Bachelor of Science in Systems Science & Engineering

Systems Engineering broadly covers how to integrate different components in engineering systems. Applications range from operations research and mathematical solutions to business problems to control engineering, the basic theory and practice used to control diverse systems such as jet airplanes, electric power grids, or the nation's economy. The Systems Science and Engineering program is ideal for students interested in math, physics and computing; business, finance or financial engineering; or applied mathematics.

The Bachelor of Science in Systems Science & Engineering (BSSSE) program lays the engineering and mathematical foundations for modeling, analyzing and designing complex systems and highlights their applications in contemporary engineering and scientific application domains. Graduates will be competent in employing a versatile, interdisciplinary systems perspective to translate practical problem formulations into mathematical models, recognizing structural commonalities across diverse systems, and solving analysis and design objectives using suitable methods at the core of systems science and engineering. The basic methodological knowledge at the core of systems science includes mathematical competence and knowledge of systems analysis, control, design methods, numerical methods, differential equations, dynamic systems theory, automatic control theory, system stability, estimation, optimization, modeling, identification, simulation and basic computer programming. Graduates will have an engineering outlook and be able to interact fully with other engineers. They will also possess sufficient proficiency in computer use to design algorithms for simulation, estimation, control and optimization.

The Bachelor of Science in Systems Science and Engineering (BSSSE) degree program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives

Within a few years of graduation, BSSSE degree program recipients are expected to do the following:

- Our graduates will be engaged as practicing professionals in a broad range of careers in industry or government or will pursue advanced degrees in academic graduate education in engineering or a related field.
- Our graduates will function effectively as members of teams demonstrating sensitivity to professional and societal contexts, integrity and versatility.

Student Outcomes

Graduates of the BSSSE program are expected to know or have the following by the time of graduation:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

BSSSE Degree Requirements

The course sequence designed to achieve the type of education outlined above requires at least 120 units, satisfies the residency and other applicable requirements of Washington University and the McKelvey School of Engineering (http://bulletin.wustl.edu/undergrad/engineering/requirements/), and meets the following program requirements:

1. Common Studies program of the McKelvey School of Engineering: This includes courses in engineering, mathematics, physics, chemistry, humanities, social sciences and technical writing. The required chemistry sequence is Chem 111A-Chem 151 (recommended) or Chem 105-Chem 151.
2. Engr 4501 Engineering Ethics and Sustainability (1 unit)
3. Required courses in systems science and engineering: ESE 105 Introduction to Electrical and Systems Engineering (3 units); ESE 205 Introduction to Engineering Design (3 units); ESE 230 Introduction to Electrical and Electronic Circuits (4 units);ESE 318 Engineering Mathematics A (3 units) and ESE 319 Engineering Mathematics B (3 units); ESE 326 Probability and Statistics for Engineering (3 units); ESE 351 Signals and Systems (3 units); ESE 403 Operations Research (3 units) or ESE 415 Optimization (3

units); ESE 441 Control Systems (3 units); ESE 448 Systems Engineering Laboratory (3 units); and ESE 499 Systems Science and Engineering Capstone Design Project (3 units)

