MTH 225: Discrete Structures for Computer Science 1

Fall 2020 Semester, Grand Valley State University

START HERE

Welcome to MTH 225! I'm Robert Talbert, a professor in the Mathematics Department, and I am grateful that you are signed up for the course and am looking forward to working with you this semester. Before reading any further, here are some first things to know:

1. **My highest priority this semester is your success in this course**. I am committed to helping you be successful in MTH 225 this semester. "Success" in the course is more than just good grades. It means that you are being **challenged** to grow as a learner, that you are **engaging actively** with tasks that feed your growth, and that you are creating **excellent work** in mathematics by completing challenging Discrete Structures-related tasks with a appropriate level of support. It also means that you are **building your lifelong learning skills** so that once the course is over, you are better and stronger as a learner and can continue to **learn new things independently**, and especially go on to **success in courses that have MTH 225 as a prerequisite**.
2. **College level mathematics is more than just computation**. On the pathway to "success" as outlined above, you will be asked to do more than just perform computations. You will be working on **explaining the meaning** of mathematical processes and results in oral and written forms to different audiences; **working on realistic applications** of basic skills to authentic problems; **extending basic ideas** to more advanced concepts; and **seeking true understanding** of underlying concepts. In fact, many of the computations you might do with algebra in high school level mathematics will be automated through computers in MTH 225.
3. **You can expect to be challenged intellectually throughout this course**. None of these elements of "success" come easily. They require dedicated devotion of time and energy to wrestling with the concepts and tasks in the course. This will require you to leave your comfort zones on a regular basis. You may find that you need to rewire your entire process for learning things. You will need to stay constantly engaged with the course through participation in class meetings and on the class discussion board: asking questions, seeking understanding, and giving help.
4. **Intellectual struggle is normal and healthy in a challenging course**. Since none of this is easy, you can expect at times to feel like you are really struggling with the material, even if in your earlier math courses you might never have experienced struggle. **This is a normal and healthy experience**. When you are building physical muscles, the point at which you are growing the most is the moment you experience the greatest strain and fatigue. Legitimate struggle is actually a sign you are doing things right, and it's a signal you're about to experience explosive growth. **Our class is a safe place for you to experience those struggles**.
5. **You have a lot of help available to you as you work**. Throughout the semester, you will be challenged but also given a lot of support to help you rise to the challenge. I will be readily available to help in several channels; your classmates will be available for help through structured and informal support groups; and the GVSU Math Department provides free help through the Math Center. **Everyone in the course has your back**.
6. **You will find MTH 225 to be very enjoyable if you embrace the challenge**. Although hard work doesn't always feel good in the moment, by embracing the challenge and committing to learning Discrete Structures, I think you will find that **growth is fun** and **Discrete Structures is really interesting**.

Finally please note that it's extremely important given our course setup and the unpredictable nature of the pandemic that you **check your email and Blackboard announcements at least once per day** and preferably more than this. All course information will be sent out as soon as possible; it's up to you to maintain awareness and act accordingly.

Course Information

Instructor: Robert Talbert, Ph.D., Professor of Mathematics. Email: talbertr@gvsu.edu. Phone: 331-8968.

Office: My office is **Mackinac Hall C-2-513**. All student meetings this semester will be conducted online unless you have a specific need that requires a physical meeting.

Open drop-in hours: **Monday through Thursday, 1-1:50pm**, using the link http://gvsu.edu/s/1qX and password **growthmind**. **You do not need an appointment.** If you cannot attend open drop-in hours, you can contact me by email, through a Campuswire direct message, or by scheduling an appointment at http://rtalbert.youcanbook.me.

Availability: I typically only check email and other messages between 6am and 6pm on weekdays and once on Saturday mornings. If you send a message that needs a response during those times, you can expect to get a response within 6 hours. Otherwise you can expect one when I am back online.

