

# CMSC 256 – 001      Spring 2023

## Data Structures and Object-Oriented Programming Syllabus

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<b>Catalog listing:</b>	CMSC 256
<b>Course Level:</b>	Undergraduate
<b>Prerequisites:</b>	CMSC 255 with a grade of C; co-requisite: CMSC 302.
<b>Instructor:</b>	Debra Duke
<b>Office:</b>	Engineering East E4250
<b>Phone:</b>	(804) 828-7135
<b>Email:</b>	<a href="mailto:s2dmduke@vcu.edu">s2dmduke@vcu.edu</a>
<b>Class website:</b>	Canvas
<b>Office Hours:</b>	Thursday 2:00 pm – 3:00 pm or by appointment
<b>Lecture:</b>	Engineering Building West 101, Tues/Thurs 12:30 - 1:45 pm
<b>Lab:</b>	Wed. 1:00 – 2:50 pm
<b>March 23:</b>	Last day to <a href="#">withdraw</a> from a course with a mark of “W”
<b>Final Exam:</b>	Tuesday, May 9, 12:30 – 3:20 pm

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### 1.0 – Overview (Catalog Course Description):

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 255 with a grade of C; co-requisite: [CMSC 302](#). Advanced programming using Java. Topics include introduction to object-oriented design, inheritance, polymorphism, exceptions, interfaces, linked lists, stacks, queues, binary trees, recursion, and basic searching and sorting techniques. Continued focus on program testing and UML notation.

### 2.0 – Course Structure:

Lecture hours/week – 3  
Lab hours/week – 2

### 3.0 – Course Goals

At the end of the course, students should be able to:

1. Design and implement Java programs and sub-programs that utilize file input/output for data to solve a specified problem.
2. Apply the object-oriented principles of abstraction, encapsulation, inheritance, interfaces, and polymorphism in program design.
3. Differentiate algorithms according to their relative efficiency by performing basic algorithm analysis of their respective running times.
4. Distinguish various data structures (arrays, lists, stacks, queues, maps, trees, and graphs) according to their use, implementation, appropriateness, and efficiency.
5. Discuss the structure of a linked list (both singly and doubly linked) in terms of its uses, implementation details, appropriateness to the problem domain, and efficiency.
6. Examine the design, implementation, and efficiency of recursive algorithms in sub-programs and identify the base case and the general case of a recursively defined problem.

7. Analyze linear and binary search algorithms along with various sorting algorithms (insertion sort, selection sort, and merge sort).
8. Write programs that use each of the following data structures: arrays, graphs, strings, linked lists, stacks, queues, sets, and maps.
9. Compare alternative implementations of data structures with respect to performance.
10. Construct, execute and debug programs using a modern IDE and associated tools such as debuggers

#### **4.0 – ABET Criteria Introduced:**

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

#### **Other Criteria Addressed:**

- Substantial coverage of at least one general-purpose programming language.
- Substantial coverage of basic algorithms with an introduction to algorithmic complexity, concepts of object-oriented programming languages, and software development.

#### **5.0 – Major Topics Covered:**

- Object-oriented programming
- Basic Data Structures
- Basic Algorithms

#### **6.0 – Textbook(s):**

There is no required textbook. Extensive references are provided in Canvas.

#### **7.0 – Class Schedule:**

**Lecture:** Section 001 - Engineering Building West 101, Tues/Thurs 12:30 - 1:45 pm

**Lab:** Section 001 - Wed. 1:00 – 2:50 pm

The course begins on 1/17/2023 and assignments may be due during the add/drop interval. Students who add the course after 1/20/2023 are responsible for completing any missed assignments by 1/25/2023.

POGIL activities are completed in class as a team. These assignments may not be completed individually or outside of class. You are allowed 2 excused POGIL activities in the semester. Any additional missed POGIL assignments are assigned a grade of 0.

