

UMBC UGC New Course Request: NAVY 301 Naval Ship Systems II (Weapons)

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COURSE INFORMATION:

Course Number(s)	NAVY 301
Formal Title	Naval Ship Systems II (Weapons)
Transcript Title (≤30c)	Nav Ship Systems II - Weps
Recommended Course Preparation	Math 151 & Math 152, completion or concurrent enrollment in Physics 121.
Prerequisite NOTE: Unless otherwise indicated, a prerequisite is assumed to be passed with a "D" or better.	Permission by the Professor of Naval Science
Credits	3
Repeatable?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Max. Total Credits	3 <small>This should be equal to the number of credits for courses that cannot be repeated for credit. For courses that may be repeated for credit, enter the maximum total number of credits a student can receive from this course. E.g., enter 6 credits for a 3 credit course that may be taken a second time for credit, but not for a third time. Please note that this does NOT refer to how many times a class may be retaken for a higher grade.</small>
Grading Method(s)	<input checked="" type="checkbox"/> Reg (A-F) <input type="checkbox"/> Audit <input type="checkbox"/> Pass-Fail

PROPOSED CATALOG DESCRIPTION (no longer than 75 words):

This course introduces the student to a comprehensive fundamental understanding of United States naval weaponry. Includes theory and employment of weapons systems, including the processes of detection, evaluation, threat analysis, weapon selection, delivery, guidance, and explosives. Radar and sonar systems and major weapon types, including capabilities and limitations. Facets of command, control, and communications as means of weapons system integration. Curriculum presents an in-depth review of surface, sub-surface, aviation, and Marine Corps weapons and platforms.

RATIONALE FOR NEW COURSE:

a) **Why is there a need for this course at this time?** For students to be successful U.S. Navy and Marine Corps officers, understanding of weapons systems fundamentals and core concepts is critical to professional performance and technical proficiency. The Navy and Marine Corps are charged with maintaining superiority in the maritime domain, and comprehension of fundamental theories and basic operations of naval weapons systems. Class on electromagnetic waves, radar, acoustic waves, and underwater propagation, electronic warfare, undersea warfare, fire control systems, weapon architecture, and guidance systems will inform the future Navy and Marine Corps officer.

b) **How often is the course likely to be taught?** The course will be piloted in the Spring 2017 semester and the course will be taught every spring semester (once per Academic Year). Once approved, the course will be adopted into the NROTC program at UMBC as part of its Naval Science curriculum offerings.

c) **How does this course fit into your department's curriculum?** This course is designed to fulfill the U.S. Navy-mandated ship weapons systems requirement. The class is a foundational skills course for midshipmen/students

focused on joining the NROTC program and commissioning as an officer in the U.S. Navy. Students will practice the maritime proficiency professional competency required to become a naval officer, and develop a basic understanding of naval weapons systems concepts that are core to the Navy such as theory and employment of weapons systems, including the processes of detection, evaluation, threat analysis, weapon selection, delivery, guidance, and explosives. Physical aspects of radar and underwater sound along with facets of command, control, and communications as means of weapons system integration.

d) **What primary student population will the course serve:** This course is intended for NROTC scholarship students and those students who wish to join the NROTC program and commission as an officer in the U.S. Navy or Marine Corps. It is open to all enrolled UMBC students with approval by the Professor of Naval Science. This course is designed for midshipmen/students in their third year of academic study within the NROTC program, although other students may be accepted for attendance on a case-by-case basis. A thorough knowledge of calculus and calculus based physics is essential for completion of this course.

e) **Why is the course offered at the level (ie.100, 200, 300, or 400 level) chosen?** This course is intended for NROTC scholarship students and those UMBC students seeking to join the NROTC unit who desire a commission in the U.S. Navy. It is offered at the 300 level with the intention, but not required, for participating students to have completed MATH 151 & 152 as well as PHYS 121 for background prior to this course. The four-year curriculum track for NROTC scholarship students is designed for enrollment of midshipmen/students to this course who are in their junior year of collegiate study. Course completion for students participating in NROTC on two- or three-year curriculum tracks will be accepted pending referral from NROTC Academic Advisors.