Face-to-face Meetings: 12:00-12:50pm MWF in Mackinac Hall B-1-132. The course uses a *synchronous staggered hybrid* setup in which your section is split into two groups: **Red** and **Blue**. The **Red** group meets face to face (F2F) on **Mondays**; the **Blue** group meets F2F on **Wednesdays**; and on Fridays the entire class meets synchronously online. Please note that **all students are expected to participate in all meetings**; if it is not your group's designated F2F day, you'll participate remotely via a live stream. Please see "Structure and Flow of the Course" below for more information on accessibility and attendance expectations.

Textbook: Discrete Mathematics: An Open Introduction by Oscar Levin, which is available for free online at the link. If you prefer a paper copy, here are instructions on how to purchase a printed copy. The book is not sold in the GVSU bookstore. Please note, this book does not cover all the content in the course; content not found in the textbook will use homemade notes.

Course website and discussion board: All course announcements, assignments, and grades will be communicated using the course **Blackboard** site available at http://mybb.gvsu.edu All other course communications (including additional examples, guidance on assignments, etc.) will be available through **Campuswire**, our class discussion tool; to join, go to http://www.campuswire.com and use the code 0540.

Course calendar: A calendar for the course, will all due dates and other important time-sensitive information posted on it, is available on Blackboard through a link in the left sidebar. **Be sure to check the calendar once daily** for upcoming events. The calendar is kept up-to-date constantly and **in cases of apparent conflicts in times or dates, the calendar is considered to be correct always.**

Technology: To use the course tools, you will need to have access to the following:

- **A laptop or tablet device**, preferably one with a **touchscreen that allows writing on the screen with a stylus**. Please plan on bringing this device with you to all F2F meetings.
- **A modern web browser**. Chrome is preferred, but browsers such as Firefox and Edge are also fine.
- **Reliable access to high-speed internet**.
- **An active GVSU network account** so that you can access email, Blackboard, and Google Docs.

We will use a variety of course tools during the semester, but these are free to use, and you will be taught how to use them as part of the class. If you have any issue with accessing any of the above, please let me know as soon as possible.

What Discrete Structures is about: *Discrete mathematics* refers to the study of structures that can be separated and counted. The word "discrete" is the opposite of "continuous", which refers to things that flow together and cannot be easily separated. A useful analogy comes from sports, namely American football versus soccer. Whereas the gameplay in soccer is mostly *continuous*, with the ball passing from one side to the other without breaks, gameplay in American football is *discrete* with each side taking turns that are clearly separated and can be counted. Discrete mathematics is the theoretical foundation for computer science, since computers do not operate on continuous flows of information but rather through discrete packets, processed using algorithms that have discrete steps. By studying

discrete structures, you'll gain a foundation for understanding computing that applies to *any* hardware and *any* software, including those that haven't been invented yet!

Course content: Key topics in the course will include different modes of representation of integers (whole numbers), binary and modular arithmetic, symbolic logic, set theory, functions, counting techniques, recursion and induction, and the basics of mathematical proof. In every topic, we seek a **conceptual understanding** from several perspectives, the ability to **apply ideas**, development of **logical reasoning and communication skills**, and an **appreciation for Discrete Structures as a whole**.

Official course description: . Logic, sets, counting techniques, cardinality, relations, functions and sequences, matrices, mathematical induction, and computer science applications. Please see the mathematics program for placement details. Offered fall and winter semesters. *Prerequisite*: MTH 122 or MTH 123 or MTH 124 or MTH 201 or assignment through Grand Valley math placement.

Structure and flow of the course

Default setup: This section of MTH 225 uses a **synchronous staggered hybrid** format. In practice, this will work as follows:

- The class roster is divided into two groups (Red and Blue).
- The Monday and Wednesday meetings will be F2F and live-streamed on Zoom or Google Meet. On *Mondays*, the **Red** group meets F2F while the Blue group participates remotely through the live stream; on *Wednesdays*, the **Blue** team meets F2F while the Red group participates remotely through the live stream; and on *Fridays*, the entire class meets together synchronously online.

