CURRICULUM OF

Master of Science in Applied Mathematics and Computational Science (AMCS)

Department of Mathematics and Physics
School of Engineering and Physical Sciences
North South University

Bashundhara, Dhaka-1229, Bangladesh

1 PART A: INTRODUCTION

1.1 TITLE OF THE PROGRAM

Master of Science in Applied Mathematics and Computational Science (MSc in AMCS)

1.2 NAME OF THE UNIVERSITY North South University

1.3 VISION OF THE UNIVERSITY

North South University will be and remain a center of excellence in higher education. It will gain recognition nationally and globally, and will attract students, faculty, and staff from all parts of the world.

1.4 MISSION OF THE UNIVERSITY

The mission of North South University is to produce competent graduates in their selected disciplines who will have productive careers or choose to engage in advanced studies.
Our students will be:

1. Life-long learners with good leadership skills
2. More proficient in oral, written and electronic communication
3. Critical thinkers with well-developed analytical skills
4. Ethical and socially responsible
5. Champions of diversity and tolerance

6. Globally aware with commitment to social justice and sustainability

1.5 NAME OF THE PROGRAM OFFERING ENTITY Department of Mathematics and

Physics (DMP)

1.6 VISION OF THE PROGRAM OFFERING ENTITY

The Department of Mathematics and Physics (DMP) would like to transform into a full-fledged Department of Mathematical and Physical Sciences, which will offer eventually undergraduate majors in both Mathematics and Physics. DMP will also be a center of excellence for graduate and undergraduate research in Mathematical and Physical Sciences.

1.7 MISSION OF THE PROGRAM OFFERING ENTITY

The mission of the Department of Mathematics and Physics (DMP) at North South University (NSU) is to equip students of the university with mathematics and physics backgrounds through quality teaching and excellent research. The specific missions of DMP are as follows:

M1	To equip the students with mathematics and physics backgrounds by offering undergraduate major programs in both Mathematics and Physics
M2	To provide quality education in mathematics and physics to students of different disciplines under various departments across the university
M3	To enrich the existing undergraduate minor programs in Mathematics and Physics to attract the best caliber Engineering, Economics, Business, and Environmental sciences majors
M4	To disseminate the knowledge in mathematics and physics through cutting-edge research to serve as a resource center of mathematics and physics expertise

1.8 OBJECTIVES OF THE PROGRAM OFFERING ENTITY

To support its vision and mission, the Department of Mathematics and Physics (DMP) at North South University has established the following goals:

1. To become a full-fledged department by offering major programs in Mathematics and in Physics, and maintain a high standard in teaching and learning
2. To enrich the existing minor programs more efficiently to attract students of different disciplines across the university
3. To provide an international standard curriculum by offering advanced education and research training with modern computing facilities
4. To prepare students with skills in critical-thinking, analysis, communication, teamwork, leadership, social awareness, diversity, tolerance, ethics, and sustainability
5. To obtain national and international recognitions both in academia and in industry

1.9 NAME OF THE DEGREE

Master of Science in Applied Mathematics and Computational Science (MSc in AMCS)

1.10 DESCRIPTION OF THE PROGRAM

The Master of Science in Applied Mathematics and Computational Science (MSc in AMCS) degree is intended to provide the student a working knowledge of several areas of applied mathematics, which may include a specific area of application, to prepare for a dynamic career in industry and academia. In addition to providing a solid conceptual foundation for the applications of mathematics, students will be prepared to complete a thesis in topics related to Applied Mathematics and Computational Science.

- VISION OF THE PROGRAM

The Master of Science in Applied Mathematics and Computational Science (MSc in AMCS) wishes to develop and enhance students' understanding and skill by offering advanced education and research training in applied mathematics.

- MISSION OF THE PROGRAM
- To educate the students to meet high standards of excellence in applied mathematics by offering comprehensive up-to-date education in the main areas of computational and applied mathematics
- To foster skilled applied mathematicians equipped with advanced computing knowledge and well-prepared for professional careers or PhD studies
- To create and disseminate progressive knowledge through applied research in different fields of applied and computational mathematics

1.11 GRADUATE ATTRIBUTES

Graduate attributes describe profiles of students when they graduate. Our students will graduate from a program in which the opportunities for local and global engagements are a dominant feature of the student experience. The program enables the students to:

- be equipped with comprehensive knowledge and understanding of their subject area, and the ability to apply their knowledge in practice, including in multi-disciplinary or multiprofessional contexts;
- exhibit well-developed skills in critical and creative thinking, and to engage in innovative research to conceive innovative responses to future challenges;
- well-prepared for living, learning, and working in a digital society;
- convey complex ideas and information effectively to a range of audiences for a variety of purposes and contribute in a positive and collaborative manner to achieving common goals;
- become responsible and effective global citizens whose personal values and practices are consistent with their roles as responsible members of society.

These attributes will be reflected in the formal curriculum and tested through academic assessment.

