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TOWSON UNIVERSITY

Kim E. Schatzel, Ph.D.
President

Office of the President
8000 York Road
Towson, MD 21252-0001

June 25, 2021

James D. Fielder, Ph.D.
Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201

Dear Secretary Fielder:

Towson University seeks your review and approval of a **Bachelor of Science in Computer and Mathematical Sciences** under Code of Maryland Regulations (COMAR) 13B.02.03.06.

This program includes two concentrations: Applied Mathematics and Computer Science, and Computer and Mathematical Sciences Secondary Education, addressing Maryland's growing need for Mathematics and Computer science educators.

Please contact Dr. Westley Forsythe if you have any questions or require additional information (410-704-3312, wforsythe@towson.edu).

Thank you in advance for your review.

Sincerely,

Kim Schatzel, Ph.D.
President

KS/wrf

cc: Dr. Antoinette Coleman, Associate Vice Chancellor, Academic Affairs, USM
Dr. David Vanko, Dean Fisher College of Science and Mathematics
Dr. Maggie Reitz, Vice Provost

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Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Towson University

Each action below requires a separate proposal and cover sheet.

- (●) New Academic Program
- ( ) New Area of Concentration
- ( ) New Degree Level Approval
- ( ) New Stand-Alone Certificate
- ( ) Off Campus Program
- ( ) Substantial Change to a Degree Program
- ( ) Substantial Change to an Area of Concentration
- ( ) Substantial Change to a Certificate Program
- ( ) Cooperative Degree Program
- ( ) Offer Program at Regional Higher Education Center

Payment Submitted: ( ) Yes ( ) No | Payment Type: (●) R*STARS ( ) Check | Payment Amount: $850 | Date Submitted:

Department Proposing Program	Computer and Information Sciences	
Degree Level and Degree Type	Bachelor of Science	
Title of Proposed Program	Computer and Mathematical Sciences	
Total Number of Credits	126	
Suggested Codes	HEGIS: 83301.00	CIP: 13.1311
Program Modality	(●) On-campus	( ) Distance Education (*fully online*)
Program Resources	(●) Using Existing Resources	( ) Requiring New Resources
Projected Implementation Date	(●) Fall ( ) Spring ( ) Summer	Year: 2021
Provide Link to Most Recent Academic Catalog	URL: https://catalog.towson.edu/undergraduate/	
Preferred Contact for this Proposal	Name: Westley Forsythe	
	Title: Director of Accreditation and Compliance Services	
	Phone: (410) 704-3312	
	Email: wforsythe@towson.edu	
President/Chief Executive	Type Name: Kim E. Schatzel	
	Signature: Kim Schatzel	Date: 6/28/21
	Date of Approval/Endorsement by Governing Board:	

Revised 3/2019

B.S. Computer and Mathematical Sciences

Executive Summary

The Department of Computer and Information Sciences at Towson University, in partnership with the Department of Mathematics, proposes a new Computer and Mathematical Sciences degree program. This program consists of two concentrations: a Applied Mathematics and Computer Science concentration, and a Computer and Mathematical Sciences Secondary Education concentration addressing Maryland's growing need for Mathematics and Computer science educators.

The proposed Applied Mathematics and Computer Science concentration addresses a growing need for a combined major providing an opportunity for students pursuing computer science to bolster their mathematical and analytical skills and mathematics majors to build foundational computer science skills.

The Computer and Mathematical Sciences Secondary Education concentration will lead to dual teacher certification for Computer Science and Mathematics Secondary Education (grades 7-12). The most recent Maryland teacher staffing report identifies Computer Science and Mathematics as "areas of critical shortage," while the state requires high schools to begin offering at least one computer science course beginning AY 2021-2022 as per 2018 MD House Bill 281. This concentration is designed to address the needs of Maryland schools, many of whom may not be in a position to hire a dedicated computer science educator but would benefit from hiring an educator certified to teach both mathematics and computer science. The dual-certification also addresses graduates' needs, offering them greater flexibility and opportunity to secure employment.

The Departments of Computer and Information Sciences and Mathematics have the resources, experience, and expertise to offer the proposed program to the benefit of the Maryland School districts, future graduates, and the reputation of Towson University.

A. Centrality to institutional mission statement and planning priorities

This program aligns with and supports the Towson University Strategic Plan[1]:

Educate: Both concentrations include innovative and rigorous mathematics and computer science courses that prioritize engaged learning.

Innovate: Being among the first undergraduate Computer Science Education programs in the state, this program exemplifies innovative approaches to learning in STEM teacher preparation. It will also allow faculty to study the successes and challenges of the program, leading to the generation of new knowledge about computer science teacher preparation (a relatively new field of study).

Engage: The Secondary Education concentration, in cooperation with Towson UTeach, will partner with local public schools which serve as Professional Development Sites, bringing expertise about computer science education to the community. After graduation, teacher candidates will serve the region and the state with their ability to offer high-quality computer science courses in local school districts.

Include: Equity in computer science education is a founding principle of this new program. Special attention will be paid in several courses (including COSC418 and COSC 492) to concerns of equity, inclusion, diversity, and justice in computing and computer science education.

Support: The Applied Mathematics and Computer Science concentration will allow for recruiting exceptionally talented computer science and mathematics majors into the dual-focused major, allowing them to build their mathematical and computing expertise simultaneously. The Secondary Education concentration will allow recruiting computer science and mathematics majors to the teaching profession. Both concentrations will

[1] https://www.towson.edu/about/mission/strategicplan.html

support students through engaging campus experiences such as clubs, internships, and undergraduate research experiences.

Sustain: This program promotes sustainability by educating computer science teachers who will be able to sustain the profession by offering high-quality educational experiences to high school students, leading to *more, better prepared*, and *more diverse* computer science majors in the future.

Notable Design Features of the Proposed Program

The proposed Computer and Mathematical Sciences program's Applied Mathematics and Computer Science concentration addresses needs of a growing number of CS students who want to add a strong mathematical background to their CS degree, as well as mathematics majors who want to add a strong computing component to their pure or applied math degree. Given the current demand for computer scientists, especially those equipped with the strong problem-solving skills that come with a strong math background, the interest in this program from both students and industry is expected to grow further. The proposed Applied Mathematics and Computer Science concentration will work to satisfy the currently unmet demand. The Applied Mathematics and Computer Science concentration requires a minimum of 124 credits comprised of: 49 credits in computer science and related core requirements; 44 credits in mathematics, and 31 additional credits to complete the Towson Core Curriculum.

Towson University's proposed Computer and Mathematical Sciences Secondary Education concentration is specifically designed as a dual-certification concentration for computer science and mathematics secondary education. It requires a minimum of 127 credits, is comprised of 36 credits in computer science, 38 credits in mathematics, 25 credits in education, and 28 additional credits in core curriculum. In line with the University's mission statement seeking to meet the educational needs of the state, we have consulted with education, computer science, and mathematics faculty as well as advisers from four local community colleges. We have determined that in each case there exists a potential 2+2 pathway that includes a two-year degree at the community college level and culminates in a bachelor's degree leading to dual certification in computer science and mathematics.

The decision to develop a dual-certification concentration addresses the flexibility of needs of Maryland school districts. Many schools are not currently in the position to hire full-time

teachers in computer science, despite a growing interest to do so. Graduates of this program will help school districts meet their staff needs in computer science, while also serving as mathematics instructors. This type of dual certification approach is supported by national organizations like Code.org (https://code.org/files/TeacherPathwayRecommendations.pdf) as well as conversations among Steering Committee members of the Maryland Center for Computing Education (MCCE). This program also aligns with the University's mission statement seeking to promote economic and workforce development to keep Towson graduates working in Maryland by providing a pathway for graduates who wish to teach computer science to find employment within the Maryland school system.

A dual-certification program in computer science and mathematics will also widen the prospects for recruiting students to this major. To date, there are few pre-service teacher preparation programs in Maryland that lead to secondary education certification in computer science. While awareness of the program matures in the early years, we expect that recruitment from computer science and mathematics majors will contribute significantly to the population of the major.

We note that all courses associated with an SPA assessment for CAEP certification of TU's existing Mathematics Secondary Education major are embedded in the proposed Computer and Mathematical Sciences Secondary Education major. Thus, in terms of certification, graduates of the Mathematics Secondary Education major and those of the proposed Computer and Mathematical Sciences Secondary Education major will not be distinguishable.

B. Critical and compelling regional or State-wide need as identified in the State Plan

There is a dramatic shortage of computing professionals in the U.S. Less than 80,000 bachelor's degrees in computing were awarded in 2019[2], while there were 500,000 unfilled computing jobs[3]. This has serious strategic and economic implications for the nation. As a result, there has been a concerted, national effort to integrate computer science education throughout K-12, jump-started by President Obama through the Computing for All initiative. Indeed, computational thinking has now been identified as a skill as fundamental as reading, writing and arithmetic for today's students, and critical for the U.S. to remain internationally competitive in the future[4]. The National Academies of Science, The National Science Foundation, and Code.org (sponsoring the annual Hour of Code[5], involving 100 million students from 180 countries) highlight some of the ongoing efforts to encourage and support efforts to provide and integrate computational thinking into curricula from elementary through secondary school (and on through the university level). Supplementing the current programmatic offerings at Towson, this new program answers two complementary needs – (1) educating more secondary school teachers in mathematics and computer science; and (2) producing more computing professionals with skills both in mathematics and computer science.