f) **Explain the appropriateness of the recommended course preparation(s) and prerequisites(s).** Based upon the complexity of weapons system, mechanics, sound propagation, and electromagnetic theory, this course requires background in calculus and calculus based physics. This class is one of the required naval science courses required for completion of the commissioning requirements for the NROTC scholarship, however, it is open to all UMBC students with permission from the Professor of Naval Science.

g) **Explain the reasoning behind the P/F or regular grading method.** Students are able to take a pass/fail course only after they have completed 30 or more credits. Because this class is a core course within the student's Naval Science curriculum continuum, it should only be available as a course with a regular grading method.

h) **Provide a justification for the repeatability of the course.** The Ship Systems II (Weapons) course will be offered once per academic year, dependent on the availability of classrooms and associated resources. It is a core course in the NROTC curriculum continuum, and must be completed with a grade of C or higher. Students may repeat the course only one time, consequent to academic review by the Professor of Naval Science.

ATTACH COURSE OUTLINE (mandatory):

NAVY 301 – SYLLABUS
NAVAL SCIENCE – NAVAL SHIP SYSTEMS II (WEAPONS)

Spring 2017

Meeting Times: Monday / Wednesday or Tuesday / Thursday 0730 – 0850

Location/Time: TBD

Course Coordinators: CAPT Troy Mong CDR Stew Wennersten
UC 116, 410-455-8035 UC 116, 410-455-8035
tmong@umbc.edu swenners@umbc.edu

Office Hours: The coordinators' office door is open most of the time – feel free to drop in and visit. If no one is available, please arrange an appointment via email. When sending an email, always include your full name and course number in the subject line. Also, use your UMBC email account to ensure validity and delivery.

Fixed office hours for the Course Coordinators will be provided on the official syllabus for this class.

Resources: Texts, assigned readings and handouts, websites, and potential guest lecturers. Texts will be loaned to all NROTC students by the Department of Naval Science, and to all other UMBC students as available. The texts are the property of the U.S. Government. Students can highlight the texts, but should not write in the margins. The books must be returned at the end of the semester in usable condition. If the text is unavailable from the Department of Naval Science, students can either buy or rent the textbooks. Additionally, a copy of each text can be found in the UMBC Albin O. Kuhn Library.

Texts: The following resources will be distributed during the first class.

1. Payne, Craig M., ed. Principles of Naval Weapon Systems. Annapolis, MD: Naval Institute Press, 2006.
2. Additional readings to be assigned at the instructor's discretion, available via Blackboard or provided by the instructor.

Computers: Students are permitted to use computers during class for note-taking and other class-related work. All electronic media will be provided by the NROTC unit. Those using computers during class for work or communication not related to that class must leave the classroom for the remainder of the class period.

Blackboard Site: A Blackboard course site is set up for this course. Each student is expected to check the site throughout the semester as Blackboard will be the primary venue for outside classroom communications between the instructors and the students. Students may access the course site and support at <https://blackboard.umbc.edu>.

Course Description: NAVY 301 prepares future leaders by providing students with a comprehensive fundamental understanding of American naval weaponry. Course delivery will emphasize practical competencies required of a future operator although it will also rely on fundamentals required of a theorist or designer. Pre-calculus and calculus concepts will be utilized as required to gain an understanding of the supported material; however, an understanding of the pre-requisite physics courses are essential to mastery of such concepts. This base will allow full exploration of an in-depth presentation of USN and USMC platforms and systems that will represent the capstone of this course. These periods will represent the heart of the course and will feature guest lecturers and videos whenever possible, in order to complement an in-depth canvassing of the Naval inventory including surface, sub-surface, aviation, and Marine Corps platforms. Students will also examine case studies to apply and analyze course topics within naval contexts. The curriculum composes a foundational knowledge course for midshipmen/students focused on joining the NROTC program and commissioning as an officer in the U.S. Navy or Marine Corps.

Prerequisites: Permission of the Professor of Naval Science. Completion of calculus courses (Math 151 & Math 152) and calculus based physics course (PHYS 121) should be completed prior to enrolling in NAVY 301.

