certifications/ licenses, occupational experience, scholarly contributions, etc.
(*FT Faculty hire at SUNY Korea to be conducted after the approval of Ministry of Education to start this degree program*)		(*will be determined in conjunction with the qualification and needs*)			
Will be hired by SUNY Korea					
Will be hired by SUNY Korea					
Will be hired by SUNY Korea					

Appendix I: List of Undergraduate Industrial & Systems Engineering Courses Descriptions

Appendix II: Graduate program requirements and course descriptions

Contents:

- Requirements for Master of Science in Industrial and Systems Engineering
- Requirements for Doctoral Program in Industrial and Systems Engineering
- Complete Listing of Graduate Courses

Appendix III: Additional Supporting Documentation

Contents:

- SUNY Board of Trustees Resolution 075 regarding SUNY Korea

APPENDIX I:

COMPLETE LISTING OF UNDERGRADUATE COURSES:

ISE 211 Engineering Economics
The fundamentals of engineering economy are introduced in this course. Topics covered include time value of money, equivalence, cash flows all at varying interest rates and points of time. The factors commonly used in industry for economic evaluation of alternatives are introduced and applied in this course. The analysis includes both a before tax and after tax evaluation of competing investment alternatives. 4 credits

ISE 212 Engineering Computing
The objectives of the course are to: demonstrate the ability to design systems for automating processes in manufacturing, demonstrate problem-solving skills in automation, and to demonstrate the skill of using the LabVIEW and MATLAB software packages. Prerequisite: WTSN 104/112 or consent of department chair. 4 credits

ISE 231 Human Factors
Review of the concepts involved in the application of scientific principles, methods, and history to the development of engineering systems in which people play a significant role. Primary focus is on the man/machine interface and how to design for the human being as part of an overall system. Prerequisite: MATH 222 or consent of department chair. 4 credits

ISE 261 Probabilistic Systems I
This course provides an introduction to probability models and statistical methods most likely to be encountered and used by students in their careers in engineering and the natural sciences. This introduction will emphasize, from the outset, that variation is the source from which all statistical methodology flows. Discussion includes the practical aspects of data collection and descriptive statistics with an introduction to the basic concepts of probability theory and probability distributions, correlation, point estimation, confidence intervals, and test of hypothesis. Prerequisites: WTSN 104/112 or consent of department chair. 4 credits

ISE 295 Seminar Course
Development of the non-technical skills essential to effective engineering. Focus is on the overview of ISE curriculum and review of technical elective options. Review of internships, resume building, issues relevant to careers in ISE (e.g., typical tasks done by ISEs) are explored. Discussion and exploration of opportunities within program. Prerequisite: WTSN 104/112. 1 credit

ISE 311 Enterprise Systems
Course introduces the concepts, design and planning of operating systems, with particular emphasis on manufacturing systems. Topics include introduction to lean manufacturing, JIT, Kanban, value stream mapping, standard times, MRP, inventory control, etc. The course includes plant tours to local industries that practice the concepts of the Toyota production system. Prerequisite: ISE 364 or consent of department chair. 4 credits

ISE 312 Manufacturing Systems - elective
This course has three main areas of focus: production and inventory control, planning and design of manufacturing facilities, and understanding the physical fundamentals of processes and is designed mainly for engineering students intent on following an engineering career in a manufacturing industry. This course covers the models, networking, and systems needed to design and manage a manufacturing enterprise. Topics include facility design and material handling, forecasting techniques, demand

management, economic lot size, inventory management, and scheduling methods. This is considered a technical elective. Prerequisite: WTSN 104/112 or consent of department chair. 4 credits

ISE 314 Computer Program for Engineers
This course provides an introduction to computer programming and its applications for industrial and systems engineering (ISE) students emphasizing modern software engineering techniques in the context of industrial systems. Topics will include the fundamental concepts and applications of computer programming, software engineering, database management, computational problem solving, and statistical techniques for data mining. In this course, programming languages such as Python, VB.Net, or Matlab will be taught along with Excel VBA and SQL. Students will learn how to apply computer-programming techniques to solve different ISE problems. 4 credits

ISE 315 Enterprise Resource Planning - elective
This course introduces the student to the main areas of production, including production planning, control, master scheduling, finance and human resources. It provides a hands on approach to these areas through an Enterprise Resource planning software. Prerequisites: Junior standing in ISE or consent of instructor. 3 credits

ISE 320 Optimization & Operation Research I
Operations research (OR) is devoted to determination of the optimal course of action of a decision problem given resource restrictions. This course primarily covers deterministic optimization and operations research techniques. Following a review of linear algebra, students learn how to mathematically model an engineering problem, how to solve the problem to optimality and how to perform sensitivity analyses on the results. Students learn linear programming (LP), integer programming (IP), branch-and-bound (B and B), and other optimization techniques. Special emphasis on the solution of engineering decision making includes the following areas: transportation models; network models; inventory models; assignment problems; decision making under risk and uncertainty; and game theory. For non-ISE students using this course as an elective for the Sustainability Engineering minor, application of these techniques as applied to decision-making for sustainability are included. Prerequisite: Math 304 or consent of department chair. 4 credits

ISE 321 Modeling And Simulation
Model building, nature of simulation and material on the full range of simulation activities, such as input analysis, output analysis, verification and validation, and model animation. Includes random number generation; distribution functions and random variates; applications of discrete event simulation methods to queueing, inventory control and production planning problems; Markov processes, queueing theory and decision analysis. Prerequisites: ISE 362 and ISE 320 or consent of department chair. 4 credits

ISE 362 Probabilistic Systems II & DOE
Methods of inference involving two independent samples and paired data are presented. The analysis of variance is examined for single-factor and multi-factor experiments. Regression analysis for simple linear models and correlation are discussed followed by non-linear and multiple regression models. A practical, yet fundamental, approach for building quality control charts from statistical concepts, as well as a goodness-of-fit test for testing discrete and continuous underlying distributions, are reviewed. Prerequisites: ISE 261 Probabilistic Systems I or consent of department chair. 4 credits

ISE 363 Quality Engineering
Learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed. Topics include the principles of experiment design, analysis of variance, completely randomized designs, randomized block designs, other blocking configurations, general full factorial, 2k, 3k full factorial and fractional factorial designs. Blocking and confounding in a factorial experiment and alias phenomena in a fractional factorial experiment will be emphasized. Prerequisite: ISE 362 or consent of department chair.

4 credits

ISE 370 Industrial Automation
Industrial automation is a major field in the application of computer controls and the many advances in computer systems. The objectives of this course are to: demonstrate the ability to design systems for automating processes in manufacturing, demonstrate problem-solving skills in automation, and safely use the machines in the engineering laboratory to complete designed experiments. Lectures and laboratories include exploring the use of sensors, industrial robotics, numerical control, programmable logic controllers, machine vision, electrical circuits and the fundamentals of common electrical devices, fuzzy control, the implementation of online computer control, and the ability to use industrial technical software including Pro-Engineer and AutoCAD. Laboratory work and technical reports are required. Prerequisites: ISE 212 or consent of department chair. 4 credits

ISE 391 Systems Design
Covers the design process from the definition of requirements through the final output. Focus is on the design principles and design methodologies used to ensure a quality outcome. Prerequisite: ISE 320 or consent of department chair. 4 credits

ISE 415 Operations Management Supply Chains – elective
Course deals with management of supply chains, in particular, with the operational aspects. A broad overview of supply chains of a company is introduced, together with performance measures and needed critical success factors. The course concentrates on supplies, inventories, manufacturing, and logistics of distribution. Managerial aspects as well as mathematical modeling for better planning and control will be covered. This course is considered a technical elective for undergraduate students. Prerequisite: ISE 311 and ISE 320 or consent of department chair. Cross-listed with SSIE 515. 3 credits

ISE 418 Collective Dynamics of Complex Systems - elective
Introduces students to the study of collective dynamics demonstrated by various natural, social and artificial complex systems, i.e., systems made of a massive amount of lower-level components interacting with each other in a nonlinear way. Discusses several computational modeling frameworks, including agent-based models (particle models, ecological and evolutionary models, game-theoretic models), complex network models (small-world and scale-free networks, dynamical networks, adaptive networks), and spatial models (cellular automata, partial differential equations). Also discusses mathematical concepts and tools to analyze and understand their behavior, e.g., mean-field approximation, linear stability analysis, scaling, renormalization, bifurcation, chaos, pattern formation, and phase transition. Python will be used as a primary computer programming language for modeling and simulation. Prior computer programming experience is helpful, but not strictly required. Cross-listed with SSIE 523. 3 credits

ISE 419 Applied Soft Computing – elective
Covers relatively new approaches to machine intelligence known collectively as ""soft computing"". Introduces various types of fuzzy inference systems, neural networks, and genetic algorithms, along with several synergistic approaches for combining them as hybrid intelligent systems. Emphasis is on applications, including modeling, prediction, design, control, databases and data mining. This course is considered a technical elective for undergraduate students. Prerequisites: Basic knowledge of calculus and discrete mathematics and competence in at least one programming language, or consent of department chair. Cross-listed with SSIE 519. 3 credits

ISE 420 Optimization & Operations Res II
Operations research (OR) is devoted to the determination of the optimal course of action of a decision problem given resource restrictions. This course is intended as a second course in an Optimization and OR sequence and builds upon the material presented in ISE 320. ISE 320 primarily restricts attention to deterministic OR models. In addition to covering additional deterministic techniques (e.g., deterministic

dynamic programming and additional inventory problems not covered in ISE 320, among others), ISE 420 covers probabilistic and advanced OR topics such as Monte Carlo simulation, fundamentals of queueing theory, probabilistic dynamic programming, and others. The course also introduces the student to emerging optimization techniques including, but not limited to, tabu search, simulated annealing, and genetic algorithms. Prerequisite: ISE 320 or consent of department chair. 4 credits

ISE 434 Fundamentals of Health Systems – elective

One of the growing systems in our society is that of the healthcare delivery system. The purpose of this course is to introduce the concepts behind the healthcare delivery systems and to focus upon the systems improvement or continuous improvement techniques available for complex systems. Topics would include improvement to, and problems with: organizational structure, managing change, the financial structure, the responsibility structure, quality data and implications of quality measures, use of clinical decision support systems and the caregiver's role in the system. There will also be a focus upon suppliers to the healthcare delivery system and the unique requirements placed upon their products and processes. This course is considered a technical elective for undergraduate students. Prerequisite: ISE 311 or consent of department chair. Cross-listed with SSIE 534. 3 credits