In recent years, computer science education in Maryland has gained greater prominence at the secondary school level. In 2016, the Maryland State Department of Education (MSDE) approved computer science courses as fulfilling the technology education requirement in Maryland public schools. The 2018 MD House Bill 281 requires that beginning in 2021-2022, each MD public school system must require each of its high schools to offer at least one computer science course. This, and a complementary national effort, has been the catalyst for the growing demand for computer science courses in Maryland schools, which, in turn, has created a rapidly growing need for properly trained

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2 https://educationdata.org/number-of-college-graduates/

3 https://csedweek.org/resource_kit/blurbs

4 J.M. Wing, "Computational Thinking," CACM Viewpoint, March 2006, pp. 33-35

5 https://hourofcode.com/us

teachers. This need will likely only increase in the foreseeable future. Current bills under consideration by the Maryland House of Delegates include HB 820, which would require each county school board, beginning in 2023-2024, to submit a report on CS course data, such as enrollment and demographics; HB 823, which would allow students to partially satisfy their mathematics requirements by completing a credit in certain CS courses under certain circumstances; and HB 824, which would create a cybersecurity safety guide and training course to be implemented in public schools. This ongoing legislation demonstrates the increasing attention to Computer Science education at the secondary level, and, if passed into law, will create additional demand for highly qualified computer science teachers.

Increasing the capacity for computer science courses in Maryland high schools can significantly increase the number and diversity of students choosing to major in computer science in college. According to Code.org, students who learn computer science in high school are six times more likely to major in it, while women are 10 times more likely[6]. To meet this challenge, school systems need teachers with the depth of knowledge of computer science commensurate with teachers in the other STEM disciplines. The proposed Computer and Mathematical Sciences program is designed to address this need of teachers and as a result address the greater need for a diverse workforce in the region.

C. Quantifiable and reliable evidence and documentation of market supply and demand in the region and State

The proposed program would be one of the first undergraduate program in the state with the designation of 13.132 (Computer Teacher Education). The most recent Maryland teacher staffing report 2016-2018[7] declares that educators for computer science and mathematics (grades 7-12) are “areas of critical shortage” and the Maryland State Department of Education states a need to expand computer science teacher certification

6 https://code.org/advocacy/state-facts/MD.pdf
7 http://marylandpublicschools.org/stateboard/Documents/10252016/TabF.pdf

options. This program attempts to address this public policy need. Table 1 (below) identifies the number of teacher candidates graduating from an approved program in Mathematics-Secondary Education from all Institutions of Higher in the state of Maryland[8]. Table 1 also demonstrates that Towson University is the leading institution in terms of the number of teacher candidates in Mathematics Secondary Education, indicating that we are well-positioned to offer this new program. Furthermore, the same Maryland State Department of Education data indicates that in all the years that data was collected (2013-2017), there were 0 graduates from Maryland IHEs who completed an approved Computer Science 7-12 certification program. This program attempts to address this public policy need.

Year	*2013-2014*	*2014-2015*	*2015-2016*	*2016-2017*	*Total*
Bowie State University	0	1	1	3	**5**
Frostburg State University	4	2	0	2	**8**
Hood College	0	0	0	2	**2**
Johns Hopkins University	1	1	3	1	**6**
Loyola University Maryland	2	5	1	5	**13**
McDaniel College	2	1	0	3	**6**
Mount St. Mary's University	4	2	1	2	**9**
Notre Dame of Maryland University	8	12	9	7	**36**
Salisbury University	4	8	12	10	**34**
St. Mary's College of Maryland	0	1	1	3	**5**
Stevenson University	0	0	2	1	**3**

[8] MSDE Approved Programs Dashboard: https://mldscenter.maryland.gov/webcenter/faces/oracle/webcenter/page/scopedMD/sa8bbbac1_8caf_4819_a5a1_7b1d774ceb9d/Page6.jspx

Towson University	18	15	8	13	**54**
Univ. of MD Eastern Shore	1	1	0	1	**3**
Univ. of MD University College	7	1	3	4	**15**
Univ. of MD, Baltimore County	7	11	9	3	**30**
Univ. of MD, College Park	11	9	11	13	**44**
Washington College	1	1	0	0	**2**
Total	**70**	**71**	**61**	**73**	**275**

Table 1: Initial teacher certification program graduates by University and year.

D. Reasonableness of program duplication

There exists no current single degree program in the state that is targeted at preparing graduates in both Mathematics and Computer science. The nearest comparison to the proposed program would be Universities that allow students to simultaneously meet the requirements for their Mathematics and Computer science programs, receiving a double major degree. For instance, University of Maryland [9] and McDaniel College [10] allow students to pursue a double major in Mathematics and Computer Science. A dual major degree requires students to complete the requirements of their primary major and take additional units to meet the requirements of the second major. For example, at McDaniel College the computer science major requires up to 54 total hours and the dual major of Computer Science of Mathematics requires an additional 17 hours. In contrast, the proposed program described herein is a single integrated program offering education in the areas of Computer Science and Mathematics.

The proposed program's Secondary Education concentration emphasizes the institutional goals of making Towson a first-choice institution for an increasing percentage of students.

[9] University of Maryland Math and Computer Science Dual major. https://www-math.umd.edu/double-major.html#cs

[10] McDaniel College Computer Science and Mathematics dual major. http://catalog.mcdaniel.edu/preview_program.php?catoid=41&poid=3923&returnto=2712&print

This program would be among only three approved programs in the state of Maryland for undergraduates wishing to pursue computer science secondary education, and the *only* degree program that prepares graduates for dual certification in both mathematics and computer science. The only two other programs in the state that lead to certification in computer science secondary education (at Washington College and University of Maryland – College Park, both approved since 2018) are both single-certification options. Graduates from the secondary education concentration will be certified to teach Mathematics, for which there is a growing need (see Section C. above), and Computer Science, helping to meet the MD House Bill 281 requirement that each high school is required to offer at least one computer science course and the increasing national demand for computer science educators.

E. Relevance to high-demand programs at Historically Black Institutions (HBIs)

Similar programs do not currently exist at HBIs, or elsewhere in the state. This program will have no impact on the uniqueness and institutional identities and missions of HBIs.

F. Relevance to Historically Black Institutions (HBIs)

Similar programs do not currently exist at HBIs, or elsewhere in the state. This program will have no impact on the uniqueness and institutional identities and missions of HBIs.

G. Adequacy of curriculum design and delivery to related learning outcomes consistent with COMAR 13B.02.03.10 (See COMAR Title 13B.02.03.10 for the regulation.)

The Applied Mathematics and Computer Science concentration in this program will not be a screened major and any student admitted to Towson University will be able to select this concentration.

The Secondary Education concentration will require the students to be admitted to the Towson University UTeach program (https://www.towson.edu/fcsm/departments/uteach/admission.html). The updated requirements are guided by the Towson Teacher Education Executive Board standards, and currently include completion of 45 college units, an overall 3.0 GPA, and satisfactory completion of a criminal background check.

Program Educational Objectives:

1. Graduates will be able to apply their depth of understanding in computer and mathematical sciences to facilitate successful careers in computer science and related fields.
2. Graduates will be able to apply their broad knowledge in the fundamental areas of computer and mathematical sciences to allow them to continue their professional development and sustain a life-long career in in the field either through graduate study or continuing self-directed learning and development activities.
3. Graduates will apply their teamwork, communication, and interpersonal skills to enable them to work effectively with interdisciplinary teams and practice their profession with regard to ethical and societal responsibilities.

The program educational objectives directly support the institutional mission by focusing on the development of knowledge in a specialized field, critical thinking skills, and effective communications skills. They also emphasize the institutional goals of developing an awareness of local and global culture and as well as high standards for integrity and societal contributions.

All students in the Computer and Mathematical Sciences Major must complete the shared coursework. Each student will also select the Applied Mathematics and Computer Science or Secondary Education concentration and fulfil all the requirements listed for that concentration. The two concentrations in the program will be assessed independently to support the student learning outcomes for each.

Applied Mathematics and Computer Science Concentration

The Applied Mathematics and Computer Science concentration requires students to complete 124-126 units, distributed between 49 units required from computer science and related core requirements, 44-46 units required from mathematics, and 31 additional units from the core curriculum. These are designed to combine the bulk of the core requirements of the computer science and mathematics majors and to maximize potential synergies between the majors and among their electives so that this concentration replicates the benefits of a double major (in computer science and mathematics) at a lower course load.