Course Purpose: For students to be successful U.S. Navy and Marine Corps officers, understanding of weapons systems fundamentals and core concepts is critical to professional performance and technical proficiency. The Navy and Marine Corps are charged with maintaining superiority in the maritime domain, and comprehension of fundamental theories and basic operations of naval weapons systems. Class on electromagnetic waves, radar, acoustic waves, and underwater propagation, electronic warfare, undersea warfare, fire control systems, weapon architecture, and guidance systems will inform the student officer candidates. The course will consist of 1.25 hours of instruction twice each week and practical assessments.

The purpose of this course is to help you develop professional core competencies:

I. ACADEMIC STANDARDS

A. Demonstrate a proficiency of the English language through usage, both spoken and written.

II. TECHNICAL FOUNDATIONS

- A. Know the use of computers, electronic, and space-based communications.
- B. Comprehend the factors and criteria for structural integrity and operational employment in platform design.
- C. Know the operating principles and common uses of platform weapon systems.
- D. Comprehend the basic theory and use of radar, sonar, and fire control systems.
- E. Comprehend the basic theory of electronic warfare systems.

III. NAVAL WARFARE

- A. Know the missions and basic organization of the major components of all the U.S. Armed Forces.
- B. Know how each of the following components of Naval warfare contributes to the basic sea control and power projection missions of the Naval service:

1. electronic warfare
2. C5I warfare (command, control, communications, computers, combat systems, intelligence)

C. Know the basic characteristics and capabilities of the major weapons systems and platforms of the U.S. Naval forces. Know the designations, characteristics, capabilities, and missions of ships, aircraft, and weapon systems of the U.S. Navy, Marine Corps, and Strategic Sealift Officer (SSO).

D. Know the basic threats potential adversaries can employ against U.S. Naval platforms.

E. Know how chemical/biological/radiological attacks affect the combat environment.

F. Know the significance of intelligence in the application of Naval warfare.

G. Comprehend the spectrum of warfare.

IV. MARITIME PROFICIENCY

A. Comprehend relative motion and demonstrate capability to solve problems associated with relative motion.

Course Learning Outcomes: By the end of this course, students will be able to understand and comprehend:

- The concept of an integrated weapon system, including definitions, purposes and various components.
- The military requirements and general characteristics of Naval weapon systems.
- System tasks and operational phases from initial sensing, detection, and tracking through engagement to include launching, guidance and acquisition before ultimately engaging and detonating.
- Functional elements of various weapons such as warhead, propulsion and launch vehicles.
- The need for system integration and the effect of delay, system errors and reaction time on weapon effectiveness.
- The requirement for command, control and integration.
- Operations of various search, tracking, and fire control sensors such as radar and sonar.
- Most importantly, the Naval Officer's roles in the application of these weapon systems for a successful engagement.

COURSE STRUCTURE

This is an introductory course instructed by a Department of Naval Science faculty member. Each week, students and faculty will meet Monday / Wednesday or Tuesday / Thursday 0730 – 0850. Course activities include the following:

- Class Participation/Attendance/Quizzes/Homework (40%). Students are expected to **read** and **study** any handouts provided ahead of class. This will enable the students to comprehend the topics covered during the week and to be prepared for class. Students will also participate in class discussions to demonstrate comprehension of fundamental course core competencies. It is paramount that students read each session's objectives and complete the assigned reading prior to attending class. Unexcused absences, tardiness, and lack of class preparedness will result in the reduction of this grade (2% per absence, 1% per tardiness). Late homework submissions will incur a 25% per day penalty. There will be announced and unannounced quizzes over the course of the

Semester. Students should complete applicable assignments after each lesson to ensure complete understanding of the material – all concepts are related. Quizzes may be given online via Blackboard.

- **Group Project Presentation and Paper (20%)**. The project consists of two parts; the first is a technical paper and the second is a presentation. **Applicable dates are delineated on the class schedule.**

The primary purpose of the group project is to broaden your professional knowledge by applying the concepts and theories presented in this course to a functional weapon system currently in the U.S. Navy/Marine Corps arsenal. Directly relate your topic to the concepts we cover in class. For example, do not just say that the “platform is SAR capable”. Explain how SAR works in theory and how its function is unique to your system.