Please note, **all students are expected to participate in all meetings**. If it's not your group's designated F2F day, then you should plan on participating remotely. Please do not schedule plans that conflict with remote participation on the days you're not meeting F2F.

Multiple ways to participate: You should plan on following the default setup above for course participation (attend F2F one day per week, participate synchronously online the other two days). However, to give you maximum flexibility and choice for how to interact with the course, **(1) you are free to opt out of your group's F2F meeting and participate synchronously online** if you wish; and **(2) special asynchronous versions of class activities will be posted** for those who cannot or choose not to attend the synchronous sessions. What this means is that:

> **Any student may choose to opt out of their designated F2F meeting and choose the synchronous or asynchronous versions of the activities, at any time. No questions asked, no permission needed, no penalities incurred.**

It's possible to complete the entire course without attending a single F2F meeting if you use this option repeatedly. This is allowed, but the default setup of one F2F meeting per week is probably the most beneficial for your learning. So again, please plan on following the *default* setup unless you have good reason.

Please note you may *not* choose to attend the F2F meeting of the other group (that is, Red students may not attend Wednesday F2F meetings and Blue students may not attend Monday F2F meetings) because of social distancing constraints.

How you'll participate in the course: The material in MTH 225 is split up into 12 **modules**, each lasting about three class days and focused on a single theme. (See the Appendix for a list.) The first two days of a module are designated as "Part A" and "Part B" and are focused on learning activities to gain skill with the Learning Targets in the course (described later). The third day is set aside as a catch-all day to deal with open questions, further examples, and other things you need to know. Your work in the class will follow a basic pattern:

- **BEFORE each class**: You'll complete a **Daily Prep** assignment in which you'll get familiar with the basic concepts of the upcoming lesson. Daily Prep assignments will typically be due by 11:59pm ET the night before the lesson; you'll be able to work ahead if you want.
- **DURING each class**: Class meetings will typically start with 10 minutes for going over the Daily Prep assignments and fielding questions. Then we will spend around 30 minutes doing activities together on the harder concepts from the material. Then we will typically spend 10 minutes wrapping up, going through some of the main points of the activity, taking short ungraded quizzes to give you feedback on your learning, and getting your feedback on the lesson.
- **AFTER each class**: Students choosing the asynchronous version of the class activities will complete those activities and submit them within a 24-hour window. (Students attending F2F or synchronously online will complete these during their meetings.)

Finally, there is ongoing work outside the flow of class meetings, such as weekly practice homework and application/extension problems. More on these in the "Learning Activities in MTH 225" section below.

Learning activities in MTH 225

Both to learn the material and to demonstrate how well you have learned it, you will be engaging with several different kinds of activities in the course. Our course uses a **mastery grading** system in which **most graded items do not use points**, but rather your work will be required to meet certain levels of quality that demonstrate mastery. We will say much more about this in this syllabus and in class.