## Tentative Weekly Schedule (subject to change; check Canvas for updates)

Week	Topics Video Lectures/ Readings	• Tuesday Activity	Wednesday Lab <i>Due by end of day</i>	Thursday Activity	Assignments Due by end of day on Friday
1	<b>Object Oriented Programming</b> <ul style="list-style-type: none"> <li>Review 2D Arrays, Java Basics, and Java Classes</li> <li>Inheritance</li> <li>Encapsulation</li> <li>Overriding</li> <li>Polymorphism</li> </ul>	<ul style="list-style-type: none"> <li>Course Overview</li> <li>CS1 Concept Inventory</li> <li>Data Structures Concept Inventory</li> </ul>	Debugging Your Code Inheritance Lab	Abstract Classes & Interfaces POGIL-01	
2	<b>Abstract Classes &amp; Interfaces</b> <ul style="list-style-type: none"> <li>Abstract Classes</li> <li>Interface</li> <li>Data Structures, Abstract Data Types, &amp; UML</li> </ul>	<ul style="list-style-type: none"> <li>Method Design &amp; Implementation</li> <li>2D Array Algorithms</li> <li>Interfaces &amp; Abstract Classes</li> <li>UML and File I/O</li> </ul>	Interface Implementation with the Comparable Interface	Recursion POGIL-02	<b>Project 1</b> Interface Implementation
3	<b>Recursion</b> <ul style="list-style-type: none"> <li>OpenDSA</li> <li>codingbat.com</li> </ul>	<ul style="list-style-type: none"> <li>Project 1 Review</li> <li>Implementing Recursion</li> <li>Flow of Control</li> </ul>	Accessing Data from a remote API	<b>Test 1</b>	
4	<b>Generics</b> <ul style="list-style-type: none"> <li>Java Generics</li> </ul>	Generics & Collections POGIL-03	Generics Lab Generic Method Implementation practice	Implementing Linked Lists POGIL-04	<b>Project 2</b> Extending a Generic Abstract Class
5	<b>Lists &amp; Linked Lists</b> <ul style="list-style-type: none"> <li>OpenDSA – Lists &amp; Linked Lists</li> </ul>	<ul style="list-style-type: none"> <li>Review of Test 1</li> <li>Project 2 Review</li> <li>Debugging a Linked List</li> </ul>	Array-based List Implementation	<b>Test 2</b>	
6	<b>Iterators</b>	Iterators POGIL-05	Iterating over Lists	Coding with Iterators	<b>Project 3</b> Doubly Linked List Implementation
7	<b>Algorithm Efficiency</b> <ul style="list-style-type: none"> <li>OpenDSA – Algorithm Analysis</li> </ul>	Algorithm Analysis POGIL-06	Algorithm Analysis	Algorithm Analysis Review	
	<i>Spring Break, March 5 - 12</i>				
8	<b>Stacks, Queues, and Deques</b> <ul style="list-style-type: none"> <li>OpenDSA – Stacks, and Queues</li> </ul>	Stacks POGIL-07	Stack Implementation	Stack and Queue Applications	<b>Project 4</b>
9	Sorting Algorithms <ul style="list-style-type: none"> <li>OpenDSA – Sorting</li> </ul>	Sorting POGIL-08	Searching and Sorting	<b>Test 3</b>	<i>Withdrawal Deadline March 24</i>

10	Trees • OpenDSA – Binary Trees	Binary Trees POGIL-09	Binary Search Tree Implementation	Tree Topics	<b>Project 5</b>
11	Trees OpenDSA – Balanced Binary Trees and Heaps	Balanced BST POGIL-10	Min Heap Implementation	AVL Tree Practice	
12	Trees	Tree Applications	Huffman Coding Lab	Hashing POGIL-11	<b>Project 6</b>
13	Hashing & Hash Tables Readings: OpenDSA – Hashing	Hash Function & Collision Resolution Practice	Hash Table Implementation	<b>Test 4</b>	
14	Graphs and Applications Readings: OpenDSA – Graphs	Graphs POGIL-12	Graphs	Graph Algorithms	<b>Project 7</b>
15	Graphs Algorithms	<b>Test 5</b>	Exam Prep Lab	Final Exam AMA	
Section 001 Final Exam – Tuesday, May 9, 12:30 – 3:20 pm					