ISE 437 Industrial & Systems Engineering in Healthcare - elective

Introduction to health systems and healthcare delivery. The application of industrial and systems engineering principles to continuous process improvement in the healthcare domain will be studied. Concepts that will be addressed will include, but not be limited to, process mapping, optimization, scheduling, lean and flexible systems, quality enhancement, simulation, supply chain management, inventory control, and information management. The course is considered a technical elective for undergraduate students. Prerequisites: ISE 311 or consent of department chair. Cross-listed with SSIE 537. 3 credits

ISE 439 Human Factors Engineering in Health – elective

This course introduces and emphasizes the role that human factors engineering/ergonomics plays in healthcare systems, with a focus on its applications to help improve quality, safety, efficiency, and effectiveness of patient care. Focused topics include human factors in workflow models; work system design for patient safety; human error analysis/taxonomies to reduce medical errors; task analysis and data collection methods in healthcare environments; clinical staff workload and patient safety; physical ergonomics in healthcare and human performance modeling; and diffusion and adoption of technology in healthcare, with emphasis on the usability and design of medical devices and information systems. Prerequisite: ISE 311 or consent of department chair. Cross-listed with SSIE 539. 3 credits

ISE 440 Intro to Systems Science – elective

Includes the following: a general characterization of systems science as a field of study; intellectual roots, philosophical assumptions and historical development of the field; an overview of fundamental systems concepts, principles and laws; and a survey of application areas of systems science and its implications for other fields of study. This course is considered a technical elective for undergraduate students. Prerequisite: None. Cross-listed with SSIE 501. 3 credits

ISE 462 Cost Estimating for Engineers – elective

Changes in our society have resulted in major changes in manufacturing to the point at which labor costs are no longer the controlling cost, or even the major cost. Major costs have shifted to the material and material-related costs, with the overhead and burden costs almost as significant. While innovative design is critical to engineering, being profitable is also critical, and profit starts with determining the proper costs for a product or idea. Topics include costs of labor, equipment, material, overhead or burden, volume/cost relationships, use rates, collection, build-up of costs, costing of manufacturing operations, standard costs and variances. This course is considered a technical elective for undergraduate students. Prerequisite: ISE 364 or consent of department chair. 3 credits

ISE 463 Project Analysis and Control – elective
Course covers the topics of project planning, economic design making, costing and pricing. The topics include network planning, present worth, annual cost, rate of return, activity based costing, inflation, price change, etc. 3 credits

ISE 464 Elem of Fuzzy Logic & Fuzzy Set Theory – elective
Simple introduction to basic elements of fuzzy logic and fuzzy set theory, including an overview of classical logic and classical set theory. Included are basic concepts and properties of classical sets and fuzzy sets, classical relations and fuzzy relations, classical logic and fuzzy logic, and fuzzy arithmetic. The practical utility of fuzzy logic and fuzzy set theory is illustrated by describing selected applications in various areas of human affairs. This course is considered a technical elective for undergraduate students. Prerequisite: ISE 261 or consent of department chair. 3 credits

ISE 473 Processes for Electronic Manufacturing – elective
The purpose is for the students to gain a broad knowledge and understanding of the basics of printed circuit board manufacturing and assembly. The course offers an introduction to surface mount and insertion mount components, materials and processes as well as to PCB design and manufacturing. Lectures will introduce assembly process flows and component types, PCB construction and defects solder paste printing and equipment, placement processes and equipment, reflow and ovens, flip chip assembly and underfilling, defects and mitigation, reliability optimization and testing. Efforts will be made to include visits to local industrial assembly facilities as well as equipment on campus. The overall goal is to provide the students with a basis for communicating and working with subject matter experts. This course is considered a technical elective for undergraduate students. Prerequisite: None. Cross-listed with SSIE 578. 3 credits

ISE 492 Systems Design Project
The capstone project for the undergraduate degree. Students are expected to work in multi-disciplinary teams to provide solutions through design. Prerequisite: ISE 491 or consent of department chair. 4 credits

ISE 496 Industrial Internship
Special topics in industrial and systems engineering. Credits vary.

ISE 497 Independent Study
Guided independent study under an advisor. Credits vary.

APPENDIX II

Master of Science in Industrial and Systems Engineering (MS ISE)

The Master of Science in Industrial and Systems Engineering provides a balance of theory and practical knowledge for the practice of the profession or for advancement to a doctoral program. In recognition of the high concentration of industry in the Binghamton area, this program has been structured to serve both the full- and part-time graduate students. Taking advantage of this industrial resource allows the program to develop a realistic approach to integrating both engineering and non-engineering systems, such as those found in manufacturing, healthcare, supply chain management, and transportation, using a wide variety of industrial and systems engineering tools, such as modeling and simulation, statistical process control, scheduling, human factors, and optimization, among others.

The academic environment of the department may be enriched by the appointment of adjunct faculty members employed in local industry. Under appropriate circumstances, thesis and/or project activity may be carried out in industrial laboratories.

MS ISE Requirements

Applicants that have already earned a BS degree in engineering or a related field are invited to apply for admission to this program. The Graduate Record Examination (GRE) is required. In addition to the requirements listed below, a student whose undergraduate degree is not in engineering may be required to complete some preparatory study, to be defined by the graduate director based on the candidate's background. The preparatory study does not count toward the graduate degree. The student must maintain at least a B average in all graduate coursework. Plan of study:

- Four required courses:
    - SSIE 505. Applied Probability and Statistics
    - SSIE 510. Enterprise Systems Engineering
    - SSIE 520. Modeling and Simulation
    - SSIE 553. Operations Research or SSIE 561. Quality Assurance for Engineers
- Four additional graduate-level courses from the department, at least one of which must be at the 600 level. Subject to the Director of Graduate Studies approval, the student may elect to substitute up to two graduate-level courses from a non-SSIE department, including those graduate-level courses the candidate may wish to transfer, pending approval, from another institution.
- Either of the following termination requirements:
    - Thesis: Oral presentation and defense of the thesis are required (at least 6 credits — SSIE 599).
    - Non-Thesis: With departmental approval, the thesis requirement may be replaced by one approved elective course and a termination project of at least 3 credits — (SSIE 598).

For students with adequate backgrounds, electives may be substituted for these courses with consent from the advisor and the Director of Graduate Studies.

Health Systems Concentration

The option health systems concentration is geared to prepare professional or leadership roles in the healthcare areas including hospital operations management, health systems engineering, health information technology, and consulting.

In addition to the required courses of all students in the MS ISE program:

- The student must take an additional required "core" course, i.e., SSIE 537 — Industrial and Systems Engineering in Health Care (Note: This reduces the number of electives by one course),
- The thesis or project must be healthcare-related, chosen in consultation with the advisor, and
- The student must take at least one of the approved healthcare-related courses (see below) in consultation with either the advisor or the Director of Graduate Studies.
    - SSIE 530. Healthcare Policy Analysis
    - SSIE 534. Fundamentals of Health Systems
    - SSIE 538. Healthcare Finance & Accounting
    - SSIE 539. Human Factors Engineering in Healthcare
    - SSIE 637. Advanced Topics in Health Systems

Doctoral Program in Industrial and Systems Engineering

The Doctoral Program in Industrial and Systems Engineering offers a wide variety of research topics such as: optimization, human factors/ergonomics, supply chain management, healthcare systems, enterprise systems, intelligent systems, electronics manufacturing processes, particularly in the areas of printed circuit-board production and automated assembly. The PhD requires 24 credits of coursework in addition to credits for research/dissertation.

Minimum Requirements

- Satisfaction of a Learning Contract (described below), including proficiency in teaching and residence requirements
- Satisfaction of comprehensive qualifying requirement
- Presentation of colloquium on proposed research
- Acceptance of prospectus outlining dissertation research
- Submission of dissertation
- Defense of dissertation at oral examination

Guidance Committee

Upon acceptance into a program, students must form an approved guidance committee. The guidance committee consists of three to five members, normally full-time Watson School faculty; however, students may propose members from other schools at Binghamton University, faculty from other universities or professionals from outside academia. The guidance committee must be approved by the Graduate School. The guidance committee advises the student and evaluates and certifies the student’s performance throughout the program of study and research.

Learning Contract

In consultation with the guidance committee, the student prepares a Learning Contract in which a program of study is specified, including the major area of research, additional course requirements, teaching requirement, evaluation procedures and the form of the comprehensive examination. Although the Learning Contract may be modified as the research interests of the student develop, to ensure competence and depth in the major area and breadth in relevant disciplines, each modification must be approved by the guidance committee and properly documented. A copy of the Learning Contract is placed on file within the department. Additional information concerning doctoral students can be found on the websites of the Graduate School and Thomas J. Watson School of Engineering and Applied Science.

THOMAS J. WATSON SCHOOL OF ENGINEERING AND APPLIED SCIENCE
BINGHAMTON UNIVERSITY
DOCTORAL (PhD) PROGRAMS

The Learning Contract: Recommended Format (Sample)

In consultation with the Guidance Committee, the student prepares a learning contract, in which a program of study is specified, including the major area of research, additional course requirements, teaching requirement, evaluation procedures, and the form of the comprehensive examination. Although the Learning Contract may be modified as the research interests of the student develop, to assure competence and depth in the major area and breadth in relevant disciplines, each modification must be approved by the Guidance Committee, and must be properly documented. A current copy of the learning contract is placed on file in the Dean's Office.

The new doctoral student should start to work immediately with the advisor to develop a learning contract. A major purpose of the learning contract is to define the program of study, including the knowledge and skills required to pass the comprehensive examination. The learning contract should identify core courses and concepts which must be mastered in order to provide breadth of background, as well as specialized courses and concepts which are germane to the proposed area of research. The learning contract can be modified at a later date if additional knowledge is required or if the field of research is changed.

The following format is recommended for the Learning Contract:

Title Page

The Learning Contract should have a Title page, including the following information (also see sample on next page):

Thomas J. Watson School of Engineering and Applied Science
(Department Name)
LEARNING CONTRACT

PhD Candidate: (Candidate's name. Leave space for candidate's signature, and date of signature.)