- **Daily Preparation (DP)**: You will complete Daily Prep assignments before each of your F2F meetings. Each Daily Prep assignment involves reading, video-watching, or playing with an interactive tool and then answering questions and working exercises on basic learning obejctives. Each Daily Prep is graded with a "check" if it is submitted by the deadline (given on the course calendar), every exercise has a response, and each response indicates a good-faith effort to be right. Otherwise the work receives an "x".
- **Class Activities (CA)**: The first two class meetings of each module focus on a set of activities. Those activities will be available for those participating synchronously, and in a slightly modified form for those participating asynchronously. Your work on the activities will be turned in and checked for completeness and effort. As with Daily Prep, Class Activities are graded with a "check" if submitted by the deadline (given on the course calendar), every exercise has a response, and each response indicates a good-faith effort to be right. Otherwise the work receives an "x".
- **Weekly Practice (WP)**: In a typical week, you will be given a set of exercises that give further practice on the week's concepts. These are to be done individually, written up, and turned in on Blackboard. They are graded using the "EMRN" rubric described later in this syllabus. Weekly Practice sets also may contain items done for engagement credits (below).
- **Learning Target Checkpoints**: On a roughly bi-weekly basis, you'll receive a take-home exam called a *Checkpoint* that consists of several problems, each one of which focuses on a single Learning Target from the list in the Appendix. Each Checkpoint will contain one problem for every Learning Target that has been covered up to that point. These Checkpoints offer opportunities to demonstrate mastery of Learning Targets. **You will only need to attempt problems for Learning Targets that you have not yet mastered**. The cumulative structure allows you to attempt problems multiple times in different weeks. Students will be provided with a detailed rubric for what constitutes acceptable work on each Checkpoint problem. Work that meets the criteria for acceptable work will be given a "check"; work that does not meet the criteria will receive an "X". **Work receiving an "X" can be redone at any later Checkpoint**. See the Revision policy for details. You can also earn a "check" through other means.
- **Application/Extension Problems (AEPs)**: There will be at least 8 problem sets given that are focused on challenging applications or extensions of the basic ideas from the course. Students pick and choose from these and work on them through the semester at their own pace. These are graded using the EMRN rubric

described later and can be revised and resubmitted according to the revision policy described later in this syllabus.

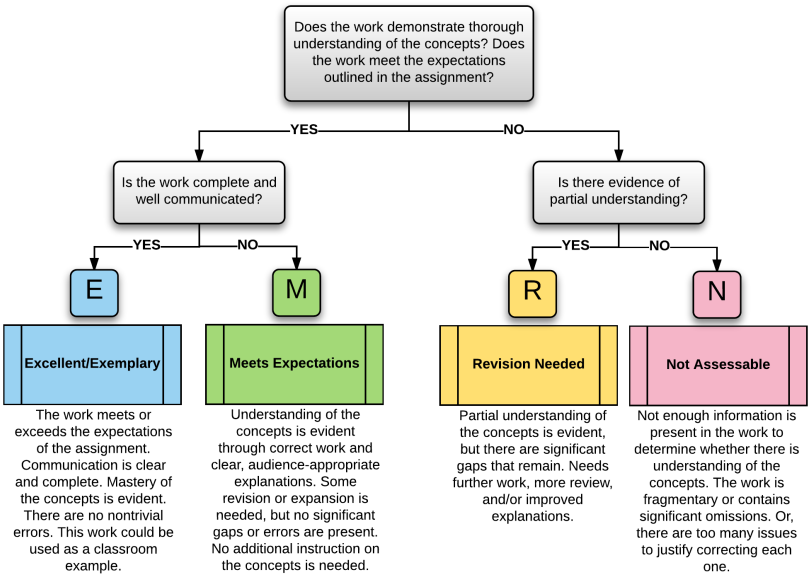
- **Miscellaneous engagement opportunities**: Various other activities in the class will give you the opportunity to get and stay engaged with the course. These include the Startup assignment in week 1, occasional discussion board activities, meeting certain incentive bonus deadlines, and other items. Designated items will carry 1 "engagement credit", and engagement credits will accumulate through the semester. In particular, every "check" on a Daily Prep and Followup activity is worth 1 engagement credit.

We will also have a **Final Exam** consisting of two parts. The first part consists of big-picture questions on the overall ideas of the course and an opportunity to show that you have satisfied the three "CS" learning objectives (see Appendix). Your performance on this part contributes to the plus/minus grade in the course. The other part of the final exam will be a last Checkpoint of the semester and will give you the chance to meet additional learning targets that have not yet been mastered. The Final Exam will be done asynchronously and will be assigned on Wednesday, December 16 and due on Friday, December 18.