## 8.0– Evaluation:

### General Instructions:

1. It is expected that you will spend at least 12 hours a week on this class completing readings / related activities, and programming outside of scheduled lab and lectures. For every credit hour it is expected that students are putting in 3-4 hours of work. This is a 4-credit class so that means 12 – 14 hours outside of class and labs should be devoted to this course.
2. This class has a dedicated lab time and lab assistance is available **only during this time**. If you choose not to attend the lab, **you are responsible for completing/debugging the lab on your own**. It is recommended that you prepare for labs by reading through the module's assigned readings and lab instructions before the start of lab to make efficient use of the time.
3. All programming assignments must be uploaded to Gradescope on or before the due date specified. Only files submitted on or before the due date will be considered for grading, unless an extension was granted prior to the due date. *In all circumstances, an assignment will not be accepted after it has been reviewed and a solution presented in class.*
4. Requests to re-grade any assignment or assessment must be made within one week from the date the project grade is posted in Canvas, requests after this time will be denied.
5. No assignments will be accepted late unless special permission has been given prior to the due date. *In all circumstances, an assignment will not be accepted after it has been reviewed and a solution presented in class.*
6. No makeup exams or quizzes will be given unless special permission has been given prior to the date of the test. Be prepared to provide documentation for the reason you are requesting the makeup exam, or permission may not be granted.
7. Request to adjust scores or re-grade tests must be made within one week after the test results are released, requests after this time will be denied.
8. All programming projects are to be individual efforts. **Plagiarism applies to source code as with any other intellectual property. Plagiarized code is a form of cheating and will be treated as such.** Instances of plagiarism and other violations of the VCU Honor Code will be reported to the VCU Honor Council.

9. Personal computers/laptops/cell phone may be used in class only with the instructor's permission.
10. Use of any electronic device is prohibited during exams. **Students may not leave the exam room once testing begins for any reason.** Violations of these class rules will result in a grade of zero (0) for the exam.

### Course Standards for Cheating and Plagiarism

It is important that the work you hand in is your own. It is fairly easy to copy someone else's program (especially as the due date approaches). For you to learn the material in order to perform well on the tests and subsequent programs and courses, it is imperative that you understand everything that is in your program.

Obtaining verbal assistance on assignments is allowed. This means that you may discuss algorithms. **You may not view or discuss written algorithms or code with anyone other than your instructor or course teaching assistants.**

Remember, programming is a learn-by-doing skill. The programming assignments are key tools for learning the material in the course. *Doing the programming projects as "group projects" is strictly prohibited, an honor code violation, and will invariably lead to you performing poorly in the course.*

Just make sure that the work you hand in is truly yours. Three simple guidelines to insure this are:

1. The "form of expression" must be original.
2. Understand everything in your program.
3. Never copy files from someone else, never give files to someone else, never examine someone else's code, never debug someone else's code, never show someone else your code.

The internet is a great resource for finding alternate explanations or examples for programming concepts that may help you better understand the material and you are allowed, and encouraged to utilize it. However, asking for specific help that is targeted towards a homework assignment or programming project on "homework help" sites, tutoring sites, blogs, or forums is considered cheating and will be reported to the VCU Honor Council for investigation. The TAs and the instructor are much better sources of assistance.

Code that is obtained from outside sources, such as the internet, and used in a homework submission **MUST** be approved by your instructor and properly cited in the code comments or it will be considered plagiarism.

The TAs and I will be using Gradescope's software and Stanford University's Moss (for Measure Of Software Similarity) program to detect software plagiarism along with the measure of similarity provided by Gradescope.

You are reminded that all homework is pledged to be your own work as described above and it is an honor code violation to misrepresent work that is not yours. Programs that violate these standards will be immediately referred to the Honor System for action.