A secondary purpose is to improve each student’s communication skills through technical writing and oral presentation, both of which are prerequisites of fleet and life success. The assignment will challenge the student’s ability to obtain, compile, and reference information concerning the weapon system of his/her choice. The oral presentation (brief) will prepare the future officer or engineer for wardroom or boardroom presentations.

- Instructions: Students should partner with another student to complete this assignment. As available, the partnerships must consist of midshipmen and civilian students. If there are an odd number of students in a section, one group may contain three students. Each group will select a weapon system currently in the Navy/Marine Corps arsenal or in the final stages of development. The selection of the weapon system should be given careful consideration with respect to the format requirements outlined in the following section. Do not choose to cover all the variants of the MH-60 helicopter as it does not truly meet the requirements of the assignment. Choosing one specific variant and reporting on how it ultimately completes its mission would be more appropriate. Group membership along with the primary and secondary weapon system selection will be submitted for approval in accordance with the course syllabus. Each group is expected to do extensive research on their weapon system that might include contacting the manufacturer/defense contractor in order to augment commercially available information. **Your paper is due the same day as your presentation.**
- Format: The paper will be double-spaced, observing standard margins and tabs, and contain the following elements:
 - Cover sheet - include the title of weapon system, your class section, names of the students in the group, and picture of weapon system
 - Technical data and parameters page (to include, but not limited to: dimensions, fuel type, warhead, weight, range, speed, etc...)
 - Introduction – include a brief historical background on the weapons system including the reason it was developed, the threat it poses to the enemy or counters from the enemy, etc.
 - Discussion (minimum 3 pages) – describe in exact and precise terms what the weapon system is, its component parts and subsystems, and the principles behind how it works

- Guidance/homing system principles of operation (in detail)
- Propulsion system architecture and principles of operation
- Detect-to-Engage (DTE) sequence for the weapon system
- DTE drawing including range, altitude/depth, and guidance modes
- Supporting Diagrams and Figures
 - Damage mechanism explanation (e.g., fragmentation, incendiary, nuclear, armor piercing, shaped charge, etc.)
 - Fuzing system diagram and explanation
 - Radar explanation and calculations (type of radar, principles of operation, radar performance factors including min and max range, range resolution, etc.)
 - Sonar explanation and calculations (type of sonar, principles of operation, sonar performance factors including figure of merit for active and passive modes)
 - Electro-optical sensor explanation and calculations (principles of operation, EO sensor performance factors including max range, seeker bandwidth, wavelength of maximum energy, etc.)
- Technical drawings in support of your topic
- Bibliography in endnote format. I'm not concerned with the nuances but rather seek to properly acknowledge authors and applicable research while preserving a smoothly flowing paper.

The research to support the required discussion points above cannot be accomplished in one or two days! Be sure to leverage time management principles to work steadily throughout the semester in order to produce a complete project. Wikipedia cannot be used as a primary reference; three NON-internet sources must be used. Ensure that the research is done on the correct version of the chosen selection/topic. (For example: If you are writing about the correct Mod of the Mk-48 torpedo include information that is relevant to TODAY's version, not information for the version as it was first produced.)

Presentations will be made in class as specified on the following pages. This is a formal presentation and should be treated as such. Professional / business attire should be worn on presentation day. Students may use PowerPoint, white board, slides, video, or any other aid to communicate the subject's relevance to the course and demonstrate course concepts. Students must provide a 15-minute presentation, followed by a 5-minute question and answer session.

The presentation should be given as though you are a Defense Contractor. While at the same time as covering the above information and requirements, I want you to sell me your weapon platform. Tell me why your platform is better than the other options available. Make me want to spend BILLIONS of dollars on your project. Also, comment on strategy / the implementation of this weapon by specific countries against specific threats.