Applied Mathematics and Computer Science Concentration Requirements

Required Computer Science Courses (34 credits)

COSC 236	Introduction to Computer Science I	4
COSC 237	Introduction to Computer Science II	4
COSC 290	Principles of Computer Organization	4
COSC 336	Data Structures and Algorithm Analysis	4
COSC 350	Data Communications and Networking	3
CIS 377	Information Systems Security	3
COSC 412	Software Engineering	3
COSC 439	Operating Systems	3
COSC 455	Programming Languages: Design & Implementation	3
COSC 457	Database Management Systems	3

Computer Science Elective Courses: Choose 2 of the following (6 credits)

COSC 397	Internship in COSC	3
COSC 417	Introduction to the Theory of Computing	3
COSC 459	Computer Simulation and Modeling	3
COSC 461	Artificial Intelligence	3
COSC 465	Robotics	3
COSC 471	Computer Graphics	3
COSC 483	Design and Analysis Algorithms	3
COSC 495	Independent Study[2]	3

Required Mathematics Courses (32 credits)

MATH 265	Elementary Linear Algebra	4
MATH 267	Introduction to Abstract Mathematics	4
MATH 273	Calculus I	4
MATH 274	Calculus II	4
MATH 275	Calculus III	4
MATH 330	Introduction to Statistical Methods	4
or MATH 331	Probability	4
MATH 369	Introduction to Abstract Algebra	4
MATH 372	Real Analysis I	4

Math Elective Courses – Group 1: Choose 2 of the following (6-7 credits)

MATH 314	Introduction to Cryptography	3
MATH 331	Probability	4
MATH 332	Mathematical Statistics	3
MATH 374	Differential Equations	3
MATH 377	Mathematical Models	3
MATH 379	Fourier Analysis with Applications	3
MATH 435	Numerical Analysis I	3
MATH 437	Operations Research	3
MATH 439	Computational Probability Models	3

Math Elective Courses – Group 2: Choose 2 of the following (6-7 credits)

MATH 315	Applied Combinatorics	4

MATH 451	Graph Theory	3
MATH 457	Differential Geometry	3
MATH 463	Linear Algebra	3
MATH 465	Number Theory	3
MATH 467	Algebraic Structures	3
MATH 472	Real Analysis II	3
MATH 475	Complex Analysis	3
MATH 477	Topology	3

Required Core Courses (9 credits)

COMM 131	Public Speaking **(Core 5)**	3
ENGL 317	Writing for Business and Industry **(Core 9)**	3
COSC 418	Ethical and Societal Concerns CS **(Core 14)**	3

Total (93-95 required; 31 additional core) 124+
Course catalogue descriptions are included in Appendix I.

Secondary Education Concentration

The Secondary Education concentration will satisfy the Specialized Professional Associations (SPA) assessment for the Council for the Accreditation of Educator Preparation (CAEP) for Mathematics Secondary Education programs. In addition, the concentration will also align with Computer Science Teachers Association Standards (CSTA). Student achievement in each of the following standards will be assessed. Standard 1-16 SPA standards for Mathematics Secondary Education and Standards 17-21 are CSTA standards.

Standard 1: Knowledge of Mathematical Problem Solving
Standard 2: Knowledge of Reasoning and Proof
Standard 3: Knowledge of Mathematical Communication
Standard 4: Knowledge of Mathematical Connections
Standard 5: Knowledge of Mathematical Representation
Standard 6: Knowledge of Technology
Standard 7: Dispositions
Standard 8: Knowledge of Mathematics Pedagogy
Standard 9: Knowledge of Number and Operation
Standard 10: Knowledge of Different Perspectives on Algebra
Standard 11: Knowledge of Geometries
Standard 12: Knowledge of Calculus
Standard 13: Knowledge of Discrete Mathematics

Standard 14: Knowledge of Data Analysis, Statistics, and Probability

Standard 15: Knowledge of Measurement

Standard 16: Field-Based Experiences

Standard 17: Computer Science Knowledge and Skills

Standard 18: Equity and Inclusion

Standard 19: Professional Growth and Identity

Standard 20: Instructional Design

Standard 21: Classroom Practice

Secondary Education Concentration Requirements

Required Computer Science Courses

CIS 377	Information Systems Security	3
COSC 236[1]	Introduction to Computer Science I	4
COSC 237	Introduction to Computer Science II	4
COSC 336	Data Structures and Algorithm Analysis	4
COSC 412	Software Engineering	3
COSC 418	Ethical and Societal Concerns CS **(Core 14)**	3
COSC 109	Computers and Creativity **(Core 4)**	3
ITEC 250	Fundamentals of Computer Networks	3
COSC 482	Teaching Computer Science in Secondary Schools	3
COSC 492	Internship Secondary Education-Computer Science	6

Required Mathematics Courses

MATH 265	Elementary Linear Algebra	4
MATH 267	Introduction to Abstract Mathematics	4
	or MATH 263 Discrete Math	3
MATH 273	Calculus I	4
MATH 274	Calculus II	4
MATH 275	Calculus III	4
MATH 310	Functions and Modeling **(Core 9)**	3
MATH 330	Introduction to Statistical Methods	4
MATH 353	Euclidean and Non-Euclidean Geometry	3
MATH 423	Teaching Mathematics in the Secondary Schools	3
MATH 426	Internship Secondary Education – Mathematics	6

Required Education Courses

SEMS 110	Intro to STEM Teaching I	1
SEMS 120	Intro to STEM Teaching II	1
SEMS 230	Knowing & Learning	3
SEMS 240	Classroom Interactions	3
SEMS 250	Perspectives in Science and Mathematics **(Core 5)**	3
SEMS 370	Project-Based Instruction	3
SEMS 498	Intern. Math and Science Secondary Education	3
SEMS 430	Seminar in STEM Education	1

SCED 460	Using Reading & Writing in the Secondary Schools	4
SCED 461	Teaching Reading in the Secondary Content Areas	3

Total (100 required; 28 additional core) 127+
Course catalogue descriptions are included in Appendix I.

H. Adequacy of articulation

Towson has transfer agreements with community colleges with programs in the CIS Department and beyond. Many courses (that lie outside of articulation agreements) transfer through the transfer equivalency system at Towson (https://tes.collegesource.com/publicview/TES_publicview01.aspx?rid=5238dc5e-5503-4fd6-86a5-13b67093b7d0&aid=8f38118f-ccf9-4534-8f42-bbf970321b39).

Since this program is based on lower-level courses that already exist, we anticipate no issues in transferring equivalent courses form community colleges and other four-year institutions using our current mechanisms.

I. Adequacy of faculty resources (as outlined in COMAR 13B.02.03.11)

Faculty who will contribute to the program:

Faculty Member	Highest Degree Earned - Field and Year	Rank [1]	FT/PT	Courses Teaching [2]
Acharya, Subrata	Ph.D., Computer Science (2008)	P	FT	*NSF Rotation 2020-2021
Ali-Gombe, Aisha	Ph.D., Engineering and Applied Science-Computer Science (2017)	AST	FT	COSC 236
Alkharouf, Nadim	Ph.D. Computational Sciences and Informatics (2004)	P	FT	COSC 236
Brown, Cheryl Thomas	M.S., Information & Telecommunications Systems (1995)	I	FT	CIS 377
Chakraborty, Suranjan	Ph.D., Information Systems (2008)	P	FT	COSC 237

Conover, Adam	Sc.D., Applied Information Technology (2008)	AST	FT	COSC 236, COSC 455
Davani, Darush	Sc.D. Engineering and Applied Science (1985)	P	FT	COSC 175, COSC 459, COSC 465
Dehlinger, Josh	Ph.D., Computer Science (2008)	P	FT	CIS/COSC/ITEC 397, COSC 495
Deng, Lin	Ph.D., Information Technology (2017)	AST	FT	COSC 412
Dierbach, Charles	Ph.D., Computer Science (1991)	ASC	FT	COSC 109, COSC 237, COSC 495
Downing-Harris, Terry	M.S., Business Administration (2005)	I	FT	COSC 175
Dudley, Alfreda	Ph.D., Technology & Culture (2008)	P	FT	COSC 418
Eyer, Robert	M.S. Computer Science (2001)	I	FT	COSC 236
Hilberg, Scott	Ed.D., Organizational Innovation & Leadership (2007)	P	FT	
Hong, Sungchul	Ph.D., Management Science (1999)	ASC	FT	COSC 457
Hornberger, Alex	M.S. Computer Science	I	FT	CIS 377
Hossain, Moinul	Ph.D., Electrical and Computer Engineering (2020)	AST	FT	ITEC 250
Karne, Ramesh	Ph.D. Computer Science (1992)	P	FT	COSC 439