## Grading:

Category	% weight
Lab	10
Homework and Classwork	10
Programming Projects	30
Tests	30
<b>Final Exam</b>	<b>20</b>

## Grading scheme:

- A:  $\geq 90\%$
- B:  $\geq 80\%$  and  $< 90\%$
- C:  $\geq 70\%$  and  $< 80\%$
- D:  $\geq 60\%$  and  $< 70\%$
- F:  $< 60\%$

*Please consult external resources for VCU policies regarding academic honesty, students with disabilities, student conduct in the classroom, withdrawal from classes, and others.*

## Course Attendance Policy:

This is a cooperative, active learning course therefore your presence in class is essential to your success and the success of your classmates. In class activities (POGIL & Problem-solving classwork) may not be completed independently. You will be excused from a maximum of two POGIL activities without penalty. Other classwork that is missed will result in a grade of 0 for the missed classwork.

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Use VCU Libraries to find and access library resources, spaces, technology and services that support and enhance all learning opportunities at the university. (<https://www.library.vcu.edu/>)

Students should [visit http://go.vcu.edu/syllabus](http://go.vcu.edu/syllabus) and review all syllabus statement information. The full university syllabus statement includes information on safety, registration, the VCU Honor Code, student conduct, withdrawal and more.

## Campus emergency information

What to know and do to be prepared for emergencies at VCU:

- Sign up to receive [VCU text messaging alerts](#). Keep your information up-to-date. Within the classroom, the professor will keep his or her phone on to receive any emergency transmissions.
- Know the safe evacuation route from each of your classrooms. Emergency evacuation routes are posted in on-campus classrooms.
- Listen for and follow instructions from VCU or other designated authorities. Within the classroom, follow your professor's instructions.
- Know where to go for [additional emergency information](#).
- Know the emergency phone number for the VCU Police (828-1234).
- Report suspicious activities and objects.
- Keep your permanent address and emergency contact information current in eServices.

## **Class registration required for attendance**

Students may attend only those classes for which they have registered. Faculty may not add students to class rosters or Canvas. Therefore, if students are attending a class for which they have not registered, they must stop attending.

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## **Honor System: upholding academic integrity**

The VCU Honor System policy describes the responsibilities of students, faculty and administration in upholding academic integrity, while at the same time respecting the rights of individuals to the due process offered by administrative hearings and appeals. According to this policy, "Members of the academic community are required to conduct themselves in accordance with the highest standards of academic honesty, ethics and integrity at all times." In addition, "To support a commitment to the Honor System, all members of the VCU community are required to:

- Adhere to the Honor System policy and its procedures;
- Report any suspicion or knowledge of possible violations of the Honor System;
- Answer truthfully when called upon to do so regarding Honor System matters;
- Maintain appropriate confidentiality regarding related to Honor System matters." More information can be found at in the VCU policy library.

## **Managing stress**

Students may experience situations or challenges that can interfere with learning and interpersonal functioning including stress, anxiety, depression, alcohol and/or other drug use, concern for a friend or family member, loss, sleep difficulties, feeling hopeless or relationship problems. There are numerous campus resources available to students including University Counseling Services (804-828-6200 MPC Campus, 804-828-3964 MCV Campus), University Student Health Services (MPC 804 828-8828, MCV Campus 804 828-9220) and the Wellness Resource Center (804-828-9355). 24-hour emergency mental health support is available by calling 828-1234 and asking to speak to the on-call therapist or utilizing the National Suicide Prevention Lifeline (1-800-784-2433).

## **Student conduct in the classroom**

According to the Faculty Guide to Student Conduct in Instructional Settings, "The university is a community of learners. Students, as well as faculty, have a responsibility for creating and maintaining an environment that supports effective instruction. In order for faculty members (including graduate teaching assistants) to provide and students to receive effective instruction in classrooms, laboratories, studios, online courses, and other learning areas, the university expects students to conduct themselves in an orderly and cooperative manner." Among other things, cell phones should be turned off while in the classroom. The Student Code of Conduct also prohibits the possession of or carrying of any weapon. For more information see <http://register.dls.virginia.gov/details.aspx?id=3436>.

