**WHAT ARE COMPLEX SYSTEMS?**

Complex systems are networks of many components with nonlinear interactions which arise and evolve through self-organization. These properties can be found in many real-world systems, such as political organizations, human cultures/languages, national and international economy, stock markets, the internet, social networks, global climate, food webs, brains, physiological systems, and even down to gene regulatory networks in a single cell. In all of those systems, a massive amount of microscopic components are interacting with each other in non-trivial ways, where critically important information resides in the relationships between parts, not necessarily within parts themselves. It is therefore imperative to construct a model of how such interactions form and operate in order to understand what will emerge at a macroscopic scale in the system.

The recognition of this fact has been intellectually a huge leap from traditional “reductionist” approaches in natural and social sciences, where people used to understand a system by breaking it into parts and accumulating their properties. In the last several decades, however, a plethora of concepts and phenomena have been discovered for which such traditional approaches just do not work, including nonlinear dynamics and chaos, feedbacks and self-reference, pattern formation, evolution and adaptation, agent interaction in games, collective behavior and phase transition, and complex network topologies. While many of them were originally developed in statistical physics and mathematics, they are now recognized as fundamental concepts and applied in many other disciplines beyond physical sciences, ranging from philosophy and social sciences to biology and engineering.

**WHY SHOULD I GET A CERTIFICATE IN COMPLEX SYSTEMS SCIENCE AND ENGINEERING?**

Complex Systems Science and Engineering is a rapidly advancing field of research that investigates structural/dynamical properties of systems to obtain general, cross-disciplinary implications and applications. The broad applicability of its concepts and methodologies to various forms of real-world problems has attracted increasing attention from a number of application areas, including systems engineering, organization management, data analysis, marketing, finance, medicine and healthcare, environmental management, homeland security and defense, education, art and aesthetics, and beyond. Consequently, there are increasing societal demands for personnel that have a solid understanding of complex systems and technical capabilities to model, analyze and manipulate such systems.

Obtaining a Certificate in Complex Systems Science and Engineering will thus help significantly enhance your competitiveness in various professional and academic job markets in the areas such as those listed above. The Certificate will be a strong endorsement for your technical knowledge and skills as well as your intellectual activity and interdisciplinary perspective. This certificate program will also serve as an accessible gateway to STEM-related interdisciplinary areas for those who currently major in humanities or other non-STEM disciplines.

**ABOUT BINGHAMTON UNIVERSITY**

**TOTAL ENROLLMENT:** 14,700+
**GRADUATE SCHOOL ENROLLMENT:** 2,800+
**ACADEMIC COLLEGES:** 6
**SPECIALIZED RESEARCH CENTERS:** 28
**GRADUATE PROGRAMS:** 60+ MASTER’S DEGREE, 30 DOCTORAL DEGREE, NUMEROUS CERTIFICATE PROGRAMS

Binghamton University is a highly selective, mid-sized public institution, one of four research universities within the State University of New York system. Binghamton has a world-class faculty and a reputation for academic distinction.

National publications consistently place Binghamton among the elite public universities in the nation. U.S. News & World Report has listed Binghamton among the top 50 public doctoral universities for over a decade, and the Princeton Review includes Binghamton in its top 10.

Binghamton’s innovative international programs have garnered seven national awards for excellence in internationalism. The University fosters a rich international environment that attracts students from nearly 100 different countries to our campus. One-third of our graduate students are international.

Located in the Southern Tier of upstate New York, the University sits on more than 900 acres in a beautiful hillside setting. Recreational and cultural opportunities abound in the area. Greater Binghamton is a friendly, affordable and safe community just hours away from major metropolitan areas such as New York City, Boston, Philadelphia and Washington, D.C.

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