Date of Contract: (Date that Learning Contract is approved by Committee Chairperson)

Degree and Specialization Sought: (Degree and specialization)

Guidance Committee Members: (List the Committee Chairperson, and list the names of all Committee members, including their home department and school. Leave space next to each member's name, for signature, and date of signature. By their signatures, the members of the Guidance Committee approve the learning contract. All Committee members, and the PhD candidate, should sign and date the Learning Contract.)

Major Area of Research

(Description of research area. Typically 2-3 paragraphs.)

Relevant Prior Graduate Coursework

(Prior coursework to be used toward PhD degree. List course names and number of credits for each.)

Course Requirements to be Completed

(Current and future coursework to be used toward PhD degree. List course names and number of credits for each.)

Comprehensive Examination

(Brief description of areas in which the student is to be examined, and the form the examination will take.)

Reading List

(List of books and/or other publications to be used to prepare for the Comprehensive Exam, with titles and authors. The nature and specifics of this list are dependent on the department and guidance committee.)

Teaching Requirement
(Description of how teaching proficiency requirement will be met.)

Progress Evaluation Procedures
(Describe periodic evaluation for meeting the goals of the learning contract.)

Colloquium and Prospectus
(Brief description of how and when the colloquium and prospectus requirements will be met.)
(sample Title Page)

Thomas J. Watson School of Engineering and Applied Science

Department of *Systems Science and Industrial Engineering*

LEARNING CONTRACT

PhD Candidate: _____ _____ _____
Name Signature Date

Date of Contract: _____

Degree and Specialization Sought: *PhD in Industrial and Systems Engineering*

Guidance Committee Members:

Chair:	**Nagen Nagarur**	**SSIE**	_____	_____
	Name	Department	Signature	Date
Member #1:	**Mohammad Khasawneh**	**SSIE**	_____	_____
	Name	Department	Signature	Date
Member #2:	**Mark Poliks**	**SSIE**	_____	_____
	Name	Department	Signature	Date
Member #3:	**Daryl Santos**	**SSIE**	_____	_____
(If Available)	Name	Department	Signature	Date

By their signatures, the members of the Guidance Committee approve this learning contract.

Student Learning Outcomes:

Successful completion of each core curriculum marker is ascertained that at least 50% of students reach 75% performance in each SLO. Additional measurements specific to the MS and PhD programs are included in the sheets that follow.

Samples of the alumni survey included as part of this evaluation are also below (distributed with subject "Response Requested: Alumni Survey").

PhD:

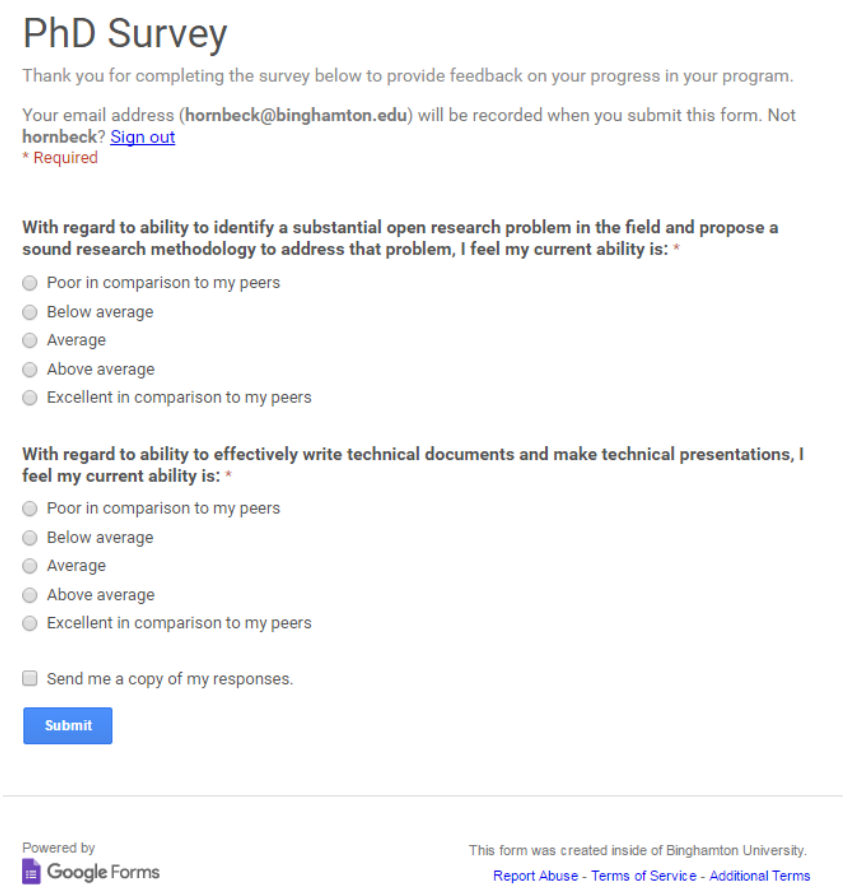
Dear Graduates of the PhD Programs,

Thank you for taking a few moments to complete the survey via the link below:

https://docs.google.com/a/binghamton.edu/forms/d/e/1FAIpQLSdnP6u4vt5rhMCuUzxK1tz8jPO0hEpd4V2fEFI6g7MUCXbLtQ/viewform

Your responses are critical to helping us maintain accreditation (and the overall value) of your degree program. Thank you in advance for your candid responses.

The survey link above leads to a page with the following questions:



PhD Survey

Thank you for completing the survey below to provide feedback on your progress in your program.

Your email address (**hornbeck@binghamton.edu**) will be recorded when you submit this form. Not **hornbeck**? Sign out

* Required

With regard to ability to identify a substantial open research problem in the field and propose a sound research methodology to address that problem, I feel my current ability is: *

- Poor in comparison to my peers
- Below average
- Average
- Above average
- Excellent in comparison to my peers

With regard to ability to effectively write technical documents and make technical presentations, I feel my current ability is: *

- Poor in comparison to my peers
- Below average
- Average
- Above average
- Excellent in comparison to my peers

Send me a copy of my responses.

Submit

Powered by Google Forms

This form was created inside of Binghamton University.

Report Abuse - Terms of Service - Additional Terms

MS:

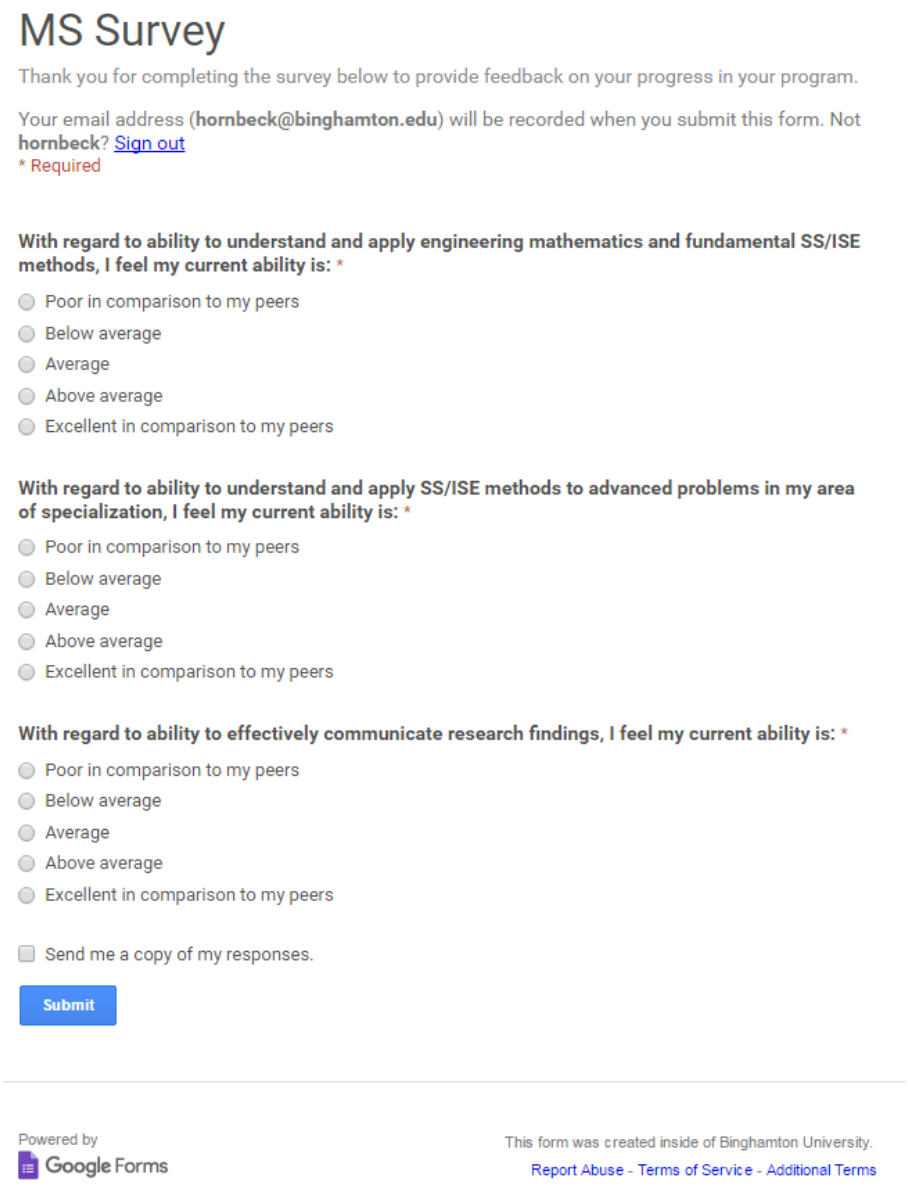
Dear Graduates of the MS Programs,

Thank you for taking a few moments to complete the survey via the link below:

https://docs.google.com/a/binghamton.edu/forms/d/e/1FAIpQLSfy4jn19v_vedrGchXTwDWz3qzSoDlNagxyJU4oSn50Nnh_vA/viewform

Your responses are critical to helping us maintain accreditation (and the overall value) of your degree program. Thank you in advance for your candid responses.