Kaza, Sidd	Ph.D., Management Information Systems (2008)	P	FT	COSC/CIS As needed.
Kelleher, Tina	Ph.D., Literature (2005)	I	FT	COSC 418
Kim, Yanggon	Ph.D., Computer Sciences (1995)	P	FT	COSC 290
Liao, Weixian	Ph.D., Computer Engineering (2018)	AST	FT	COSC 236
Loksa, Dastyni	Ph.D., Information Science – Computer Science Education (2020)	AST	FT	COSC 236
Lu, Chao	Ph.D., Engineering (1988)	P	FT	COSC 290
Meiselwitz, Gabriele	Ed. D., Instructional Technology (2005)	P	FT	COSC 109
Nguyen, Nam	Ph.D., Computer Science	ASC	FT	COSC 336, COSC 483
O'Leary, Michael	Ph.D., Mathematics	P	FT	
Pak, Jinie	Ph.D., Information Systems (2014)	ASC	FT	CIS 377, COSC 418
Saeedloei, Neda	Ph.D., Computer Science (2011)	AST	FT	COSC 455, COSC 461
Sanders, Willie	M.S., Applied Information Technology (2017)	I	FT	CIS 377
Song, Yeong-Tae	Ph.D., Computer Science (1999)	P	FT	COSC 290, COSC 412
Tang, Katherine	Ph.D., Computer Science (2011)	ASC	FT	COSC 336, COSC 439, COSC 471
Tavakolan, Mona	D. Sc., Towson University (2014)	AST	FT	ITEC 250
Taylor, Blair	D.Sc., Applied Information Technology (2008)	ASC	FT	CIS 377, COSC 236

Tessler, Chuck	Ph.D., Computer Science (2019)	AST	FT	COSC 439
Wang, Kathy	Ph.D., Computer and Information Science (2008)	AST	FT	COSC 418
Wijesinha, Alexander	Ph.D., Computer Science (1996)	P	FT	COSC 350
Wilbanks, Linda	Ph.D., Computer Science (1991)	I	FT	CIS 377
Yu, Wei	Ph.D., Computer Engineering (2008)	P	FT	COSC 237
Zimand, Iliana	M.S., Computer Science (1999)	I	FT	COSC 236, COSC 237
Zimand, Marius	Ph.D., Computer Science (1996)	P	FT	COSC 336
Mostafa Aminzadeh	Ph.D. in Statistics	P	FT	Math 27x, 330, 331
Sergiy Borodachov	Ph.D. in Mathematics	P	FT	Math 2xx, 374, 379, 435, 457, 472, 475
Christopher Cornwell	Ph.D. in Mathematics	AST	FT	Math 2xx, 369, 457, 463, 467, 477
Linda Cooper	Ph.D. in Mathematics Education	P	FT	SEMS 240, SEMS 370, Math 330, Math 426
Kimberly Corum	Ph.D. in Mathematics Education	AST	FT	SEMS 370, Math 426
Yunwei Cui	Ph.D. in Statistics	ASC	FT	Math 27x, 330, 331, 332, 439
Min Deng	Ph.D. in Statistics	P	FT	Math 331, 332
Kristin Frank	Ph.D. in Mathematics Education	AST	FT	Math 310, 420, 423, 426

Mathew Gluck	Ph.D. in Mathematics	I	FT	Math 2xx, 372, 374, 377, 435, 457, 472, 475
T Elizabeth Goode	Ph.D. in Mathematics	ASC	FT	Math 2xx, 369, 451,
Vincent Guingona	Ph.D. in Mathematics	AST	FT	Math 2xx, 315, 369, 372, 463, 465, 467
Ge Han	Ph.D. in Mathematics	ASC	FT	Math 27x, 330, 331, 332
Xuezhang Hou	Ph.D. in Mathematics	P	FT	Math 2xx, 372, 374, 379, 472, 475
Min Ji	Ph.D. in Actuarial Science	ASC	FT	Math 27x, 330, 331, 332
Gail Kaplan	Ph.D. in Mathematics	P	FT	Math 310, 320, 423, 426
Opel Jones	Ph.D. in Mathematics	I	FT	Math 2xx, 315, 369, 451
Alexei Kolesnikov	Ph.D. in Mathematics	P	FT	Math 2xx, 314, 315, 369, 377, 437, 467
Angel Kumchev	Ph.D. in Mathematics	P	FT	Math 2xx, 369, 372, 374, 463, 465, 467, 472, 475
Lindsey-Kay Lauderdale	Ph.D. in Mathematics	AST	FT	Math 2xx, 314, 315, 369, 451, 463, 465, 467
Nathan McNew	Ph.D. in Mathematics	AST	FT	Math 2xx, 314, 315, 369, 451, 463, 465, 467

Michael O'Leary	Ph.D. in Mathematics	P	FT	Math 27x, 314, 374, 377, 435, 437, 472, 475
Miriam Parnes	Ph.D. in Mathematics	I	FT	Math 2xx, 315, 369, 374, 463, 467
Moustapha Pemy	Ph.D. in Mathematics	P	FT	Math 27x, 331, 372, 374, 437, 439, 472
Tatyana Sorokina	Ph.D. in Mathematics	P	FT	Math 2xx, 372, 374, 435, 457, 463, 472, 477
Sandy Spitzer	Ph.D. in Mathematics Education	P	FT	SEMS 230, Math 426
Leonid Stern	Ph.D. in Mathematics	P	FT	Math 2xx, 369, 463, 465, 467
Jing Tian	Ph.D. in Mathematics	AST	FT	Math 2xx, 372, 374, 377, 379, 435, 457, 472, 475
Mircea Voisei	Ph.D. in Mathematics	ASC	FT	Math 2xx, 372, 374, 472
Rajeev Walia	Ph.D. in Mathematics	I	FT	Math 27x, 369, 374, 463
Xiaoyin Wang	Ph.D. in Mathematics	P	FT	Math 330, 332
Na Zhang	Ph.D. in Mathematics	AST	FT	Math 27x, 330, 331, 439
Jay Zimmerman	Ph.D. in Mathematics	P	FT	Math 2xx, 369, 451, 457, 465, 467, 475

[1] Code: P=Professor, ASC=Associate Professor, AST=Assistant Professor, I=Instructor, A=Adjunct, O=Other

[2] 2xx and 27x indicates teaching any 200 or 270 Math courses, respectively.

J. Adequacy of library resources (as outlined in COMAR 13B.02.03.12)

Towson University students and faculty benefit from the library's participation in two local library consortia, the University System of Maryland and Affiliated Institutions (USMAI) and the Baltimore Academic Library Consortium (BALC). Towson University students and faculty can order materials through the shared USMAI catalog from other University System of Maryland Libraries and have them delivered directly to the Cook Library in three to five days. The University of Maryland College Park's EPS Library has a particularly strong computer and information science collection to support their well-known Computer Engineering program. University of Maryland at Baltimore County (UMBC) and Bowie State University have solid collections to support their accredited computer science programs. In addition, students and faculty can check out materials from nearby BALC libraries such as Loyola University's library, another accredited computer science institution and member of the Baltimore Academic Library Consortium.

Through the Cook Library's **ILLiad online interlibrary loan system**, students and faculty may request items not available through the USMAI catalog or articles not accessible in print or online format through Cook Library. ILLiad facilitates the electronic delivery of interlibrary loan materials to the desktops of Towson faculty and students. In special cases, Cook Library can rush materials to users in 24 hours, but most interlibrary loan requests are filled within 10 to 14 days. Generally, materials are free to Towson University borrowers, but if the lending library charges special fees these are passed on to borrowers. The interlibrary loan statistics enable the library to identify journals that should be owned at Towson University because of their high use.

K. Adequacy of physical facilities, infrastructure and instructional equipment (as outlined in COMAR 13B.02.03.13)

This program will be housed in the department of Computer & Information Sciences and will utilize the existing physical facilities, infrastructure, and instructional equipment. The program will leverage existing classroom space and optimize timing of courses to offer the proposed program without requiring additional facilities, infrastructure, or instructional equipment. The computing resources available to students, as provided by the department and the university campus computing by OTS, gives students access to abundant computing resources. In addition, the Secondary Education concentration will utilize the

existing infrastructure of the Towson UTeach program that includes two Towson UTeach designated classrooms as well as a student resource center (available for students to study, tutor, and team build).

Classrooms / Teaching Labs

The department has **eight traditional classrooms** and **nine teaching laboratories**, each outfitted with a front instructor's projection station and a front electric projection screen. Each of the classrooms and labs hold approximately 30 students, except for **one larger class** that holds up to 60 students.

Each classroom and teaching lab are equipped with a ceiling mounted Panasonic PT-RZ570 projector and Crestron control system. The instructor can project an image to the class from a variety of systems or viewing devices. The instructor's station is also outfitted with:

- Separate cables (audio, HDMI, Ethernet, and video) for the instructor to connect a laptop or other HDMI devices to the projection system.
- A Mid Atlantic Products PO-915RV-RN Power Amp and Crestron DMPS-300C Audio Mixer
- Bogen HFCSI recessed ceiling speakers (four)

The equipment meets the needs of instructors with different teaching styles, from markers and whiteboard to more web-enhanced and multi-media presentations. Equipment and instructor needs are reviewed each semester and updated as necessary.

Open Project Labs

The department has **two open project labs** that are available for student use. The labs are open from 8am-10pm Monday-Thursday, 8am-5pm Fridays, and 10am-3pm on Saturday and Sunday. Extended hours are available upon request and during Final Exams Week. Students in the secondary education concentration also have access to the UTeach Student Resource Center which includes additional space and contexts for student work.