- Examinations (40%). Both exams are conventional written exams and comprised primarily of closed-loop questions including multiple choice and matching. However, there may be some open-looped questions asked, primarily in the form of short-answer and word problems. The final exam will be comprehensive of the material covered

through the duration of the class as each subsequent lesson will build off of all previous lessons.

GRADING AND EVALUATION

Letter grades will be assigned on a straight 90+ = A, 80+ = B, etc. basis. There is no curving; the grade is a reflection of how much students learned, not how much more or less they learned when compared to other students.

EVALUATION	% of GRADE
Class Participation / Attendance	15
Quizzes / Homework	15
Group Presentation	10
Topic Paper	10
Mid-Term Exam	20
Final Exam	20
TOTAL	100

COURSE POLICIES

Classroom Conduct: This class will be commensurate with a junior-level course. The Instructor acts as a facilitator to ensure discussions (as required) remain pertinent to the subject matter and that the interaction among students remains on a professional level. Thorough preparation and participation are critical to success, but so are demonstrated respect and consideration for your classmates' views and opinions. Inappropriate behavior or conduct will not be tolerated and can result in dismissal from the course.

Apart from the military courtesies extended to the instructor by the NROTC students, the classroom behavior of all students should be "collegiate," courteous, and respectful. Students are free to interject and question, even without waiting for direct recognition from the instructor (i.e. raising hand and being called upon), so long as the interjection is not unduly disruptive. Both students and the instructor will "police" classroom behavior.

Respect the viewpoints of others. Discussions of controversial subject matter may arise in class. Students' candid opinions are required to meet seminar objectives. However, remarks intended to offend classmates, or slurs that target race or religion will not be tolerated. And while students are encouraged to have "thick skins" regarding the viewpoints of others, when remarks create a hostile classroom environment the dialogue suffers. A simple standard will be applied to controversial remarks: Was the intent of the remark to heighten the dialogue?

Any views expressed by the instructor, unless specifically attributed otherwise, should be considered the personal views of the instructor and may not be representative of any official policy or viewpoint of the government, U.S. Naval Services or UMBC.

Honor Code: "A midshipman does not lie, cheat, or steal, nor tolerate those who do." All students are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion).

Attendance: Your presence at every class session, including discussion sections, is mandatory and expected. Unusual circumstances will be handled on a case-by-case basis. Absences are to be arranged with the Instructor prior to the class session. Subsequent make-up work will be assigned accordingly. If you need to miss class due to illness, or are otherwise unexpectedly detained, you must notify your class leader no later than 15 minutes prior to the beginning of class. An “excused” absence is at the sole discretion of the Instructor. Unauthorized absences will negatively affect your grade. All NROTC scholarship students are expected to attend every class, as it is their appointed time and place of duty for that day.

COURSE SCHEDULE

The following is a tentative timeline and is subject to change.

Lesson	Date	Topic	Item Due
1		Course Introduction and Book Checkout Read: Syllabus	- Blackboard Familiarization
2		Lesson 1 – Weapons Systems Overview, Detect-To-Engage (DTE) Sequence, Characteristics of Electromagnetic Waves Read: Ch. 1, 2 (Pp. 5-8)	
3		Lesson 2 –Electromagnetic Wave Fundamentals, Antennas and Beamforming, Propagation Paths and Effects Read: Ch. 2 (Pp. 8-21)	
4		Lesson 3 – Wave Propagation Modes, Radar Components and Principles of Operation Read: Ch. 2 (Pp. 21-25), Ch. 3 (Pp. 26-30)	- Group Project Partners
5		Lesson 4 – Radar Performance Factors Read: Ch. 3 (Pp. 30-38)	
6		QUIZ 1 Lesson 5 – Review of Radar Performance Factors, The Simplified Radar Range Equation, Continuous Wave Radar Read: Ch. 3 (Pp. 39-40), Ch. 4 (Pp. 42-45), Supplementary notes	
7		Lesson 6 – Pulse-Doppler Radar, Velocity Measurement Limitations (Doppler Dilemma) Read: Ch. 4 (Pp. 45-50), Supplementary notes	- Group Project Topics
8		Lesson 7 – Higher Resolution Radar Systems Read: Ch. 2 (Pp. 20-21), Ch. 4 (Pp. 51-55)	
9		Lesson 8 – Phased Array Radar Read: Ch. 4 (Pp. 54-63)	
10		QUIZ 2 Lesson 9 – Servo (Monotrack) Tracking Systems, Monopulse Radar Read: Ch. 5 (Pp. 66-74)	
11		Lesson 10 – Range Tracking and Track-While-Scan Read: Ch. 5 (Pp. 74-82) Midterm Review	
12		MIDTERM EXAM	