The program also prepares graduates as very active and engaged global citizens who:

- demonstrate international perspectives
- can engage constructively with their local and international communities
- are able to work both independently and collaboratively with others
- know how to set and achieve personal and professional goals

1.12 **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

Today's world is moving very fast to engage new technologies that are changing our lives. Adaptation of these new innovations demands individuals with sound knowledge of applied mathematics and computation. This cutting-edge Master degree program, "Applied Mathematics and Computational Science," is a blended form of these diverse areas of knowledge which will help our graduates to grow intellectually, develop their critical and analytical reasoning skills, produce a strong background in computational skills, and expose them to the global as well as the local job market and research sector. Specifically, the graduates of the program will be able to:

PEO1	Excel as professionals in fields concerned with applied mathematics, by building upon problem-solving skills and knowledge, teamwork abilities, and communication skills.
PEO2	Articulate with competent computational skills for analyzing and illustrating complex mathematical models related to real life problems and making decisions.
PEO3	Participate in lifelong-learning activities that enhance their professional and personal development through graduate studies, professional trainings, and experiences.
PEO4	Demonstrate globally recognized social justice, ethical and leadership role, and responsibilities through personal and professional contributions to the society.

1.13 PROGRAM LEARNING OUTCOMES (PLOs)/PROGRAM OUTCOMES (POs)

The program learning outcomes of MSc in AMCS are listed below:

PLO (a): Mathematical Knowledge	Apply knowledge of mathematics, specially applied mathematics, and computational sciences to find feasible solutions to complex mathematical problems.
PLO (b): Problem Analysis	Demonstrate ability to formulate, interpret, and represent mathematical models by developing the student's capability on strong problem-solving skills in diverse areas of applied mathematics.
PLO (c): Development/Design Solutions	Develop solutions for complex mathematical problems and design mathematical models for systems, components, or processes in related fields.
PLO (d): Investigation and Make Decision	Conduct investigations of complex mathematical problems using research-based knowledge, and demonstrate the ability to implement mathematical results, and review them critically as well as in depth.
PLO (e): Usage of Modern Tools of Computation	Apply appropriate computational techniques and modern mathematical tools for modelling and analyzing complex mathematical models of related fields.
PLO (f): Professionalism and Sustainability	Understand and evaluate the sustainability and impact of professionalism in the process of solving complex mathematical problems in diverse areas of computational science and applied mathematics.
PLO (g): Ethics	Apply ethical principles and commit to professional ethics, responsibilities, and the norms of academic practice.
PLO (h): Individual Work and Teamwork	Perform effectively as an individual, and as a member or leader in different teams and in multi-disciplinary settings.
PLO (i): Communication	Communicate effectively with different scientific communities, and able to comprehend and write effective reports, make effective presentations, and interact with clear instructions.
PLO (j): Lifelong Learning	Recognize the necessity, and have the preparation and adaptability to engage in independent, lifelong learning in the broader aspect of technological changes.

1.14 MAPPING MISSION OF THE UNIVERSITY WITH PEOs

Table 1 Relationship between NSU mission and PEOs

	NSU Mission 1	NSU Mission 2	NSU Mission 3	NSU Mission 4	NSU Mission 5	NSU Mission 6
PEO1	**	***	***	***		*
PEO2	**	***	***	***		*
PEO3	***	**	**	***		***
PEO4	***	**	**	**	***	***

Note: ***: Strong correlation, **: Medium correlation, *: Low correlation

1.15 MAPPING OF PLOs WITH THE PEOs

Table 2 Relationship between PLOs and PEOs

	PLO(a)	PLO(b)	PLO(c)	PLO(d)	PLO(e)	PLO(f)	PLO(g)	PLO(h)	PLO(i)	PLO(j)
PEO1	***	***	***	**	***			*	*	
PEO2	**	**	**		***	*			*	
PEO3				*	***	***	**	***	*	***
PEO4				**		***	*	**	*	***

Note: : Strong correlation, **: Medium correlation, *: Low correlation

2 PART B: CURRICULUM STRUCTURE

2.1 DURATION OF THE PROGRAM

The curriculum is semester based, 2 semesters a year. The degree must be completed in minimum one and a half (1.5) years to maximum three (3) years from the date of enrollment. The Academic Council must approve any exception to the above.

2.2 ADMISSION REQUIREMENTS

General requirements for admission to the Masters in AMCS program:

A 4-year bachelor in mathematics or applied mathematics, or equivalent degree in statistics, physics, applied physics, engineering, computer science & engineering, information & communication technology, and economics from an accredited public or private university in Bangladesh or abroad with a grade point average of at least 2.75 (in a scale of 4.0) or minimum of 2nd class in BSc-Hons/MSc.

- A 3-year bachelor in mathematics or applied mathematics, or equivalent degree in statistics, physics, applied physics, engineering, computer science & engineering, information & communication technology, and economics or any related areas from an accredited public or private university in Bangladesh or abroad with a grade point average of at least 2.75 (in a scale of 4.0) or minimum of 2nd class (55% marks) in BSc-Hons/MSc may be admitted on condition that at least 09 credits of remedial mathematics courses must be completed at NSU in order to be a regular student in the MS in AMCS program.
- Acceptable score in the NSU administered Admission Test or a score of 1100 in the Quantitative and Verbal part of GRE General Test.
- Two letters of recommendation (one from the host institute of bachelor degree).