Research Labs

The department also has **nine research labs** located in the building to facilitate co-located work, meetings, and research. These labs would be accessible to students of the

proposed program should they choose to contribute to research or are interested in more further engaging with the topics addressed in the lab.

- Research Project Lab
- Bare Machine Computing and Software Engineering Lab
- Human Computer Interface (HCI) Lab
- Advanced Network and Honeynet Lab
- Computer Vision Lab
- Forensics and Wireless/RFID Lab
- Learning Management Systems and Voice Over IP Lab
- Network Security Lab
- Bioinformatics Lab

Additionally, the department also has **four specialized technology teaching and research labs**, as follows:

- Security Lab
- Linux-VM Lab
- IT Program Lab
- Hardware Lab

Campus Computing Facilities

The university has a **wireless network** that gives students access to the university systems. Computer labs are also available for all students on campus in Cook Library, maintained by OTS. These labs are available from 8am - 9:30pm Monday-Thursday, 8am - 4pm on Friday, 10am - 5:30pm on Saturday, and 12pm - 9pm on Sunday.

Administrative Offices

The department has adequate office space and facilities for the administrators in the program. The “front/lobby area” of the department is directly off the main hallway. It contains a reasonable-sized waiting area staffed by the same fulltime level-two administrative assistant every day. The offices of the department chair, associate chair, and the Student Services Coordinator are easily accessible to the lobby area expediating addressing any needs for a student, staff, or faculty to speak with the administrators.

Faculty Offices

Each full-time faculty member in the department has their own office. All faculty offices are in the same area, with various printer stations at the perimeters.

Resident Students Computing Access

The **Towson University Resident Network** (ResNet) is a secure network managed by OTS that provides students access to campus computing from their dormitories.

L. Adequacy of financial resources with documentation (as outlined in COMAR 13B.02.03.14)

The proposed program requires minimal additional resources as it is built upon the existing courses in the Mathematics and Computer Science Majors. All but two courses are permanent running courses in the two majors already. Reallocated funds are used to staff the courses (all but two of which already serve existing majors). We predict the hiring of one master teacher at the clinical track.

We do not anticipate needing any additional funding to cover the first year of the program. While we anticipate needing a new faculty member starting in year 2, the expected tuition from students in the proposed program will be enough to cover the salary and benefits of a new faculty member. Please see details in Table 1: Resources and Table 2: Expenditures.

M. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15)

The adequacy of the course content and learning outcomes for both concentrations within the program will be evaluated by a program committee which will be instituted when the program is approved. The program committee shall meet 3 times a semester and will oversee the program. The department of Computer and Information Sciences will be the home department for the program working on close coordination with the Department of Mathematics. While mid-semester meetings will focus on course development issues, the department retreat in August will be used to develop long-term strategic goals for the program and address any changes to accreditation requirements. The program will be assessed within the 7-year assessment cycles at Towson University.

Faculty will be evaluated each semester using quantitative, qualitative and peer evaluations as measures. The evaluations will be reflected upon in the annual faculty reviews.

Student performance and outcomes will be assessed by many metrics including:

- Records of job offers and career advancement.
- Records of admission to graduate program
- Faculty evaluation of students' internship experiences combined with recommendations from industry professional.
- Faculty evaluation of students' paper discussing how they would solving ethical issues related to computer science and related field.

The faculty committee will review the curriculum each semester. Appendix II includes the full Assessment Plan for this program.

N. Consistency with the State's minority student achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education)

Towson University is one of the most diverse higher education institutions in the nation and is staunchly committed to building an inclusive, equitable and diverse campus community. In Fall 2020, a new diversity and equity strategic plan was launched at Towson focusing on TU's aspiration to become a more inclusive and equitable institution of distinction. The Fisher College of Science and Mathematics and Department of Computer and Information Sciences will align their diversity and inclusion plans with the university in 2021. In 2021, the CIS department also begins work on a department-wide effort to increase inclusion and retention of minorities in the computing programs through a grant from the Center of Inclusive Computing at Northeastern University. The CIS department has a student population that has 50% minorities (by race) and this program will use this population as a feeder group. Long-term, enhancing teachers' preparation and ability to offer computer science courses in Maryland high schools is likely to promote diversity within the Department Computer and Information Science (since empirical data suggests that students from historically under-represented populations, such as women and BIPOC,

are more likely to choose computing as a career if they take a computer science course in high school)[11].

O. Relationship to low productivity programs identified by the Commission

Not Applicable.

P. If proposing a distance education program, please provide evidence of adequacy of the program addressing the Council of Regional Accrediting Commissions (C-RAC) Interregional guidelines for the evaluation of distance education (as required in COMAR 13B.02.03.22C).

Not Applicable

[11] https://code.org/diversity

Q. Program Resources and Expenditures Tables

TABLE 1: RESOURCES					
Fill in items highlighted in blue only					
Resources Categories	**(Year 1)**	**(Year 2)**	**(Year 3)**	**(Year 4)**	**(Year 5)**
1. Reallocated Funds[1]	**402,960**	**419,078**	**435,842**	**453,275**	**471,406**
2. Tuition/Fee Revenue[2]	80,916	120,456	159,996	183,720	188,592
a. Annual Full-time Revenue of New Students					
Number of Full-time Students	9	14	19	22	22
Annual Tuition Rate	$7,296	$7,296	$7,296	$7,296	$7,296
Subtotal Tuition	$65,664	$102,144	$138,624	$160,512	$160,512
Annual Fees	$612	$612	$612	$612	$612
Subtotal Fees	$5,508	$8,568	$11,628	$13,464	$13,464
Total Full-time Revenue of New Students	$71,172	$110,712	$150,252	$173,976	$173,976
b. Annual Part-time Revenue					
Number of Part-Time Students	2	2	2	2	3
Credit Hour Tuition Rate	$304	$304	$304	$304	$304
Annual Fees Per Credit Hour	$102	$102	$102	$102	$102
Annual Credit Hours Per Student	12	12	12	12	12
Subtotal Tuition	$7,296	$7,296	$7,296	$7,296	$10,944
Subtotal Fees	$2,448	$2,448	$2,448	$2,448	$3,672
Total Part Time Revenue	$9,744	$9,744	$9,744	$9,744	$14,616
3. Grants, Contracts & Other Sources[3]	**$0**	**$0**	**$0**	**$0**	**$0**
4. Other Sources	**$0**	**$0**	**$0**	**$0**	**$0**
TOTAL (Add 1 - 4)	$483,876	$539,534	$595,838	$636,995	$659,998

TABLE 2: EXPENDITURES

Fill in blue shaded areas only.

Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses	$0	$99,750	$103,740	$107,890	$112,205
(b + c below)					
a. #FTE	0.0	1.0	1.0	1.0	1.0
b. Total Salary		75,000	78,000	81,120	84,365
c. Total Benefits	0	24,750	25,740	26,770	27,840
2. Total Administrative Staff Expenses	0	0	0	0	0
(b + c below)					
a. #FTE	0.0	0.0	0.0	0.0	0.0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Total Support Staff Expenses	0	0	0	0	0
(b + c below)					
a. #FTE	0.0	0.0	0.0	0.0	0.0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	5,000	5,000	5,000	5,000	5,000
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	7,200	7,200	7,200	7,200	7,200
TOTAL (1-7)	$12,200	$111,950	$115,940	$120,090	$124,405

Appendix I – Course Descriptions

CIS 377 INTRODUCTION TO CYBERSECURITY (3)

Provides an overview of key cybersecurity concepts and practices and broadly characterizes the global security landscape, including cyber law and cyber warfare. It is structured as a series of ordered modules that cover foundational security principles, risk management, and adversarial thinking as an organizing narrative for a series of modules on data security, system security, network security, personal security, and societal security. Prerequisite: major or minor sophomore standing.

COMM 131 PUBLIC SPEAKING (3)

Perspectives of rhetoric and public speaking, investigating contemporary American experiences, delivering, and critiquing speeches. Core: Arts & Humanities.

COSC 109 COMPUTERS AND CREATIVITY (3)

Creative activities involving symbolic manipulation and computer graphics; animation, dynamic storytelling, computer music, visual effects, Web publishing, computer games, artwork and multimedia. Additional laboratory time required. Core: Creativity & Creative Development.

COSC 236 INTRODUCTION TO COMPUTER SCIENCE I (4)

Introduction to structured problem solving, algorithm development and computer programming. Three lecture hours and two laboratory hours. Prerequisites: COSC 175 and (MATH 119, MATH 231, MATH 273, MATH 274, MATH 275, or a qualifying score on the Math Placement exam).

COSC 237 INTRODUCTION TO COMPUTER SCIENCE II (4)

Development of programming and problem-solving skills, with a focus on object-oriented programming and design. Students will design and develop programs using encapsulation and information hiding, inheritance, polymorphism, and generics. Introduction to data structures and their implementations (lists, stacks, queues, and trees), recursion, and searching and sorting algorithms. Includes two laboratory hours per week. Prerequisites: COSC 236; MATH 211 or MATH 273.