The survey link above leads to a page with the following questions:



MS Survey

Thank you for completing the survey below to provide feedback on your progress in your program.

Your email address (**hornbeck@binghamton.edu**) will be recorded when you submit this form. Not **hornbeck**? Sign out

* Required

With regard to ability to understand and apply engineering mathematics and fundamental SS/ISE methods, I feel my current ability is: *

- Poor in comparison to my peers
- Below average
- Average
- Above average
- Excellent in comparison to my peers

With regard to ability to understand and apply SS/ISE methods to advanced problems in my area of specialization, I feel my current ability is: *

- Poor in comparison to my peers
- Below average
- Average
- Above average
- Excellent in comparison to my peers

With regard to ability to effectively communicate research findings, I feel my current ability is: *

- Poor in comparison to my peers
- Below average
- Average
- Above average
- Excellent in comparison to my peers

☐ Send me a copy of my responses.

Submit

Powered by Google Forms

This form was created inside of Binghamton University.

Report Abuse - Terms of Service - Additional Terms

Student Learning Outcomes Assessment Plan and Report

Academic Department/Program: Systems Science and Industrial Engineering

Program: MS in ISE (thesis/project option)

Learning Outcomes	Supports Learning Goals	Assessment Method/Measure	Achievement Target/Criterion for Success	Types of Assessment	Assessment Results	Action Plans and Follow Up	Evidence of Improvements
SLO 1: Students will be able to apply engineering mathematics and fundamental ISE methods.	Goal 1	Achievement of identified PEOS in core courses. Students' performance will be evaluated by key questions or projects related to PEOs	100% students will score 95 out of 100 points in relevant projects/assignment.	Direct			
		Successful completion of core ISE graduate coursework	100% students in all required graduate courses will achieve ≥3.0 GPA.	Indirect			
		Post-MS defense self-assessment survey	100% of the students will (use the scale here). For example, 100% student will strongly agree/agree that they are able to apply engineering mathematics and fundamental methods.	Indirect			

Student Learning Outcomes Assessment Plan and Report

Academic Department/Program: Systems Science and Industrial Engineering

Program: MS in ISE (thesis/project option)

Learning Outcomes	Supports Learning Goals	Assessment Method/Measure	Achievement Target/Criterion for Success	Types of Assessment	Assessment Results	Action Plans and Follow Up	Evidence of Improvements
SLO 2: Students will be able to apply ISE methods to advanced problems in their area of specialization.	Goal 2	Accepted MS thesis/project	100% of the Student's Thesis/Project will be accepted by MS committee and research advisers.	Direct			
		Post-MS defense self-assessment survey	100% of the students will (use the scale here). For example, 100% student will strongly agree/agree that they are able to apply ISE methods to advanced problems in their area of specialization.	Indirect			
SLO 3: Students will be able to effectively communicate research findings.	Goal 3	Accepted MS project/thesis	100% of the Student's Thesis/Project will be accepted by MS committee and research advisers.	Direct			
		Post-MS defense self-assessment survey	100% of the students will (use the scale here). For example, 100% student will strongly agree/agree that they are able to effectively communicate research findings.	Indirect			

Student Learning Outcomes Assessment Plan and Report

Academic Department: Systems Science and Industrial Engineering

Program: PhD in ISE

Learning Outcomes	Supports Learning Goals	Assessment Method/Measure	Criterion for Success	Types of Assessment	Assessment Results	Action Plans and Follow Up	Evidence of Improvements
SLO 1: Students will be able to apply engineering mathematics and fundamental systems science/industrial and systems engineering concepts and methods.	Goal 1	PhD Qualifying Exam will be evaluated by Dissertation Committee	100% of the candidates will pass the Qualifying Exam.	Direct			
		Students' performance will be evaluated by SSIE Graduate Level GPA in relevant courses	100% of the students in selected courses will have GPA ≥ 3.0.	Indirect			
SLO 2: Students will be able to apply specialized methods to advanced problems in their specialization.	Goal 2	Submitted PhD Prospectus	100% of the candidates will have their PhD prospectuses approved.	Direct			
		Students' performance will be evaluated by Graduate Level GPA in specialized coursework	100% of the students in selected courses will have GPA ≥ 3.0.	Indirect			

Learning Outcomes	Supports Learning Goals	Assessment Method/Measure	Criterion for Success	Types of Assessment	Assessment Results	Action Plans and Follow Up	Evidence of Improvements
SLO 3: Students will be able to identify a substantial open research problem in the field and propose a sound research methodology to address that problem.	Goal 3	Submitted PhD Dissertation will be evaluated by Dissertation Committee	100% of the candidates will pass.	Direct			
		Post-Defense Assessment Survey	100% of the students will (use the scale here). For example, 100% student will strongly agree/agree that they are able to identify a substantial open research problem in the field and propose a sound research methodology to address that problem.	Indirect			
SLO 4: Students can effectively write technical documents and make technical presentations	Goal 4	Submitted PhD Dissertation & Defense	100% of the candidates will successfully pass the PhD defense.	Direct			
		Post-Defense Assessment Survey	100% of the students will (use the scale here). For example, 100% student will strongly agree/agree that they are able to effectively write technical documents and make technical presentations.	Indirect			

COMPLETE LISTING OF GRADUATE COURSES:

SSIE 500, COMPUTATIONAL TOOLS
This course will introduce students to several programming languages and basic programming techniques, with the focus on developing practical code-writing skills for scientific/engineering problem solving. Topics to be covered include: manipulation with numbers, strings, variables, lists, and arrays; creating functions; flow control; data manipulation; imperative, functional, and object-oriented programming; visualization; and presentation. LaTeX will also be introduced for typesetting professional technical documents. This course will also discuss information theory as a sample application area of computational tools. Topics include: information and entropy, mutual information, information coding and compression, Markov information source model, statistical complexity, and computational complexity. Students will write codes in their preferred language to calculate various information theoretic measurements of real-world data. 3 credits

SSIE 501, INTRODUCTION TO SYSTEMS SCIENCE
Includes a general characterization of systems science as a field of study; intellectual roots, philosophical assumptions and historical development of the field; an overview of fundamental systems concepts, principles and laws; and a survey of application areas of systems science and its implications for other fields of study. Cross-listed with ISE 440. 3 credits

SSIE 505, APPLIED PROBABILITY AND STATISTICS
Basic concepts in probability and statistics required in the modeling of random processes and uncertainty. Bayes' formula, Bayesian statistics, independent events; random variables and their descriptive statistics; distribution functions; Bernoulli, Binomial, Hypergeometric, Poisson, normal, exponential, gamma, Weibull and multinomial distributions; Chebyshev's theorem; central limit theorem; joint distributions; sampling distributions; point estimation; confidence intervals; student-t, x squared and F distributions; hypothesis testing; contingency tables, goodness of fit, non-parametric statistics, regression and correlation. Prerequisite: one year of calculus. 3 credits

SSIE 506, SYSTEMS PROBLEM SOLVING
A comprehensive conceptual framework for systems problem solving is introduced. Discusses methods applicable to broad classes of problems. Prerequisite: SSIE 505 or equivalent or consent of instructor. 3 credits

SSIE 510, ENTERPRISE SYSTEM ENGINEERING
Global competition is serving as a catalyst for continuous process improvement and the methodical enhancement of system-wide efficiencies. This is true in disciplines ranging from the medical arena and service related systems to manufacturing. The underlying science that contributes to the systematic analysis of complex enterprise-wide systems is the focus of this course. Concepts that can be used in a synergistic manner to enhance an enterprise's efficiency and profitability will be addressed. Prerequisite: Graduate standing or consent of department chair. 3 credits

SSIE 511, ADVANCED PRODUCTION AND SCHEDULE CONTROL
Production scheduling and control. Design/production interface, bills of material, engineering revision control and general concepts of production planning and control for the engineer. Prerequisite: SSIE 510 or consent of department chair. 3 credits

SSIE 512, INTEGRATED MANUFACTURING SYSTEMS
Integration of equipment, people and information required in total manufacturing systems. Product/process design, planning and support, procurement support, software/hardware. Prerequisite: graduate standing or consent of department chair. 3 credits

SSIE 513, ADVANCED DESIGN FOR MATERIAL SYSTEMS
Material and material related costs represent as much as one half to two thirds of today's manufacturing cost. The focus for a competitive manufacturing enterprise must be upon controlling and reducing these costs. Achieving this control and reduction will be brought about through an analysis of the total system from purchase through the facility and out to the customer. Specific topics to be covered will include: relationship buying, JIT, workstation design, handling systems design, facility design, and distribution systems. Prerequisite: SSIE 510 or consent of department chair. 3 credits

SSIE 515, OPERATIONS MANAGEMENT OF SUPPLY CHAINS
This course deals with management of Supply chains, in particular, with the operational aspects. A broad overview of supply chains of a company is introduced, together with performance measures and needed critical success factors. The course concentrates on supplies, inventories, manufacturing, and logistics of distribution. Managerial aspects as well as mathematical modeling for better planning and control will be covered. Enabling the supply chains by enterprise resource planning modules and e-commerce will also be discussed. Prerequisite: SSIE 505 or equivalent. Cross-listed with ISE 415. 3 credits

SSIE 517, FUZZY SETS, UNCERTAINTY AND INFORMATION
Overview of basic concepts of fuzzy set theory. Difference between probability theory and fuzzy set theory. Foundations of information theory. Uniqueness of information measures, maximum and minimum principles of information, fundamental properties of information. Prerequisites: SSIE 505 or equivalent. 3 credits

SSIE 519, APPLIED SOFT COMPUTING
Covers relatively new approaches to machine intelligence known collectively as soft computing. Introduces various types of fuzzy inference systems, neural networks and genetic algorithms, along with several synergistic approaches for combining them as hybrid intelligent systems. Emphasis is on applications, including modeling, prediction, design, control, databases and data mining. The undergraduate students are not required to do projects on the same level as the graduate students, and are not required to place the degree of emphasis on hybrids. Prerequisites: basic knowledge of calculus and discrete mathematics, and competence in at least one programming language, or consent of the instructor. Cross-listed with ISE 419. 3 credits