## **Student email policy**

Email is considered an official method for communication at VCU because it delivers information in a convenient, timely, cost-effective, and environmentally aware manner. Students are expected to check their official VCU email on a frequent and consistent basis in order to remain informed of university-related communications. The university recommends checking email daily. Students are responsible for the consequences of not reading, in a timely fashion, university-related communications sent to their official VCU student email account. This policy ensures that all students have access to this important

form of communication. It ensures students can be reached through a standardized channel by faculty and other staff of the university as needed. Mail sent to the VCU email address may include notification of university-related actions, including disciplinary action. Please read the policy in its entirety at the VCU Policy Library.

### **Student responsibilities**

(source: One VCU: Responsible Together available at: <https://together.vcu.edu/students/> )

When we return, things will look and feel different as we take necessary steps to protect the well-being of our community. Here is what is expected of you:

1. Monitor your health daily. Testing will occur according to protocols.
2. Wear a face covering or mask in common areas, including class.
3. Apply physical distance guidelines to all settings.
4. Clean and disinfect personal and shared spaces before and after use.
5. Cleaning supplies will be available in numerous locations.
6. Report symptoms associated with COVID-19 to VCU Student Health
7. A call center hotline will be available later in the summer.
8. Not sharing is caring during this unique pandemic. Please do not share
9. calculators, tools, lab supplies, etc.

Following rules regarding face coverings or masks, cleaning and disinfecting, and physical distancing is required. Students will receive reminders for daily health monitoring. Staff in the Dean of Students office will be notified after incidents of non-compliance. Refusal to comply with rules can include progressive disciplinary action up to and including suspension, based on the VCU Student Code of Conduct.

### **Requesting accommodations**

The university recognizes that some students who previously did not need Section 504 Academic Accommodations, and who have a qualifying condition or disability, may need support or assistance during the return to campus process. A modified approach for the temporary and more permanent need for accommodation has been developed and implemented to provide students with full access to programs and activities related to their academic majors. Because every case is different, student requests are evaluated on a case-by-case basis. Please share your need for an accommodation with the Student Accessibility and Education Office , or for MCV Campus students, the Division for Academic Success , after you have worked directly with your faculty member.

### **Health and Well-being**

Navigating the anticipated stressors of daily life can often be challenging enough. When unexpected stressors emerge or when we are faced with uncertainty, it can be tough to know how to cope. Try out some of these tips and resources for health and wellness to see if they are a right fit for you.

**Symptoms or Diagnosis:** If an on-campus student identifies symptoms, has tested positive for COVID-19 or has come into contact with someone diagnosed with COVID-19, that student should contact University Student Health Services . At that point, isolation should begin and contact tracing will be performed by Student Health Services. Symptoms will be monitored and the student should refer to a medical provider if symptoms worsen or be released from isolation after 14 days, if symptom-free.

### **Nondiscrimination policy**

VCU is committed to providing a safe, equitable and inclusive environment for all its employees, patients and students. Discrimination or discriminatory harassment is not only unlawful, it is harmful to the well-being of our university community. Our university's core values, specifically those related to diversity and inclusion, have withstood many difficult situations and trying times, and they will not falter now.



Reports of discrimination, bullying, harassment and/or stereotyping of persons of color or those impacted by COVID-19 or otherwise, will not be tolerated. Be assured that VCU will make every effort to address and prevent the occurrence of unlawful discrimination and, if necessary, take prompt and appropriate action to remedy and prevent its reoccurrence. Every member of our community is asked to:

- Become familiar with the university's policies on Preventing and Responding to Discrimination and Duty to Report and Protection from Retaliation in the VCU Policy Library.
- Consult with Equity and Access Services or VCU Human Resources for additional guidance on how to file a report of discrimination.
- Contact the Office of Institutional Equity, Effectiveness and Success (IES) on how to address and maintain a culture of inclusion.
- Encourage individuals who may need an ADA accommodation for a known or newly acquired disability, to contact the ADA/504 Coordinator in ADA Services.
- Bookmark and share information on university or community agencies that offer support or services, such as VCU's Counseling Services or Ombudsperson.
- Explore training and educational opportunities on diversity and inclusion at IExcel Education and through the Office of Institutional Equity, Effectiveness and Success .
- Offer nonjudgmental support and empathy to those affected by current events and this health crisis.