4. Two of the following three computer science courses: CSE 131 Introduction to Computer Science (3 units); CSE 247 Data Structures and Algorithms (3 units); and CSE 132 Introduction to Computer Engineering (3 units). Students are encouraged to take CSE 131 and CSE 247. The other possible sequence is CSE 131 and CSE 132.
5. One of the following two laboratory courses: ESE 447 Robotics Laboratory (3 units) or ESE 488 Signals and Communication Laboratory (3 units)
6. 12 units in elective courses in systems science and engineering are required: ESE 400 through 428; ESE 437; ESE 440 through 459; ESE 470 through 497; ESE 497; ESE 502 through 529; ESE 540 through 559; SWCD 5660 Designing Sustainable Social Policies & Programs: A System Dynamics Approach. Up to 3 units of the following business courses may be part of the 12 units of systems science and engineering electives: OSCM 356 Operations Management, OSCM 458 Operations Analytics, OMM 576 Foundations of Supply Chain Management, and OMM 577 Information Technology and Supply Chain Management.
7. 12 units in engineering concentration outside of systems science and engineering are required. These units must all be taken in one of the following engineering areas: Biomedical Engineering, Chemical Engineering, Computer Science & Engineering, Electrical Engineering (ESE 102; ESE 230 through 239; ESE 260 through 290; ESE 330 through 339; ESE 360 through 390; ESE 429 through 439; ESE 460 through 469; 490 through 496; ESE 498; ESE 530 through 539; ESE 560 through 589), or Mechanical Engineering & Materials Science. Of the 12 units, 9 units must be at the 200 level or higher. Sequences for concentrations in economics, mathematics, physics, pre-medicine and other fields can be arranged with special departmental approval to meet a student's specific needs. When a non-engineering discipline is chosen as the outside concentration, the student needs to pay special attention to the engineering topics unit requirement and make sure that enough engineering content is obtained from the other courses. The use of basic required courses to fulfill the requirement for an outside concentration is not permitted.
8. The entire course sequence for the BSSSE, containing engineering topics of at least 45 units, must be completed. The number of engineering topics units assigned to undergraduate courses in the McKelvey School of Engineering vary from none (0) to the number of credits given to the course. For the precise number for each course, please refer to the table of Topics Units — Engineering Courses (http://engineering.wustl.edu/current-students/student-services/Pages/default.aspx) provided by Engineering Undergraduate Student Services.
9. Limitations: No more than 6 units of the combined units of ESE 400 Independent Study and ESE 497 Undergraduate Research (including 497A and 497B) may be applied toward the SSE elective requirement (item 6 above) of the BSSSE degree. Any remaining combined units are allowed as free electives to satisfy the requirement for the total number of units.
10. The courses taken to satisfy the following BSSSE degree requirements must be taken for a letter grade and not on a pass/fail basis: item 3 (required ESE courses), item 5 (elective laboratory course) and item 6 (elective ESE courses).

Systems Science & Engineering Sample Curriculum

The program requirements for the BSSSE allow for a double major with another department. Changes in the program to accommodate such double majors may be made with departmental approval. For a sample program for the BSSSE, please refer to the following table:

Course	Fall Units	Spring Units
First Year		
Calculus II, III (Math 132, 233)	3	3
Physics I (Physics 191)	3	—
Physics I Laboratory (Physics 191L)	1	—
Humanities or social sciences elective	—	6
Introduction to Computer Science (CSE 131)	3	—
Freshman Elective	1	—
Introduction to Electrical and Systems Engineering (ESE 105)	3	—
Physics II (Physics 192), Physics II Lab (Physics 192L)	—	4
Introduction to Engineering Design (ESE 205)	—	3
	14	**16**
Second Year		
General Chemistry Laboratory I (Chem 151)	2	—
General Chemistry I or Introductory General Chemistry I (Chem 111A or Chem 105)	3	—
Data Structures and Algorithms or Introduction to Computer Engineering (CSE 247 or CSE 132)	3	—

Differential Equations (Math 217)	3	—
Introduction to Electrical and Electronic Circuits (ESE 230)	4	—
Probability and Statistics for Engineering (ESE 326)	—	3
Outside concentration elective	—	3
Signals and Systems (ESE 351)	—	3
Engineering Mathematics A (ESE 318)	—	3
Engineering Mathematics B (ESE 319)	—	3
	15	**15**
Third Year		
Humanities or social sciences elective	3	3
Operations Research or Optimization (ESE 403 or ESE 415)	3	—
Control Systems (ESE 441)	3	—
Systems science and engineering elective with engineering topics units	3	3
Outside concentration elective	3	3
Robotics Laboratory (ESE 447) an elective lab	—	3
Technical Writing (Engr 310)	—	3
	15	**15**
Fourth Year		
Systems Science and Engineering Capstone Design Project (ESE 499)	3	—
Engineering Ethics and Sustainability (Engr 4501)	1	—
Systems Engineering Laboratory (ESE 448)	3	—
Systems science and engineering elective with engineering topics units	3	3
Outside concentration elective	3	—
Humanities or social sciences elective	3	3
Free Electives	—	3
Engineering course with engineering topics units	—	6
	16	**15**

For more information about the BS in Systems Science & Engineering curriculum (https://ese.wustl.edu/undergraduate/degreeprograms/Pages/systems-science-engineering.aspx), please visit the ESE website.