SSIE 520, MODELING AND SIMULATION
Stochastic processes, review of probability and statistics, covariance, input data selection, random number generators, non-parametric tests for randomness, generation of random variates, output data analysis, terminating and non-terminating simulations, model validation, comparison of alternatives, variance reduction techniques, sensitivity analysis, experimental design and predictive models. Prerequisite: SSIE 505 or equivalent. 3 credits

SSIE 521, ANALYSIS OF SIMULATION RESULTS
Ability to analyze, understand and control complex manufacturing systems is enhanced through usage of simulation techniques. Topics include model development, theory, model validation,

and evaluation and analysis of the results. Major emphasis on projects that are development models for actual manufacturing systems. Prerequisite: graduate standing or approval of department chair. 3 credits

SSIE 522, ADVANCED DECISION MODELING
Course provides a broad foundation in decision models and techniques used in industry and research for technical and managerial problems. Topics include decision theory, risk and uncertainty, value of information, preference measurements, prioritization of alternatives, multiple objectives and hierarchical decisions. This is offered as a dual level course with ISE 422. Prerequisite: SSIE 505 or equivalent. Cross-listed with ISE 422. 3 credits

SSIE 523, COLLECTIVE DYNAMICS OF COMPLEX SYSTEMS
Introduces students to the study of collective dynamics demonstrated by various natural, social and artificial complex systems, i.e., systems made of a massive amount of lower-level components interacting with each other in a nonlinear way. Discusses several computational modeling frameworks, including agent-based models (particle models, ecological and evolutionary models, game-theoretic models), complex network models (small-world and scale-free networks, dynamical networks, adaptive networks), and spatial models (cellular automata, partial differential equations). Also discusses mathematical concepts and tools to analyze and understand their behavior, e.g., mean-field approximation, linear stability analysis, scaling, renormalization, bifurcation, chaos, pattern formation, and phase transition. Python will be used as a primary computer programming language for modeling and simulation. Prior computer programming experience is helpful, but not strictly required. Prerequisites: Graduate standing and basic knowledge of calculus, linear algebra and probability theory, or consent of instructor. 3 credits

SSIE 524, GRADUATE SEMINAR IN COMPLEX SYSTEMS SCIENCE
This course is a weekly seminar series that serves students as a venue of active discussion on current research topics and interdisciplinary networking. It is formed using the Collective Dynamics of Complex Systems seminar series as a structural basis. Faculty, graduate students and external speakers discuss complex systems related research topics. Students are required to present either literature review or their own research at least once a semester and will be graded based on class attendance, presentation and participating in discussions as well as reflection essays and final papers. Prerequisites: Graduate standing or consent of instructor. 1 credit

SSIE 525, PRINCIPLES OF SYSTEMS ENGINEERING
Basic principles of systems engineering applied in transforming client requirements into an operational system. Topics cover the full system life cycle: planning, integrated product/process development, system architecture and design, modeling, requirements analysis, development, integration, test and evaluation. Specialized concepts involved in engineering complex systems are reinforced through case studies and student exercises. Prerequisite: graduate standing or consent of instructor. 3 credits

SSIE 527, SYSTEMS DESIGN AND HUMAN INTERACTIONS
The design cycle, requirements specification, prototyping, partition and integration, production and testing. User's perception and use of system, observation, pattern recognition, and measurement using vision, hearing and speech. Presentation of information, analog and digital displays, organization of displays and data, hierarchical information and control levels.

Limitations of speed and accuracy of perception and communication, sources of error, distortion and misinterpretation. Fault tolerance, error detection and correction. 3 credits

SSIE 528, SYSTEMS ENGINEERING PROJECT
Semester-long process-orientated design experience that is a simulation of a real-world project in designing and running a manufacturing floor. Project evolves year to year as students work to include more aspects in the experience. Class is divided into teams, and each team develops its own design for the manufacturing process based on various information provided from the client and machine vendors. Teams use various tools for simulation and analysis in making and modeling their design decisions. Design project does not concentrate so much on the details of the machines and products as on the experience of designing large-scale process projects. Students must draw on systems engineering skills, apply them to a wide range of problems and experience the consequences of their decisions. Each team makes a formal presentation of its design to the faculty and to a board of industrial experts. Instructor(s) determine the final grade with input from the industrial experts. While the students are involved in team-oriented projects, grades are based on an individual's performance. Students who have had an equivalent course at the undergraduate level are not eligible to take this course. 3 credits

SSIE 529, COMPUTABILITY AND LOGIC
Studies some of the fundamental theoretical results about logic and about the capacities and limitations of computing devices. Notion of computability is introduced by means of Turing machines, whose halting problem is shown to be unsolvable. Two other notions of computability, abacus-computable functions and recursive functions, are also introduced and their interrelations discussed. Undecidability of first-order logic is also covered. 3 credits

SSIE 530, HEALTHCARE POLICY ANALYSIS
This course provides an overview of issues and policies related to health care systems, with emphasis on health care systems within the United States. The course will apply various engineering tools and approaches for policy analysis and program planning in this area. Some potential future policy changes will also be discussed, as well as challenges with implementation and change management techniques. Prerequisites: SSIE 534/ISE 434 or permission of the instructor. 3 credits

SSIE 533, HUMAN FACTORS IN ENGINEERING AND DESIGN
Introduction to Human Factors and systems: design for human use; Human Factors research methodologies; information about human performance, abilities, and limitations will be surveyed and applied: physical work and manual handling, applied anthropometry and workplace design, human control of systems, control and data entry devices, and environmental conditions; Human Factors applications including human error, accidents, safety, Human Factors and the automobile, and Human Factors in Systems Design. Prerequisite: basic course in probability and statistics or permission of the instructor. 3 credits

SSIE 534, FUNDAMENTALS OF HEALTH SYSTEMS
One of the growing systems in our society is that of the healthcare delivery system. The purpose of this course is to introduce the concepts behind the healthcare delivery systems and to focus upon the systems improvement or continuous improvement techniques available for complex systems. Topics would include improvement to, and problems with: organizational structure, managing change, the financial structure, the responsibility structure, quality data and implications of quality measures, use of clinical decisions support systems and the care givers

role in the system. There will also be a focus upon suppliers to the healthcare delivery system and the unique requirements placed upon their products and processes. Cross-listed with ISE 434. 3 credits

SSIE 535, ANALYTICAL METHODS
Survey and discussion of some of the more important and useful analytical methods for analyzing a wide variety of engineering and scientific problems. Topics include solution of differential equations, including methods for linear equations, power series, eigen-function expansions and separation of variables; topics in multivariable calculus, including vector analysis; and selected topics in linear algebra, integral transforms and functions of a complex variable. Each of the methods is introduced in the context of real, applied problems and then illustrated with typical "real-world" applications. Prerequisite: two semesters of calculus. 3 credits

SSIE 536, NUMERICAL MODELING OF PHYSICAL PHENOMENA
Efficient and effective method for solving differential equations numerically. Single and multi-step methods for initial value problems for ordinary differential equations; matrix and shooting methods for two-point boundary value problems; and shooting methods for eigen-value-eigen-function problems (for resonant frequency and mode shape calculations). Finite difference methods for partial differential equations, including the heat, wave and potential equations. Explicit and implicit methods, method of characteristics, Lax-Wendroff schemes and various methods to accelerate the convergence of the approximate solutions. Considerable emphasis on the interpretation of the numerical solutions in terms of systems they model and the qualitative (as well as quantitative) insight they provide. 3 credits

SSIE 537, INDUSTRIAL AND SYSTEMS ENGINEERING IN HEALTHCARE
The application of industrial and systems engineering principles to continuous process improvement in the health care domain will be studied. Concepts that will be addressed will include, but not be limited to, process mapping, optimization, scheduling, lean and flexible systems, quality enhancement, simulation, supply chain management, inventory control, and information management. Prerequisite: graduate standing in the department or permission of the instructor. Cross-listed with ISE 437. 3 credits

SSIE 538, HEALTHCARE FINANCE & ACCOUNTING
This course is intended to provide an overview of healthcare finance and the current financial environment for the healthcare industry and to learn how to apply engineering economics to healthcare financial management. It will provide information on financial and managerial accounting and how the use of Systems Science and Industrial and Systems Engineering principles can be applied to financial management concepts to allow for health-related organizations to make sound business decisions. Prerequisites: SSIE 534 or permission of the instructor. 3 credits

SSIE 539, HUMAN FACTORS ENGINEERING IN HEALTHCARE
This course introduces and emphasizes the role that human factors engineering/ergonomics plays in healthcare systems, with a focus on its applications to help improve quality, safety, efficiency, and effectiveness of patient care. Focused topics include human factors in workflow models; work system design for patient safety; human error analysis/taxonomies to reduce medical errors; task analysis and data collection methods in healthcare environments; clinical staff workload and patient safety; physical ergonomics in healthcare and human performance modeling; and

diffusion and adoption of technology in healthcare, with emphasis on the usability and design of medical devices and information systems. Prerequisite: Basic human factors knowledge or permission of the instructor. Cross-listed with ISE 439. 3 credits

SSIE 540, RELATIONAL DATA ANALYSIS
Introduction to fundamentals of analysis of relational data, with emphasis on formal concept analysis. Included are required preliminaries on sets, relations, and related notions. Emphasis is on discovering patterns and dependencies in relational data. Topics include: relations and relational systems; relational data and its representation; concept lattices and formal concept analysis; algorithms for formal concept analysis; uncertainty in relational data; relational factor analysis; attribute dependencies, attribute implications and non-redundant bases; algorithms for extracting attribute dependencies from data; redundancy and redundancy elimination in relational data. Prerequisite: Graduate standing in department or permission of the instructor. 3 credits

SSIE 541, ANALYSIS OF CAPITAL INVESTMENTS
Traditional methods are reviewed against changes in manufacturing. Estimating, product cost vs. utilization, risk, sensitivity analysis and decision modeling. Prerequisite: basic course in engineering economics or its equivalent, or approval of department chair. 3 credits

SSIE 544, HEURISTIC OPTIMIZATION
Covers methods of heuristic optimization in the literature. Topics include genetic algorithms, evolution strategies, tabu search and simulated annealing. Major emphasis is on NP complete combinatorial problems found in engineering. Issues such as solution encodings, stochastic convergence, selection methods, local and global search methods are discussed. Prerequisites: SSIE 505 or equivalent and knowledge of at least one programming language, such as C++ or Python. 3 credits