COSC 290 PRINCIPLES OF COMPUTER ORGANIZATION (4)

Computer organization and architecture including computer arithmetic, digital logic, principles of assembly language, memory system organization, computer interfacing,

CISC and RISC architecture. Three hours per week of laboratory work required. Prerequisites: COSC 236 and (MATH 263 or MATH 267).

COSC 336 DATA STRUCTURES AND ALGORITHM ANALYSIS (4)
Fundamental data structures used in programming and the basic techniques used to design and analyze algorithms. Topics include: complexity analysis of elementary algorithms, linear data structures, trees, heaps, graphs, search algorithms (balanced binary trees, B-trees, hashing), sorting algorithms, basic graph algorithms (graph traversal, topological sorting, shortest path, minimum spanning trees), and paradigms in the design of algorithms (divide and conquer, dynamic programming, greedy). Prerequisites: COSC 237 and MATH 274.

COSC 350 DATA COMMUNICATIONS AND NETWORKING (3)
Network architecture and protocols, data communications, LANs and cellular networks, forwarding and routing, TCP/IP suite, network programming and packet analysis. Corequisite: COSC 336. Prerequisite: COSC 290.

COSC 397 INTERNSHIP IN COSC (3)
Students work in local computing facility under on-site and faculty supervision. May be repeated for a maximum of 6 units. Only 3 units can be applied to the major. Graded S/U. Prerequisites: 6 units of upper-level COSC courses, 2.75 GPA, and consent of the internship coordinator

COSC 412 SOFTWARE ENGINEERING (3)
Methodology of designing and programming for a wide area of applications with a high degree of modifiability, efficiency, reliability, and understanding. Prerequisite: COSC 336

COSC 417 INTRODUCTION TO THE THEORY OF COMPUTING (3)
A general introduction to the theory of computation, including finite automata, compatibility, formal languages and their relation to automata, algorithms, and algorithmic complexity. The major emphasis will be on developing formal descriptions of computers and computational processes, and practical implications of theoretical results. Prerequisite: COSC 336.

COSC 418 ETHICAL AND SOCIETAL CONCERNS OF COMPUTER SCIENTISTS (3)
Ethical questions and societal concerns related to the widespread use of computers and the resulting responsibilities of computer scientists. Prerequisites: junior/senior standing;

ENGL 317 or BUSX 301; must have previously taken a computing class. Core: Ethical Issues & Perspectives.

COSC 439 OPERATING SYSTEMS (3)
Operating systems as resource managers with emphasis on file processor, memory and device management and processes. Design and implementation of a simulated multiprogramming operating system. Prerequisite: COSC 336.

COSC 455 PROGRAMMING LANGUAGES: DESIGN & IMPLEMENTATION (3)
Underlying concepts in high-level programming languages and techniques for their implementation, a survey of a selected group of such languages along with a discussion of the interrelationship between programming and programming languages. Prerequisite: COSC 336.

COSC 457 DATABASE MANAGEMENT SYSTEMS (3)
Data models and sublanguages; security and integrity problems; functions of the database administrator; implementation and use of a database management system; a comparison of widely used DBMS packages. Prerequisite: COSC 336.

COSC 459 COMPUTER SIMULATION & MODELING (3)
Simulation models and languages, data collection and output analysis, random number generation and Monte Carlo integration, model verification and validation, variance reduction techniques, optimization, the implementation and use of simulation techniques in problem solving. Prerequisites: COSC 336 and MATH 330 or CIS 334 and MATH 231

COSC 461 ARTIFICIAL INTELLIGENCE (3)
A survey of the problems and techniques involved in producing or modeling intelligence in computers. Particular emphasis will be placed on representation of knowledge and basic paradigms of problem solving. Topics include game playing, theorem proving, natural language, and learning systems. Prerequisite: COSC 336 or CIS 334.

COSC 465 ROBOTICS (3)
Physical mechanisms of robotics, issues of modeling, planning control and programming. Principles underlying the design and analysis of robotic systems, with emphasis on the autonomous, and behavior-based systems. Prerequisites: COSC 336.

COSC 471 COMPUTER GRAPHICS (3)

An introduction to the field of computer generated and/or displayed graphics data. Covers the topics of representation, transformations, curve and 3-D problems, graphics hardware, and programming considerations. Prerequisite: COSC 336.

COSC 483 DESIGN & ANALYSIS ALGORITHMS (3)

Algorithm design methods such as heuristics, backtrack programming, branch and bound, recursion, simulation, divide-and-conquer, balancing, and dynamic programming. Efficiency of algorithms - NP-complete problems. Prerequisite: COSC 336.

COSC 495 INDEPENDENT STUDY (1-3)

Directed study in selected areas of Computer Science for which there is no regular course offered. The use of a proposal and well-defined objectives as well as a formal paper or project report are required. Prerequisites: senior standing in Computer Science and consent of instructor.

COSC 482 Teaching Computer Science in Secondary Schools

Design learning environments that promote effective teaching and learning in computer science classrooms. Build skills planning and developing lessons and units that will include real-world computing problems and project-based methodologies that support active and authentic learning and provide opportunities for creative and innovative thinking. The course will cover the basics of how to teach key computer programming concepts and data abstraction along with the introduction of elements of physical computing.

COSC 492 Internship Secondary Education-Computer Science

During this experience students will 1) design instruction appropriate for all students that reflects an understanding of relevant content and is based on continuous and appropriate assessments, 2) create a classroom environment of respect and rapport that fosters a positive climate for learning, equity, and excellence, 3) promote student learning by providing responsive instruction that makes use of effective communication techniques, instructional strategies that actively engage students in the learning process, and timely high-quality feedback, and 4) fulfill professional roles and responsibilities and adhere to legal and ethical requirements of the profession.

ITEC 250 FUNDAMENTALS OF COMPUTER NETWORKS (3)

Based upon the Open Systems Interconnection Reference Model developed by the International Standards Organization. Topics include networking basics, network types and topologies, network protocols, reference models, network hardware, network applications and services, network operating systems and basic network security. Virtual lab, network management, and network simulation tools will be used. Prerequisites: COSC 236 or ITEC 236.

MATH 263 DISCRETE MATHEMATICS (3)

Sets, logic, induction, functions, relations, sequences, recursion, combinatorics, graphs and trees, matrices with an emphasis on applications in computer science. Prerequisite: four years of high school mathematics or MATH 119. Core: Mathematics.

MATH 265 ELEMENTARY LINEAR ALGEBRA (4)

Matrix calculations and determinants, vector spaces over the real numbers, linear transformations, eigenvalues, eigenvectors, and inner products with emphasis on applications. Not open to students who successfully completed MATH 365 or MATH 463. Prerequisite: MATH 211 or MATH 273.

MATH 267 INTRODUCTION TO ABSTRACT MATHEMATICS (4)

Sets, mappings, relations, logic, mathematical induction, properties of the integers, Fundamental Theorem of Arithmetic, polynomials, and elementary analytic concepts. Not open to those who successfully completed MATH 361 or MATH 467. Prerequisites: MATH 273 and MATH 265 or consent of the instructor.

MATH 273 CALCULUS I (4)

Functions, limits, and continuity; differentiation of algebraic and trigonometric functions; mean value theorem; differentials; introduction to integration; applications. Four lecture hours and one laboratory hour per week. Prerequisite: qualifying score on Math Placement exam or MATH 119. Core: Mathematics. Lab/Class fee will be assessed

MATH 274 CALCULUS II (4)

Differentiation and integration of exponential, logarithmic, and inverse trigonometric functions; techniques of integration and applications; indeterminate forms; improper integrals; sequences and series of numbers; power series. Prerequisite: MATH 273. Core: Mathematics. Lab/Class fee will be assessed.

MATH 275 CALCULUS III (4)

Vectors in two and three dimensions, differential, and integral calculus of functions of several variables. Four lecture hours and one laboratory hours per week. Prerequisite: MATH 274. Lab/Class fee will be assessed.

MATH 310 FUNCTIONS AND MODELING FOR SECONDARY SCHOOL TEACHERS (3)

Engagement in explorations of mathematics to broaden and deepen content knowledge, emphasizing concepts needed to teach secondary mathematics at various levels. Investigations into mathematical topics including regressions in modeling; functions, rates, and patterns; and functions in other systems, with an emphasis on written communication about mathematical ideas and models. Prerequisites: ENGL 102 or ENGL 190 or equivalent; MATH 273, MATH 274, and MATH 265; either SEMS 230 or SCED 305 (may be taken concurrently); MATH 267 is recommended. Core: Advanced Writing Seminar.

MATH 314 INTRODUCTION TO CRYPTOGRAPHY (3)

A broad introduction to cryptography and its mathematical foundations: Elementary number theory; classical and modern symmetric key cryptosystems; public key cryptography; primality tests, factoring algorithms; hash functions and digital signatures. Selected further topics may include security protocols, digital cash, elliptic curve cryptography, or quantum cryptography. Prerequisites: COSC 236; either MATH 263 or MATH 267; and either MATH 330 or MATH 331 (may be taken concurrently).