13		Lesson 11 – Electronic Support, Denial Jamming Read: Ch. 6 (83-90)	
14		Lesson 12 – Electronic Attack, Electronic Protection Read: Ch. 6 (90-98), Excerpts from Information Warfare references	
15		Lesson 13 – Fundamentals of Acoustic Waves, Speed of Sound in the Sea Read: Ch. 9 (153-162)	
16		Lesson 14 – Undersea Sound Propagation, Noise Read: Ch. 9 (162-178)	
17		QUIZ 3 Lesson 15 – The Sonar Equations, Figure of Merit (FOM) Read: Ch. 10 (179-191)	
18		Lesson 16 – Undersea Warfare Systems – Active Read: Ch. 11 (Pp. 192-200)	
19		Lesson 17 – Undersea Warfare Systems – Passive, Non-Acoustic Detection, Countermeasures Read: Ch. 11 (200-212)	
20		Lesson 18 – External Ballistic, Introduction to Fire Control Read: Ch. 13 (Pp. 237-238, 242-247), Supplementary notes	
21		QUIZ 4 Lesson 19 – The Fire Control Problem, Reference Frames and Alignment Read: Ch. 13 (Pp. 237-238, 247-259)	
22		Lesson 20 – Interior Ballistics, Launching Systems Read: Ch. 13 (Pp. 238-242), Ch. 14 (Pp. 262-272, 274-275)	
23		Lesson 21 – Weapon Propulsion, Missile Architecture Read: Ch. 14 (Pp. 276-289, 292-295)	
24		Lesson 22 – Guidance Systems Read: Ch. 15 (Pp. 298-313)	
25		QUIZ 5 Lesson 23 – Fuzing Systems Read: Ch. 16 (Pp. 314-329)	
26		Lesson 24 – Weapon Damage Effects, Warhead Classifications Read: Ch. 18 (Pp. 341-342, 345-360), Ch. 19 (Pp. 361-372, 376-377)	
27		Lesson 25 – Future Weapon Systems Read: Supplementary notes	
28		Group Project Presentations	- Topic Paper
29		Group Project Presentations Final Exam Review	- Topic Paper
30		FINAL EXAM	- Book Turn-In

IMPORTANT ACADEMIC POLICIES AND SERVICES

Disability Services: UMBC is committed to eliminating discriminatory obstacles that disadvantage students based on disability. Student Support Services (SSS) is designated to receive and maintain confidential files of disability-related documentation, certify eligibility for services, and determine reasonable accommodations. If you have a disability and want to request accommodations, contact SSS in the Math/Psych Bldg., room 213 or at 410-455-2459. If you require accommodations for this class, make an appointment to meet with me to discuss your SSS-approved accommodations, or any other concerns that you have.

Equity, Diversity, Equal Opportunity, and Affirmative Action: UMBC provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression.

Mental Health and Stress Management: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Counseling Center at <http://counseling.umbc.edu/services/>.

Student Success Center: UMBC's comprehensive undergraduate academic support program designed to help students reach their academic goals and become independent, lifelong learners. The Learning Resource Center collaborates with students, faculty, staff, and the community to conduct programs that maximize learning success at an honors university.

Inclement Weather Policy: Students are strongly encouraged to consult the UMBC Student Handbook and Academic Catalog and the University website for detailed information regarding the above items.

VALUES STATEMENT

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping other to commit these acts are all forms of academic dishonesty, and they are reprehensible. Academic misconduct could result in disciplinary action that may include, but not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the Policies section of the UMBC Director.