SSIE 545, HEURISTIC PROBLEM SOLVING
Concept of problem as cognitive dissonance. Methods of problem recognition, definition, solution, implementation, refinement. Intuitive approaches: analysis and syntheses; Meta-problem solving — development of strategies appropriate to problem type; inventive thinking: deferred judgment, metaphorical and visual thinking, finding order in chaos. Prerequisites: curiosity of creative process and genuine desire to innovate. 3 credits
SSIE 546, THE PSYCHOLOGY OF PROBLEM SOLVING
Current topics in cognitive science, including perception, learning, pattern recognition, creativity, artificial intelligence, neural networks, brain theory, evolution of function. 3 credits

SSIE 547, MODERN COMPLEXITY THEORY
Complexity theory is a new name for studies based largely on computational investigations of nonlinear dynamics and artificial evolutionary systems. The conceptual foundations go back to earlier thinking about self-organization systems and the origin of life. The focus of the first few lectures will be on the complexity limits of the currently popular formal and computational models, including Prigogine's dissipative structures, Kauffman's NK Boolean networks, Bak's self-organized criticality, and the broad area of discrete and continuous nonlinear dynamics, including chaos and cellular automata. The following lectures will elaborate von Neumann's earlier ideas of open-ended evolution of complexity that requires semiotic control of dynamics, and will illustrate how these ideas relate to current controversies in evolution theory over the relative importance of self-organization and natural selection. Prerequisite: graduate standing in science or philosophy or permission of instructor. 3 credits

SSIE 550, INTRODUCTION TO SYSTEMS OPTIMIZATION
Basic course in engineering optimization with emphasis on algorithms and applications. Topics: single-variable optimization, multivariable optimization, linear programming (formulation, simplex method, interior point methods, sensitivity analysis, applications), constrained optimization (LaGrange multipliers, Kuhn-Tucker conditions, direct search methods) and, time permitting, quadratic programming and linearization methods. Students gain enough proficiency to build optimization models of practical problems and solve them using tools learned in class. Use of available optimization computer codes. 3 credits

SSIE 553, OPERATIONS RESEARCH
Operations research (OR) is devoted to the determination of the best course of action of a decision problem, given resource restrictions. Course provides the engineer with a firm grounding in the use of OR (mathematical) techniques devoted to the modeling and analysis of decision problems. Techniques include the following: decision modeling; linear integer and dynamic programming; emerging optimization techniques (e.g., genetic algorithms, simulated annealing, etc.); game theory; and queueing theory. Problem areas include the following: transportation models; project/production scheduling; inventory models; assignment problems. 3 credits

SSIE 556, EXPERT SYSTEMS IN ELECTRONICS PACKAGING
Role of artificial intelligence-based expert systems in manufacturing as related to electronics packaging domain. Expert systems design and development as applied to electronics packaging. Knowledge acquisition and representation techniques solution spaces and search techniques, inference and deduction mechanism, and design and development of prototype systems. Prerequisite: graduate standing or approval of department chair. Cross-listed with ISE 456. 3 credits

SSIE 561, QUALITY ASSURANCE FOR ENGINEERS
Statistical quality control, designing for quality, process control, vendor and customer quality issues, quality costs and production. Prerequisites: BS in engineering (any field) and probability and statistics coursework, or consent of department chair. 3 credits

SSIE 562, RELIABILITY
Reliability networks, failure mode and effect analysis, apportionment, fault trees and human reliability. Prerequisites: SSIE 561 and probability and statistics, or consent of department chair. 3 credits

SSIE 566, DESIGNING WITH EXPERIMENTS
Basics of applying statistical design, and the design function, statistical experimental design, control of experimental setting, Taguchi methods and analysis of results. Prerequisites: SSIE 561 and 505 or equivalents, or approval of department chair. 3 credits

SSIE 569, MATERIALS FOR MANUFACTURING
This course provides an overview of the materials used in manufacturing that are of significant economic, technical and industrial relevance. A special emphasis will be given to polymeric materials currently used in electronics manufacturing as well as those materials emerging for use in additive manufacturing and 3D printing. Selected materials will be classified by composition, properties, manufacturing methods, applications, economics and related supply chains.

Prerequisites: undergraduate engineering or science background that includes the equivalent of freshman chemistry and physics or permission of the instructor. 3 credits

SSIE 575, SYSTEMS DESIGN
Systems approach to design process. Complex, poorly defined interdisciplinary problems. Design activities depend on class composition-professionals from health field, legal profession, municipal administration particularly welcome, since design project could then be chosen from such applications. Design viewed as problem solving and opportunity development activity. Problem solving involves problem recognition-sensitivity to design misfits; definition developing design specifications and goals; solution for actual design process from concept development to "construction" of object of design; implementation of placing object into action; review and refinement analysis of design in its environment for purposes of discovering mistakes and refining object. Opportunity development involves process and invention. Topics include user identification and satisfaction, adaptive design, design by attribute, design consciousness, models of design process, planning and scheduling, idea sketching and visual thinking, model construction. Prerequisite: open to students with advanced standing or professional experience. 3 credits

SSIE 578, PROCESSES FOR ELECTRONICS MANUFACTURING
The purpose is for the students to gain a broad knowledge and understanding of the basics of printed circuit board manufacturing and assembly. The course offers an introduction to surface mount and insertion mount components, materials and processes as well as to PCB design and manufacturing. Lectures will introduce to assembly process flows and component types, PCB construction and defects, solder paste printing and equipment, placement processes and equipment, reflow and ovens, flip chip assembly and underfilling, defects and mitigation, reliability optimization and testing. Efforts will be made to include visits to local industrial assembly facilities as well as equipment on campus. The overall goal is to provide the students with a basis for communicating and working with subject matter experts. Prerequisite: undergraduate course in manufacturing processes, related experience or consent of department chair. Cross-listed with ISE 473. 3 credits

SSIE 579, PROCESSES FOR AREA ARRAY DEVICES
The construction of area array devices (including BGA, CSP, flip chip, and wafer level) and their packaging. Assembly of these packages onto substrates at the first and second level of packaging. Process, yield, reliability, and rework issues. Cost impact of area array packaging. Packaging for optoelectronics and MEMS and related assembly issues (will include an overview of Optoelectronics and MEMS). Board level issues that pertain to the assembly of advanced packages including routing and microvias. Prerequisite: SSIE 578 or permission of instructor or department chair. 3 credits

SSIE 580, SPECIAL TOPICS
Topics vary from semester to semester. 1-4 credits

SSIE 581, PHILOSOPHY OF SCIENCE
Covers traditional concerns in the philosophy of science such as the nature of scientific theory, the nature of explanation, observation, prediction and laws, and the nature of scientific objectivity. Students seek an account of how it is that theories lead to rich and powerful explanations and deep scientific understanding of the occurrence of objective standards of theory selection. 3 credits

SSIE 583, FOUNDATIONS OF ARTIFICIAL INTELLIGENCE
Critical examination of many of the underlying assumptions in artificial intelligence (AI). By the very nature of the enterprise, AI programs and techniques often assume theories of reasoning, knowledge and language, theories that may have far-reaching implications. All too often these theories and implications are overlooked in the effort to produce working systems. Course studies classic papers in the development of AI, as well as current issues and debates. Issues concerning reasoning and formal systems are considered, as well as the body of arguments for and against the very possibility of successfully creating artificial intelligence. Some of the other topics covered include Turing machines, the notion of a symbol system, symbol grounding, intentionality, non-standard logics, neural networks, embodied cognition and AI uses in psychology and industry. 3 credits

SSIE 590, SPECIAL TOPICS — INDUSTRIAL ENGINEERING SPECIAL PROBLEM
Based upon a basic understanding of industrial engineering, covers decision making in industrial or manufacturing engineering situations. Major emphasis is usually in manufacturing systems. Prerequisite: consent of department chair. 3 credits

SSIE 592, TECH, DEV, CURRICULUM I
This course is a 32-week in-house course taught at BAE Systems for students enrolled in the BAE ELDP program only and devoted to a broad review of engineering fundamentals, with emphasis on interdisciplinary topics related to Electronic Systems products and processes, technologies, applications, and problem solving techniques. Coursework includes a team-project and presentation to engineering management. Credits vary.

SSIE 593, TECH DEV CURRICULUM
This course is a 16-week in-house course taught at BAE Systems for students enrolled in the BAE ELDP program only and devoted to challenging students with problems very similar to those frequently facing Electronic Systems engineers. Coursework includes a technical project requiring the application of systems, software, and hardware engineering skills. Credits vary.

SSIE 594, INDUSTRIAL INTERNSHIP
Industrial engineering, systems science and other professional experience. Daily log book, memo progress reports and a formal final report required. Prerequisite: consent of department chair. Credits vary.

SSIE 595, TERMINATION PROJECT: SYSTEMS SCIENCE
Project acceptable both to student and to a faculty committee. Prerequisites: consent of instructor and committee members. 1-6 credits

SSIE 597, INDEPENDENT STUDY
Supervised by department faculty member. Student must obtain consent of instructor, who then determines description of program, number of credits, frequency of meeting and location. Appropriate paperwork must be submitted to complete registration. Credits vary.