Students having a background other than mathematics or applied mathematics (i.e. statistics, physics, applied physics, engineering, computer science & engineering, information & communication technology, and economics) **must have completed the following courses in their undergraduate curriculum in order** to enroll into the Master's program.

1. Calculus of Single Variable
2. Multivariate and Vector Calculus
3. Linear Algebra
4. Differential Equations

2.3 TOTAL MINIMUM CREDIT REQUIREMENT

The MS in AMCS degree requires successful completion of a minimum of 36 credit hours to complete.

- **Coursework**: Minimum 34 credit hours of graduate-level of coursework
- **Graduate Thesis**: 6 credit hours of Graduate Thesis (minimum 2 semesters long)

2.4 TOTAL CLASS WEEKS IN A YEAR/SEMESTER

The total number of weeks in a semester is 14 weeks and the total number of weeks in a year is 28 weeks.

2.5 MINIMUM CGPA REQUIREMENTS FOR GRADUATION

A student must complete the required number of credits with a minimum CGPA of 2.75 on a scale of 4 to earn the MS in AMCS. To continue in the program a student must maintain a minimum CGPA of 2.50 at all levels of academic advancement. The student will be on academic probation if the CGPA drops below 2.50 in any semester. If a student remains on probation for two consecutive semesters, he/she will be dismissed from the program.

2.6 COURSE TRANSFER/WAIVER

Maximum course waiver is 9 (nine credits). Maximum course transfer is 12 (twelve credits). The departmental course equivalence committee will decide the maximum course waiver/transfer applicable for a student.

2.7 MAXIMUM ACADEMIC YEARS OF COMPLETION

Minimum time to complete the degree requirements is 1.5 years (3 semesters) and maximum time to complete the degree requirements is 3 years (6 semesters) from the initial enrollment of the Master program.

2.8 CATEGORY OF COURSES

Table 2.7.1 Summary of Course Categories

Total Credit Hours	Broad Categories	Number of Courses	Credit Hours
40 credits hours	Core Courses	4	15
	Elective Courses	2	6
	Optional Courses*	3	9
	GED Course	1	4
	Graduate Thesis	N/A	6

*The optional 3 courses will be determined by the department depending on the necessity to continue the AMCS major.

Table 2.7.2 Details of Courses and Credit Hours

Broad Categories	Course Code and Names	Credit Hours
Core Courses 15 Credit Hours (all courses are mandatory)	AMCS 501 Computational Linear Algebra AMCS 501L Computational Linear Algebra Lab AMCS502 High Performance Parallel Computing AMCS 502L High Performance Parallel Computing Lab AMCS 503 Partial Differential Equations: Modeling and Numeric AMCS504 Advanced Numerical Methods and Computation AMCS504L Advanced Numerical Methods and Computation Lab	3 1 3 1 3 3 1
Elective courses 6 Credit Hours (any two courses)	AMCS 505 Advanced Control Theory and Application	3
	AMCS 506 Computational Fluid Dynamics	3
	AMCS 507 Advanced Mathematical Modelling	3
	AMCS 508 Dynamical Systems and Chaos	3
Optional Courses 9 Credit Hours (any three courses)	AMCS 509 Mathematics for Data Science and Machine Learning	3
	AMCS 5010 Mathematical Control Theory	3
	AMCS 511 Operations Research	3
	AMCS 512 Numerical Analysis	3
	AMCS 513 Financial Mathematics	3
	AMCS 514 Applied Harmonic Analysis	3
GED Courses (4 Credits)	AMCS515 Essential of Advanced Mathematics -I	3
	AMCS516 Essential of Advanced Mathematics -II	3
	AMC517Research Methodology in Mathematics Education (as GED course) AMC517 L	3 1

	Labs on Mathematical Research Tools (as GED Lab)	
Graduate Thesis 6 Credit Hours	AMCS 599 Graduate Thesis (minimum 2 semesters long)	6

2.8 SEMESTER/TERM/YEAR/LEVEL WISE COURSES

Total Credit: 40 Credit Hours Credit distribution:
Maximum intake credits in each semester: 18 Minimum intake credits in each semester: 10

Semester								Credits in Semester	Total Credit Hours
First Semester	Optional Course 1 (3 credits)	GED 517 (3 credits)	GED 517L (1 credit)	Elective Course 1 (3 credits)	AMCS 501 (3 credits)	AMCS 501L (1 credit)		14	40
Second Semester	Optional Course 2 (3 credits)	AMCS 502 (3 credits)		AMCS 502L (1 credit)			AMCS 599 (Thesis) (6 credits)	13	
Third Semester	Optional Course 3 (3 credits)	AMCS 503 (3 credits)	AMCS 504 (3 credits)	AMCS 504L (1 credit)	Elective Course 2 (3 credits)		Continuation of AMCS 599	13	