MATH 315 APPLIED COMBINATORICS (4)

General counting methods, pigeonhole principle, inclusion-exclusion principle, generating functions, recurrence relations, summation techniques, partitions, permutations and pattern avoidance, Polya's enumeration, asymptotics, select topics from graph theory. Prerequisites: MATH 274; MATH 263 or MATH 267.

MATH 330 INTRODUCTION TO STATISTICAL METHODS (4)

An introductory course for students with mathematics and computing backgrounds emphasizing statistical ideas and techniques. Descriptive statistics, probability, estimation and sampling, hypothesis testing, regression and correlation, and analysis of variance. A statistical package such as MINITAB is introduced as a computational tool. Prerequisite: MATH 274.

MATH 331 PROBABILITY (4)

Probability in sample spaces, discrete and continuous random variables, distribution theory, Chebyshev's Theorem, Central Limit Theorem, expected values and moments. Prerequisite: MATH 275 (may be taken concurrently).

MATH 332 MATHEMATICAL STATISTICS (3)

Sample theory and distributions, point estimation, confidence intervals, tests of hypothesis, and theory of statistical inference. Prerequisite: Math 331 (MATH 531).

MATH 353 EUCLIDEAN AND NON-EUCLIDEAN GEOMETRIES (3)

Review of synthetic Euclidean geometry, non Euclidean geometries, finite geometries and systems of axioms, classical theorems and elementary transformations. Prerequisite: MATH 267 or all three of the following: MATH 251, MATH 273, and MATH 265.

MATH 369 INTRODUCTION TO ABSTRACT ALGEBRA (4)

Elementary number theory; congruences, groups up to and including the isomorphism theorems, commutative rings, polynomials, unique factorization, irreducibility, finite fields. Prerequisites: MATH 265, MATH 267, and MATH 274.

MATH 372 REAL ANALYSIS I (4)

An introduction to the real numbers and the analytic properties of real-valued sequences and functions. The set of real numbers; sequences and series; continuous functions and uniform continuity; differentiation; Riemann integration. Prerequisites: MATH 267 and MATH 275.

MATH 374 DIFFERENTIAL EQUATIONS (3)

Theory and application of linear ordinary differential equations: homogeneous and nonhomogeneous linear equations, initial and boundary value problems, exact equations, variation of parameters, Euler equations; solutions of non-linear ordinary differential equations of the first order and second order; power series solutions; system of linear equations. Prerequisite: MATH 274.

MATH 377 MATHEMATICAL MODELS (3)

Developing appropriate mathematical models and techniques to solve mathematical problems in sociology, psychology, economics, management science, and ecology. Prerequisites: MATH 265, MATH 274, COSC 236 and at least junior standing.

MATH 379 FOURIER ANALYSIS WITH APPLICATIONS (3)
Fourier series, orthogonal functionspartial differential equations, and boundary value problems. The Fourier integral and applications. Prerequisite: MATH 275.

MATH 423 TEACHING MATHEMATICS IN THE SECONDARY SCHOOLS (3)
Best practices for teaching mathematics at the secondary level; analysis and application of methods for planning, conducting, and reflecting on mathematics instruction and assessment. Prerequisites: MATH 353 (may be taken concurrently) and concurrent enrollment in SEMS 498, or permission of instructor.

MATH 426 INTERNSHIP IN SECONDARY EDUCATION - MATHEMATICS (6-12)
Field experience in public school classrooms under the guidance of master teachers and a university supervisor. Graded S/U. Prerequisites: MATH 423, SEMS 498, and permission of Mathematics Department and Towson UTeach. Internship/Practicum fee will be assessed

MATH 435 NUMERICAL ANALYSIS I (3)
Error analysis, interpolation, numerical differentiation and integration, numerical solution of algebraic equations, direct and iterative techniques for solving linear systems of algebraic equations. Mathematical and comparable computer algebra systems will be used. Prerequisites: MATH 265, MATH 274, and COSC 236.

MATH 437 OPERATIONS RESEARCH (3)
Introduction to linear, integer and nonlinear programming, the simplex method and interior point methods, duality and sensitivity analysis; formulation of optimization models and applications to problems from industry. Prerequisites: MATH 265 and MATH 331.

MATH 439 COMPUTATIONAL PROBABILITY MODELS (3)
Markov chains, exponential distribution, Poisson process, continuous time Markov chains, Brownian motion and stationary processes. Prerequisite: MATH 331.

MATH 451 GRAPH THEORY (3)
Hamiltonian and Eulerian graphs, coloring graphs, planar and non-planar graphs, connectivity problems; isomorphic graphs, and advanced topics. Prerequisite: MATH 263 or MATH 267.

MATH 457 DIFFERENTIAL GEOMETRY (3)

Curvatures of curves and surfaces in three dimensional Euclidean space, geodesics, invariants, mappings, and special surfaces. Prerequisite: MATH 275 and MATH 265.

MATH 463 LINEAR ALGEBRA (3)

Vector spaces over arbitrary fields, linear transformations, eigenvalues, eigenvectors, inner products, bilinear forms, direct sum decompositions and the Jordan form. Prerequisites: MATH 265 and MATH 267.

MATH 465 NUMBER THEORY (3)

An introduction to elementary number theory: prime numbers, prime factorization, modular arithmetic, arithmetic functions, primitive roots, and quadratic residues. Additional topics may include: elliptic curves, Diophantine equations, sums of squares, the distribution of primes, and applications. Prerequisites: MATH 263 or MATH 267; and MATH 274.

MATH 467 ALGEBRAIC STRUCTURES (3)

Topics include groups, solvability, and insolvability of polynomials, principal ideal, Euclidean, and unique factorization domains. Prerequisite: MATH 369.

MATH 472 REAL ANALYSIS II (3)

A second course in real analysis. Sequences of functions and uniform convergence; Metric spaces, including completeness and compactness. Functions of several variables including derivatives and differentiability, multivariable integrals and Fubini's theorem, null sets and Riemann integrability. Prerequisite: MATH 372 or MATH 473.

MATH 475 COMPLEX ANALYSIS (3)

Complex number system, analytic functions, Cauchy's integral theorem and integral formula, Taylor and Laurent series, isolated singularities, Cauchy's residue theorem and applications. Prerequisite: MATH 275.

MATH 477 TOPOLOGY (3)

Basic concepts of point set topology, separation axioms, compact and connected spaces, product and quotient spaces, convergence, continuity and homeomorphisms. Prerequisites: MATH 267 and MATH 275.

ENGL 317 WRITING FOR BUSINESS AND INDUSTRY (3)

Standard written formats used in business and industry, including correspondence, memoranda, and reports. Projects individualized to meet student needs and career interests. Requires grade of C or better to fulfill Core requirement. Prerequisite: ENGL 102 or ENGL 190 or equivalent. Core: Advanced Writing Seminar.

SEMS 110 INTRODUCTION TO STEM TEACHING I: INQUIRY APPROACHES TO TEACHING (1)

A first exploration into teaching as a career, emphasizing inquiry-based science and constructivist mathematics. Field experience with upper elementary grades includes two classroom observations and three teaching experiences.

SEMS 120 INTRODUCTION TO STEM TEACHING II: INQUIRY-BASED LESSON DESIGN (1)

A second exploration into teaching as a career, focusing on the development of SE lesson plans aligned to district curricula; attributes of adolescent students; utilization of technology; questioning strategies; and formal and informal methods of assessment. Middle school field experience in either mathematics or science includes classroom observations and three teaching experiences. Credit will not be given for both SEMS 120 and SEMS 130. Prerequisite: SEMS 110.

SEMS 230 KNOWING AND LEARNING (3)

For prospective mathematics and science teachers to construct the model of knowing and learning that they will take with them into their classrooms. Focuses on issues of what it means to know and learn science and mathematics: What are the standards for knowing? How are knowing and learning structured? How does what we know change and develop? Prerequisite: SEMS 120 or SEMS 130 (may be taken concurrently).

SEMS 240 CLASSROOMS INTERACTIONS (3)

Centered around a close examination of the interplay between teachers, students, and content, and how such interactions enable students to develop deep conceptual understanding, students design and implement instructional activities informed by their understanding of knowing and learning mathematics and science. Focus is given to building awareness and understanding of equity issues and their effects on learning and developing strategies for teaching students of diverse backgrounds equitably. Prerequisites: SEMS 120 or SEMS 130; SEMS 230 (may be taken concurrently).

SEMS 250 PERSPECTIVES IN SCIENCE AND MATHEMATICS (3)

Explores a selection of topics and episodes in the history of science and mathematics. Illustrates how knowledge has often emerged through torturous struggles against obstinate resistance and within cultural, religious, and social structures. Students are brought to understand that science and mathematics are not merely bodies of facts, theories, and techniques; they involve diverse processes by which they are continually generated and formulated. Prerequisite: MATH 115 or MATH 119 or MATH 211 (may be taken concurrently) or MATH 273 (may be taken concurrently). Core: Arts & Humanities.