SSIE 598, MS ISE PROJECT
In depth study and analysis of a selected topic in health or other service system, or manufacturing system as approved by the project advisor. Course requires a formal report, defense, and presentation. 1-6 credits

SSIE 599, THESIS
Training in the methods of research. Oral examination required. Minimum of six credits total. Bound thesis goes in University Libraries and department library.1-6 credits

SSIE 605, APPLIED MULTIVARIATE DATA ANALYSIS
Course introduces different multivariate data analysis and modeling tools, which can be used for simultaneously analyzing data with multiple dependent variables. It is designed to emphasize applied methodologies and applications in multivariate data analysis, especially in engineering fields. Topics to be covered include: multivariate regression, logistic regression, multivariate analysis of variance (MANOVA), principal components analysis, cluster analysis, canonical correlation, factor analysis, and discriminant analysis. The effective use of advanced data analysis software, such as SAS, for solving real-world engineering problems will also be addressed. Prerequisite: SSIE 505 or its equivalent. 3 credits

SSIE 606, SYSTEMS PROBLEM-SOLVING WORKSHOP
Continuation of SSIE 506; project oriented. Depending on background and interests, student may choose projects from any of the following categories: theoretical or practical work in developing some aspect of examples demonstrating applications of methods learned in SSIE 506 in special discipline; survey of current literature devoted to certain aspects of systems problem solving. Specific projects selected on basis both of the interests of individual students and composition of group. Prerequisite: SSIE 506. 2 credits

SSIE 612, ADVANCED TOPICS IN INTEGRATED MANUFACTURING
The continual need to improve quality and productivity and remain competitive in a global market requires the comprehensive integration of people, equipment, computers and information within a manufacturing systems engineering framework. Course studies manufacturing integration issues with a special focus on integrating elements such as process planning, group technology, concurrent engineering, product quality, cost analysis, flexible manufacturing, inventory control, information flow and management, and global computer-integrated manufacturing (CIM) concept. Prerequisite: SSIE 512 or equivalent or consent of department chair. 3 credits

SSIE 613, ADVANCED STATS METHOD FOR DATA ANALYSIS
This course will cover advanced data analysis methods with emphasis of their applications in industrial and systems engineering. There are three major components to the course. The first component is a brief review on basic univariate and multivariate analysis. The second component is an introduction to advanced statistical analysis methodologies such as time series modeling and forecasting, confirmatory factor analysis, multi-group discriminant analysis, multivariate analysis of variance, and structural equation modeling. The third component of the course focuses on real applications of these methods in research and data-driven decision making. Term offered varies. 3 credits

SSIE 615, ADVANCED SUPPLY CHAIN MANAGEMENT
Course deals with modeling of supply chains, concentrating on production and operations. Quantitative models will be developed and analyzed to study the benefits of information sharing, joint planning, and coordination among the various components of a supply chain. Strategic uses of information and various strategies of supply chains, like appropriate contacts, component commonality, and postponement will be covered. The material will also include service industry, and designing and managing globally dispersed entities. A major activity would be students

working in teams, and identifying relevant problems and developing models to study them. Prerequisite: SSIE 515, and/or SSIE 520 or instructor consent. 3 credits

SSIE 616, ADVANCED TOPICS IN APPLIED SOFT COMPUTING
Course is designed to follow a currently offered course, SSIE 519: Applied Soft Computing. Both courses are designed to cover relatively new approaches to machine intelligence and systems analysis known collectively as soft computing. The 519 course already introduces various types of fuzzy inference systems, neural networks, and genetic algorithms, along with several synergistic approaches for combining them, including "neuro and fuzzy" techniques, neuro-fuzzy models, the use of neural models in fuzzy systems design, genetic auto-tuning techniques, genetic training of neural nets, fuzzified neural nets, and neural genetic fuzzy models. Naturally, with so many new approaches developing in this field, it is possible in an entry-level graduate course only to cover the main topics in depth and to offer only a general overview on the more advanced hybrid approaches. The purpose of SSIE 616 is to allow students to pursue these advanced approaches to a much greater depth. The emphasis will be on applications, including modeling, prediction, design, control, databases, and data mining, just as is already the case in the 519 course. Prerequisite: SSIE 519. 3 credits

SSIE 617, FUZZY SETS, FUZZY LOGIC AND FUZZY SYSTEMS
Course consists of two parts. The first part covers fundamentals of fuzzy set theory and the associated fuzzy logic. The second part is devoted to applications of the theory. Topics of the theoretical part include basic concepts of fuzzy set theory and fuzzy logic; representations of fuzzy sets; extension principle that facilitates fuzzifications of classical mathematical concepts; aggregation operations on fuzzy sets; the concept of a fuzzy number and arithmetic operations on fuzzy numbers; fuzzy relations; fuzzy relation equations; basic ideas of fuzzy logic; possibility theory based on fuzzy sets; and information aspects of fuzzy sets. In the application part, methods of constructing fuzzy sets in various application contexts are overviewed and representative applications of fuzzy sets and fuzzy logic are examined. The application areas covered include systems science; approximate reasoning in expert systems; database and information retrieval systems; pattern recognition and image processing; decision making; medicine; economics; psychology; and various areas of engineering. Prerequisites: SSIE 505 or equivalent and calculus and discrete mathematics, or consent of instructor. 3 credits

SSIE 618, FUZZY MEASURES: THEORY AND APPLICATIONS
Provides students with a framework of the general theory of fuzzy measure. Includes some advanced knowledge on set theory (such as atom, s-compact, etc.), basic concepts of classical measure and fuzzy measure, structural characteristics of fuzzy measure, extension of fuzzy measure, concepts of "almost" and "pseudo-almost" on fuzzy measure space, measurable functions and convergence of their sequence on fuzzy measure space, concept and properties of fuzzy integral, convergence theorems of sequence of fuzzy integrals, application of fuzzy integral in synthetical evaluation. Students explore applications of these and related concepts in their areas of interest and write a term paper. 3 credits

SSIE 619, GENERALIZED INFORMATION THEORY
Primary concept in generalized information theory is uncertainty, and information is defined in terms of uncertainty reduction. After a brief overview of classical information theories, a broad framework for their various generalizations is examined in detail. The main focus of the course is on the capability of measuring uncertainty and the associated information within this broad framework, and to utilize this capability for dealing with problems involving uncertainty and

uncertainty-based information. Prerequisites: calculus and basic probability theory (e.g., SSIE 505). 3 credits

SSIE 620, ANALYSIS OF COMPLEX SYSTEMS
Techniques for and their applications to modeling and analyzing complex systems. Decision trees, graph theory, time series and forecasting, system identification and non-linear optimization, optimal allocation of resources, cluster analysis, queueing theory, analysis of specific complex systems. Prerequisites: SSIE 505, familiarity with simple differential equations. 3 credits

SSIE 621, ADVANCED SIMULATION
This course is intended as an advanced course in simulation modeling for complex systems. This is a project- and research-oriented course designed to give graduate students a foundation from which to explore areas of their own interest. Focused topics include techniques in simulation model design, advanced techniques for output data analysis, comparing alternative system designs, variance reduction techniques, design of experiments for simulation modeling, simulation-based optimization, agent-based and distributed simulation, and continuous process simulation. Prerequisites: SSIE 520 or equivalent, and knowledge of at least one programming language. 3 credits

SSIE 630, NEURAL NETWORKS AND GENETIC MODELS
The use of autonomous self-organizing models in deducing complex systems properties, behavior and relations; intelligence, learning, adaptation and emergence in artificial systems; perceptions and threshold logic units, discriminate functions, general non-parametric training; committee, piecewise linear, layered and parametric machines; evolutionary programming, genetic algorithms and satisfying vs. optimizing search strategies. 3 credits

SSIE 631, FOUNDATIONS OF NEURAL NETWORKS
Covers theory and practical applications of artificial neural networks. Neural networks are a broad class of computing mechanisms with active research in many disciplines, including all types of engineering, physics, psychology, biology, mathematics, business, medicine and computer science. Emphasizes the practical use of neural networks for industrial problems such as pattern recognition, predictive models, pattern classification, optimization and clustering. Topics include learning rules, paradigms and validation. Prerequisites: SSIE 505 or equivalent and SSIE 520. 3 credits

SSIE 632, PERTURBATION METHODS
Application of perturbation methods to problems in engineering mechanics. Regular perturbation expansions, method of matched (and composite) expansions, and method of multiple time scales are applied to problems drawn from such areas as vibrations, fluid mechanics, heat conduction, solid mechanics. Emphasis is on understanding the various methods discussed (e.g., what method applies to what kind of problem, what each method does and does not do, etc.) with applications used to illustrate the ideas. Prerequisites: two semesters of calculus and a course in ordinary differential equations. 3 credits

SSIE 633, ADVANCED HUMAN FACTORS ENGINEERING
This course is intended as an advanced course in human factors/ergonomics engineering. The course is project/research oriented in nature to provide the graduate students a foundation from which they can explore areas of their own interests. Focused topics include fundamentals and

dynamics of human performance modeling, particularly using digital humans; advanced human factors research and development, including ethics, methods, and analysis tools; human-machine systems modeling and design; human reliability analysis; adaptive hybrid systems; and control theory for humans. Application areas will include quality/process control in manufacturing, healthcare, transportation, aviation, and military systems. Prerequisite: SSIE 533 (or equivalent) or permission of the instructor. 3 credits

SSIE 637, ADVANCED TOPICS IN HEALTH SYSTEMS
This course is intended as an advanced course in health systems and health care delivery. This course is oriented to provide the graduate students with an in-depth study of the application of industrial and system engineering principles for continuous process improvement in the health care. Concepts that are addressed and studied include, but are not limited to, process mapping, optimization, scheduling, lean and flexible systems, quality enhancement, simulation, supply chain management, inventory control, and information management. SSIE 537 or permission of the instructor. 3 credits

SSIE 640, KNOWLEDGE DISCOVERY AND DECISION MAKING
Introduces selected advanced topics of knowledge discovery and decision making. Particular focus is on logical and logico-statistical approaches to knowledge discovery and decision making. Emphasis is on detailed understanding of particular methods including the purpose, mathematical and computational foundations, pitfalls, typical applications, and software tools for every method. Topics include: the process of knowledge discovery and decision making. Elements of measurement theory, information measurement, uncertainty in data and its management. GUHA method and logico-statistical calculi of knowledge discovery: logic of induction and observational calculi, logic of suggestion, GUHA software, LISP-miner. Logical analysis of data (LAD), general methodology, approximation of subspaces by Boolean functions, LAD for binary and real-valued attributes, decision making and classification with LAD. Decision making with analytical hierarchy process (AHP). Formal concept analysis (FCA), basic approach and extensions. Boolean factor analysis. Selected applications of the methods discussed in industry, business, marketing, finance, security, biological data. Software tools for the methods discussed. 3 credits

SSIE 641, ADVANCED TOPICS IN NETWORK SCIENCE
This course provides concepts, models, methods and tools developed in the rapidly advancing field of Network Science. Instructions will be largely based on primary literature published recently. Topics to be discussed will include: Complex network topologies, methods for network analysis, visualization and simulation, models of dynamical/adaptive networks, techniques for mathematical analysis, network stability and robustness, and applications to social, biological and engineering systems. Prerequisites: SSIE 523 or permission of the instructor. Students taking this course should have solid knowledge of linear algebra, probability and statistics, and differential equations. 3 credits