### **Message from your Instructor**

I am grateful for your presence and input in this online course. I appreciate and welcome you regardless of your immigration status, country of origin and/or citizenship, race, ethnicity, religious affiliation, gender/sex, gender identity, sexual orientation, age, or dis/ability. Thank you for enriching our world, sharing your vital experience, and contributing to the diversity that makes our intellectual community vibrant and evermore creative.

### **Tips for Success:**

- When taking online and hybrid courses, your self-motivation and self-pacing are absolutely critical. For this course, you should plan to work about 7-9 hours per course module as we move through the materials. Be sure to plan your time accordingly.
- Make yourself a calendar with all of your due dates across ALL of your courses. Plan for when you will work on each one for completion in advance of the due dates.
- Make sure you note any "online" course that still have a required meeting time (such as a Google Meet or Zoom session).
- Avoid the common assumption that online courses are easier or should be easier. That is a MYTH!!
- Plan Ahead!! Study as you go instead of at the last minute!

### **Where to post questions**

Questions of general interest should first be posted to the discussion board (only if they have not already been answered) so that other students can benefit from the response or have an opportunity to respond to your question.

Only questions of a private nature should be communicated to me through email. When sending a message to me, please allow a minimum of 24 hours for a response . Most of the time I will respond much faster, but sometimes meetings and other courses take over my schedule.

### **Netiquette Guidelines**

Netiquette is a set of rules for behaving properly online. Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Working as a community of learners, we can build a polite and respectful course

community. The following netiquette tips will enhance the learning experience for everyone in the course:

- Do not dominate any discussion.
- Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Popular emoticons such as 😊 can be helpful to convey your tone but do not overdo or overuse them.
- Never make fun of someone's ability to read or write.
- Share tips with other students.
- Keep an "open-mind" and be willing to express even your academically informed opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.
- Using humor is acceptable

(adapted from UWSP )

### **Be Proactive in Communication**

If you find that you have any trouble keeping up with assignments or other aspects of the course, make sure you let your instructor know as early as possible. As you will find, building rapport and effective relationships are key to becoming an effective professional. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that we can help you find a solution. (adapted from UWSP )

### **VCU Honor System**

VCU recognizes that honesty, truth, and integrity are values central to its mission to advance knowledge and student success both in the world VCU students will enter, or return to, once they have graduated and in the university community as a microcosm of that world. In a community devoted to learning, a foundation of honor must exist if that community is to thrive with respect and harmony. Therefore, all members of the university community must conduct themselves in accordance with the highest standards of academic honesty, ethics, and integrity at all times.(from <https://conduct.students.vcu.edu/vcu-honor-system/> )

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- Know the safe evacuation route from each of your Emergency evacuation routes are posted in on-campus classrooms.
- Listen for and follow instructions from VCU or other designated Within the classroom, follow your professor's instructions.
- Know where to go for [additional emergency information](#).
- Know the emergency phone number for the VCU Police (828-1234).
- Report suspicious activities and
- Keep your permanent address and emergency contact information current in

### **Important dates**

You can view important dates for the semester in the [academic calendar](#).

### **Attendance Policy**

Students are expected to participate in all class activities, submit all assignments, and complete all tests and examinations in accordance with the class syllabus and outline. Students who cannot participate in or complete assigned class activities, assignments, tests, and examinations by the

designated deadlines owing to circumstances should contact the instructor ***prior to any incidences or immediately following all unforeseen emergencies***. Simply logging into the Canvas course does not constitute attendance. Maintaining communication with the instructor via phone or email is a must when absences occur. Please note that it is your responsibility to understand and complete the course assignments. You are expected to read all the material posted in Canvas or disbursed through email. If you do not ask questions, it will be assumed that you understand the assignments.

**Military short-term training or deployment**

If military students receive orders for short-term training or for deployment/mobilization, they should inform and present their orders to Military. Student Services and to their professor(s). For further information on policies and procedures contact Military Student Services at 828-5993 or access the corresponding policies.

Please visit <http://go.vcu.edu/syllabus> and review all syllabus statement information. The full university syllabus statement includes information on safety, registration, the VCU Honor Code, student conduct, withdrawal and more.