SEMS 370 PROJECT-BASED INSTRUCTION (3)

Course has three essential components: a theory-driven perspective about how people learn and how project-based instruction may be among our most informed classroom learning environments; a technological component that will assist students in developing their own project-based unit; a field experience of observation and teaching of well-implemented project-based instruction in local schools. Prerequisites: SEMS 230 and SEMS 240.

SEMS 498 INTERNSHIP IN MATHEMATICS AND SCIENCE SECONDARY EDUCATION (3)

Clinical experience in a professional development school the term immediately prior to the full-time student teaching internship. Focus on classroom management, technology utilization, and reflective practices. Prerequisite: by permission of Towson UTeach. Graded S/U. Internship/Practicum fee will be assessed.

SCED 460 USING READING AND WRITING IN THE SECONDARY SCHOOLS (4)

Developmental reading and writing assessment; vocabulary building; comprehension; special needs adaptations; clinical practice. Individualized grade level experiences for specific content areas will be provided. Prerequisite: SCED 341 (may be taken concurrently) or permission of Towson UTeach.

SCED 461 TEACHING READING IN THE SECONDARY CONTENT AREAS (3)

Application and assessment of reading strategies and instructional frameworks in secondary content classrooms. Individualized grade level experiences for specific content areas will be provided. Prerequisites: SCED 460 and currently teaching or student teaching.

Appendix II - Assessment plan

To assess the curriculum, program educational objectives are further defined and mapped to student learning outcomes to better measure students' learning in this program. Therefore, assessment plan is presented using the student learning outcomes (SLO) based on the following mapping.

P1: Graduates will be able to apply their depth of understanding in computer and mathematical sciences to facilitate successful careers in computer science and related fields. (CS1, CS2, CS3, CS6, CS7, M1, M2, M3, M4, M5)

P2: Graduates will be able to apply their broad knowledge in the fundamental areas of computer and mathematical sciences to allow them to continue their professional development and sustain a life-long career in in the field either through graduate study or continuing self-directed learning and development activities. (CS6, CS7, M1-M5)

P3: Graduates will apply their teamwork, communication, and interpersonal skills to enable them to work effectively with interdisciplinary teams and practice their profession with regard to ethical and societal responsibilities. (CS3, CS4, CS5)

Student Learning Outcomes By Course Level:

1. CS1: An ability to analyze a problem, and to identify and define the computing requirements appropriate for its solution.
2. CS2: An ability to design, implement, and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.
3. CS3: An ability to communicate effectively with a range of audiences about technical information.
4. CS4: An ability to make informed judgments in computing practice based on legal and ethical principles.
5. CS5: An ability to function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk, and produce deliverables.
6. CS6: An ability to apply theory in the design and implementation of computer-based solutions.

7. CS7: An ability to reason about and explain computer-based solutions at multiple levels of abstraction.
8. M1: Demonstrate knowledge of the properties of numbers and sets.
9. M2: Demonstrate skills and knowledge of appropriate technology used in solving mathematical problems.
10. M3: Demonstrate skills and knowledge of the basic concepts of calculus.
11. M4: Demonstrate skills and knowledge of linear and abstract algebra.
12. M5: Demonstrate skills and knowledge of basic probability and/or statistics.

Curricular Alignment with Student Learning Outcomes:

(✓: outcome will be covered in the course, X: assessment data will be collected in the course)

Curriculum that addresses program learning outcomes in CS	SLO 1 (CS1)	SLO 2 (CS2)	SLO 3 (CS3)	SLO 4 (CS4)	SLO 5 (CS5)	SLO 6 (CS6)	SLO 7 (CS7)
COSC 236	✓	✓					✓
COSC 237	✓	✓					✓
COSC 290		✓				✓	✓
COSC 336	✓X	✓				✓	✓
COSC 350	✓	✓				✓	✓
COSC 412	✓	✓X	✓X		✓X		✓
COSC 418			✓	✓X			
COSC 439		✓	✓		✓	✓X	✓X
COSC 455		✓				✓	✓
COSC 457		✓			✓	✓	✓

1. M1: Demonstrate knowledge of the properties of numbers and sets.
2. M2: Demonstrate skills and knowledge of appropriate technology used in solving mathematical problems.
3. M3: Demonstrate skills and knowledge of the basic concepts of calculus.
4. M4: Demonstrate skills and knowledge of linear and abstract algebra.

5. M5: Demonstrate skills and knowledge of basic probability and/or statistics.

Curriculum that addresses program learning outcomes in MATH	SLO 8 (M1)	SLO 9 (M2)	SLO 10 (M3)	SLO 11 (M4)	SLO 12 (M5)
MATH 265				✓	
MATH 267	✓X				
MATH 273			✓		
MATH 274		✓	✓		
MATH 275		✓X	✓X		
MATH 369				✓X	
MATH 331					✓X
MATH 372	✓				

Student Learning Outcomes & Assessment Measures:

	Brief Description of Measure		
	Measure 1	**Measure 2**	**Measure 3**
Outcome 1	Project and targeted exam questions from COSC336	Student exit survey – Question 6	Alumni Survey – Question 5a
Outcome 2	Project from COSC412	Student exit survey – Question 7	Alumni Survey – Q 5b
Outcome 3	Project presentations from COSC412	Student exit survey – Question 8	Alumni Survey – Question 5c
Outcome 4	Final project from CIS418	Student exit survey – Question 9	Alumni Survey – Question 5d
Outcome 5	Project from COSC412	Student exit survey – Question 10	Alumni Survey – Question 5e
Outcome 6	Targeted exam questions from COSC439	Student exit survey – Question 11	Alumni Survey – Question 5f
Outcome 7	Project and targeted exam questions from COSC439	Student exit survey – Question 12	Alumni Survey – Question 5g
Outcome 8	MATH 267	Student exit survey – Question 13	Alumni Survey – Question 6a
Outcome 9	MATH 275	Student exit survey – Question 14	Alumni Survey – Question 6b
Outcome 10	MATH 275	Student exit survey – Question 15	Alumni Survey – Question 6c

Outcome 11	MATH 369	Student exit survey – Question 16	Alumni Survey – Question 6d
Outcome 12	MATH 371	Student exit survey – Question 17	Alumni Survey – Question 6e

Student Learning Outcomes & Targeted Performance:

	Brief Description of Measure		
	Measure 1	**Measure 2**	**Measure 3**
Outcome 1	For grades…in the absence of other specific grading rubrics, average scores of 70% or higher on exams, assignments, and projects is considered meeting standard; average scores of 85% or higher are considered exceeding standard	For Senior Exit Survey…70% or more of the students "agree" or "strongly agree" that the learning goal has been met for them is considered meeting standard; 85% or higher "agree" or "strongly agree" is considered exceeding standard	For Alumni Survey…70% or more respondents feel moderately to completely prepared in the field is considered meeting standard; 85% or more feel moderately to completely prepared in the field is considered exceeding standard
Outcome 2	<Same as above>	<Same as above>	<Same as above>
Outcome 3	<Same as above>	<Same as above>	<Same as above>
Outcome 4	<Same as above>	<Same as above>	<Same as above>
Outcome 5	<Same as above>	<Same as above>	<Same as above>
Outcome 6	<Same as above>	<Same as above>	<Same as above>
Outcome 7	<Same as above>	<Same as above>	<Same as above>
Outcome 8	<Same as above>	<Same as above>	<Same as above>
Outcome 9	<Same as above>	<Same as above>	<Same as above>
Outcome 10	<Same as above>	<Same as above>	<Same as above>
Outcome 11	<Same as above>	<Same as above>	<Same as above>
Outcome 12	<Same as above>	<Same as above>	<Same as above>

Student Learning Outcome & Collection Cycle:

	Collection Cycle		
	Measure 1	**Measure 2**	**Measure 3**
Outcome 1	Every other fall semester – COSC336	Survey administered each semester; Data analyzed: every other fall semester	Every three years in spring semester

Outcome 2	Every other spring semester – COSC412	Survey administered each semester; Data analyzed: every other spring semester	Every three years in spring semester
Outcome 3	Every other spring semester – – COSC412	Survey administered each semester; Data analyzed: every other spring semester	Every three years in spring semester
Outcome 4	Every other spring semester (even year)– COSC418	Survey administered each semester; Data analyzed: every other spring semester (even year)	Every three years in spring semester
Outcome 5	Every other spring semester – COSC412	Survey administered each semester; Data analyzed: Every other spring semester	Every three years in spring semester
Outcome 6	Every other spring semester (even year)– COSC439	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester
Outcome 7	Every other spring semester (even year)– COSC439	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester
Outcome 8	Every other fall semester -- MATH 267	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester
Outcome 9	Every other fall semester -- MATH 275	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester

Outcome 10	Every other fall semester -- MATH 275	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester
Outcome 11	Every other fall semester -- MATH 369	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester
Outcome 12	Every other fall semester -- MATH 371	Survey administered each semester; Data analyzed: Every other spring semester (even year)	Every three years in spring semester