SSIE 644, FOUNDATIONS OF ADAPTIVE OPTIMIZATION
This course is a survey of the newer, most common adaptive search methods. This is a project- and research-oriented course designed to give graduate students a foundation from which to explore areas of their own interest. Focused topics include simulated annealing, genetic algorithms, evolution strategies, tabu search, ant colony methods, and particle swarm optimization. Other search methods such as genetic programming, evolutionary programming and random search methods will be briefly covered. Major emphasis is on NP complete

combinatorial problems found in engineering. Issues such as solution encodings, stochastic convergence, selection methods, local and global search methods are discussed. Prerequisite: SSIE 505 or equivalent, and knowledge of at least one programming language. 3 credits

SSIE 645, STATISTICAL MODELING WITH IMPRECISE PROBABILITIES
To deal with the uncertainty and the indeterminacy in systems, course covers a new and increasingly important mathematical theory of imprecise probabilities, including upper probabilities and lower probabilities, based on three fundamental principles: avoiding sure loss, coherence and natural extension. Some useful models and strategies for assessing imprecise probability are introduced, and some applications to probabilistic reasoning, statistical inference and decision are discussed. Prerequisites: SSIE 505 and 517. 3 credits

SSIE 650, SYSTEMS OPTIMIZATION
Broad spectrum of models and methods for systems optimization. Motivating examples; classical constrained and unconstrained methods; search techniques; linear programming; network and transportation systems; introduction to integer programming. Prerequisite: SSIE 550 or consent of instructor. 3 credits

SSIE 656, ARTIFICIAL INTELLIGENCE IN MANUFACTURING
Overview of AI concentrating on Expert Systems. Emphasis on manufacturing applications, e.g., scheduling, inventory control, process planning, maintenance, etc. Design and development of prototype systems will be discussed. Topics will include: solution spaces and search techniques, knowledge representation, inference and deductions mechanisms. Prerequisite: consent of department chair. 3 credits

SSIE 660, STOCHASTIC SYSTEMS
Advanced topics in conditional probability, discrete-state Markov chains, exponential and Poisson processes, Erlang processes, basic queueing models and several important variations, congestion problems in banks, airline reservation systems, waiting lines in machine job shops, problems encountered on design and analysis of multiprogramming and timesharing computer systems, renewal theory, continuous transition Markov chains, introduction to system reliability. Modeling and methodology. Emphasis on application. Prerequisite: SSIE 505 or equivalent. 3 credits

SSIE 661, ADVANCED ISSUES IN QUALITY
The topic of quality has taken more and more of a critical nature for manufacturing systems. Course has two components. The first is a practical application of the concepts of quality, including the design and execution of experiments in a real setting. The second is the analysis and study of future issues in the field of quality, such as the development of loss equations, cost of high quality, and people and high quality. Prerequisite: SSIE 566 or a general design of experiments course. 3 credits

SSIE 670, SELECTED TOPICS IN COGNITIVE SCIENCE
Topics focus on current approaches to brain models and machine intelligence and on the different criteria that are used to evaluate such models. These approaches include programmable rule-based symbol systems (computationalism), coherent, distributed networks (connectionism) and models based on neurophysiology of simple and complex organisms. Special attention is given to the evolutionary and developmental constraints on the many functions of nervous systems and brains. Prerequisite: second-year graduate-level course. 3 credits

SSIE 673, ADVANCED ISSUES IN PROCESSES FOR ELECTRONICS MANUFACTURING
Addresses advanced topics within the processes associated with the manufacture and assembly of printed circuit boards. Addresses advanced issues in bare-board manufacture, including printed circuit board structures and processes, interconnection technology-related considerations, materials and processes used in bare-board manufacture, and reliability issues. The impact of board-pad metallurgies and surface coating on the solder joint is addressed. In the assembly area, the focus is on advanced topics in the surface mount printed circuit board assembly area. Ultrafine pitch assembly and area array assembly are addressed. Topics include solder paste deposition, component and materials issues, solderability, placement, reflow, process yield related issues, the impact of moisture, encapsulation and product reliability. Concepts such as concurrent engineering and design for manufacturing are also addressed. On completion, students have an acceptable understanding of the advanced scientific and/or engineering concepts that relate to the manufacture and assembly of surface mount printed circuit boards. Assists engineers in scientific problem solving and process development for the printed circuit board assembly domain. Prerequisite: SSIE 578 or consent of department chair. 3 credits

SSIE 680, ADVANCED SPECIAL TOPICS
Variable content, credit hours, prerequisites. When offered, covered topics, credit hours, prerequisites, text specified. May be repeated for credit with consent of instructor. Prerequisites: to be determined. 1-4 credits

SSIE 697, ADVANCED INDEPENDENT STUDY
Supervised by department faculty member. Student must obtain consent of instructor, who then determines description of program, number of credits, frequency of meeting and location. Appropriate paperwork must be submitted to complete registration. 3 credits

SSIE 698, PRE-DISSERTATION
Exploratory research oriented toward PhD dissertation. 1-9 credits

SSIE 699, DISSERTATION
Research for and preparation of PhD dissertation. 1-12 credits

SSIE 700, CONTINUOUS REGISTRATION
Required to maintain matriculation through any spring or fall semester when no other courses are taken. If minimal one-credit registration is not maintained, student must reapply for admission. 1 credit

SSIE 701, PRACTICUM FOR RESEARCH AND TEACHING ASSISTANTS
Required for all funded graduate assistants. Research or teaching supervised by faculty advisor.

SSIE 707, RESEARCH SKILLS
Development of research skills required within graduate program. May not be applied toward course credits for any graduate degree. Credits vary.

APPENDIX III:

THE STATE UNIVERSITY *of* NEW YORK

Nancy L. Zimpher
Chancellor

State University Plaza
Albany, New York
12246

518 443 5355
fax - 518 443 5360

chancellor@suny.edu
www.suny.edu

March 12, 2010

Samuel L. Stanley, Jr., M.D.
President
Stony Brook University
310 Administration Building
Stony Brook, NY 11794-0701

Dear Dr. Stanley,

Pursuant to State University of New York (SUNY) Board of Trustees Resolution 075 dated May 12, 2009, a copy of which is attached, I hereby authorize you to take all steps appropriate to execute and approve, in the name of and on behalf of the SUNY Board of Trustees, such documents necessary or proper to ensure the formation and operation of a not for profit educational institution dedicated to the delivery of SUNY academic and research programs in Songdo, South Korea.

This initiative will be a critical element in our strategic plan to enhance SUNY's educational pipeline by offering undergraduates access to SUNY degree programs and research opportunities on the international stage. SUNY Korea LLC will provide a model for the nation and the world by facilitating an innovative and productive overseas partnership that will leverage the University's areas of academic expertise and stimulate New York State's economic recovery.

Sincerely,

Nancy L. Zimpher
Chancellor

Enclosure

THE STATE UNIVERSITY *of* NEW YORK

MEMORANDUM

Office of the Chancellor

State University Plaza
Albany, New York
12246

518 443 5355
fax 518 443 5360

www.suny.edu

May 12, 2009

To: **Members of the Board of Trustees**

From: **John J. O'Connor, Officer-in-Charge**

Subject: **International Academic Initiative: Incheon Free Economic Zone**

I recommend that the Board of Trustees adopt the following resolution:

Whereas pursuant to Education Law §§ 355(1)(f) and (2)(p), the SUNY Board of Trustees is authorized to participate in inter-institutional arrangements and perform such acts as are necessary and appropriate to enhance, enrich and effectively carry out SUNY's educational mission;

Whereas the State University of New York is committed to the continued promotion and advancement of all aspects of international education through the outreach efforts of its Office of International Programs, the Levin Graduate Institute of International Relations and Commerce and various campus-administered programs of international academic achievement;

Whereas existing academic programs in Europe, the Ukraine, Turkey and Central America recently have been augmented by SUNY initiatives in the Sichuan and Jiangsu Provinces of the Republic of China and the establishment of the SUNY China Initiative office in Beijing;

Whereas SUNY's mission of promoting international education furthers the intellectual diversity of its students and faculty by facilitating access to international curricula, conferences, academic collaborations and degree programs with partner universities and institutions overseas; and

Whereas for the past year, SUNY Stony Brook has been actively engaged in negotiations with representatives of Incheon City in the Republic of Korea to establish a SUNY campus presence at the coastal Incheon Free Economic Zone ("IFEZ"); now, therefore, be it

Resolved that the Chancellor and the President of SUNY Stony Brook, or designees, be, and hereby are, authorized to take all steps necessary to develop and implement, in the name of and on behalf of the Board, overseas educational programs, curricula, conferences, and related academic degree and research collaborations with partner universities and institutions located at IFEZ in the Republic of Korea.

Background

Since its inception, SUNY has engaged in campus-administered international faculty and scholar exchanges, academic conferences, dual degree programs and research collaborations. Those collaborations now include more than 50 countries abroad. Such activities both foster the coordination of international exchange opportunities for SUNY students and support mutually beneficial academic, economic and commercial relations between SUNY and various international institutions and universities.

In late 2007, SUNY Stony Brook and several other academic institutions, including North Carolina State, Delaware, Southern California and Missouri were invited by representatives of the IFEZ Authority and the Korean Republic to participate in the creation of a dedicated academic campus to be located on the coastal region of Southeast Korea. Exploratory discussions have been ongoing, funded in significant part by the IFEZ Authority and supported by the Ministry of Knowledge Economy of the Republic of Korea.

SUNY Stony Brook is interested in offering degree programs in business administration, technology systems management, information systems, computer science, electrical engineering, and computer engineering in the facility now being built and dedicated by IFEZ to this express purpose. Faculty will be hired from the United States, the Republic of Korea, and internationally to staff the SUNY IFEZ campus; students will be drawn from a local and international applicant pool; international tuition revenues and fees will be dedicated to supporting the entire IFEZ campus initiative. As required by the Middle States Commission on Higher Education, instruction will be in English and the academic standards will be those maintained by SUNY Stony Brook in the United States. It is anticipated that after initiation of Stony Brook campus operations, other interested SUNY campuses may wish to participate in the enterprise.