How work is graded

Grading of Daily Prep and Class Activities: Daily Prep and Class Activities are graded with either a "check" or an "x". **A "check" is given if the work is turned in on time, and if every item has a response that represents a good-faith effort to be right**. Actual correctness of the answer or explanation is not part of the grading. Work that does not meet these expectations receives an "x". This includes work that has missing responses (even if by accident), work that includes responses like "I don't know" that show insufficient effort to give a good-faith response, and work that is late (again, even if by accident).

Grading for Weekly Practice and AEPs: These two items are graded on the correctness of the work and (especially) the quality of the reasoning presented, using one of four labels: **E** (Excellent/Exemplary), **M** (Meets Expectations), **R** (Needs Revision), or **N** (Not Enough Information/Not Assessable). The grade is assigned using this visual flowchart:



EMRN rubric based on the EMRF rubric, due to Rodney Stutzman and Kimberly Race: http://eric.ed.gov/?id=EJ717675

Learning Targets and Checkpoints: The main concepts to be learned in the course are represented in 23 **Learning Targets**. Ten of these are designated as **Core** Learning Targets because they are most essential concepts of the course; the other 13 are designated as **Supplemental** Learning Targets. There are also three special Learning Targets labeled "CS" that deal with big-picture skills; these are dealt with on the final exam and are not included in the grading process below.

One of your goals in the course is to **demonstrate proficiency and (eventually) mastery of the Learning Targets**. You will do so through work on Checkpoints and approved alternatives to Checkpoints. Every time you provide evidence of skill and mastery of a Learning Target, you earn a "check" on that Target. There are two levels of ratings possible on any Learning Target:

- **Proficiency**, which you earn by **earning one check on the Target**; and
- **Mastery**, which you earn by **earning two checks on the Target**.

You can earn a check on a Learning Target in four different ways:

1. *(The simplest way)* **Do work on a Checkpoint** that meets the criteria for acceptable quality.
2. **Schedule an oral assessment** (on videoconference) during which I will give a new version of a Checkpoint-like problem for that Learning Target, and you solve that problem "live" at an acceptable level.
3. **Create a video** of yourself working out the solution to a Checkpoint-like problem that I will make for you, then submit the video. If you choose this option, you'll also be required to have a follow-up video meeting with me to discuss the solution and answer additional related questions to make sure you really understand the ideas.
4. **Use work on an AEP set** and schedule a videoconference meeting with me to argue that your work on the AEP demonstrates mastery of the Learning Target, as well as answer follow-up questions. For example, you might do work on an AEP that you believe demonstrates proficiency with "find[ing] closed-form and recursive expressions for arithmetic and geometric sequences and find their sums" (Learning Target SR.3). If so, then you could schedule a meeting with me to explain why you think your work satisfied SR.3; I would listen and, if I agree, I might ask you to work out a second problem also related to SR.3 to make sure you really understand the idea.

Please note the following restrictions on options 2-4 above:

- *No more than one check per week can be earned through options 2-4.*
- *Option 3 (make a video) must adhere to standards for video creation* (to be posted separately; basically the video must have clear sound and audio, and keep face, handwriting, and voice in the frame at all times).
- *Mastery (two checks)* must* include at least one Checkpoint problem*. That is, you can't earn Mastery on a learning target through options 2-4 alone.

So for example, to earn a Mastery rating on Learning Target S.4 (*I can determine whether a function is injective, surjective, or bijective*) you could:

- Do satisfactory work on a Checkpoint problem for S.4, then do it again on a later Checkpoint problem (which would be a new version of the same problem you did earlier). Most students will earn mastery on most learning targets this way.
- Do satisfactory work on a Checkpoint problem for S.4, then do it again via an oral exam. Or do it this way but in reverse order (oral exam first then a Checkpoint).
- Do satisfactory work on a Checkpoint problem for S.4, then show me some work you did on an AEP that, in your view, shows you have mastered determining whether a function is injective, surjective, or bijective.

Other combinations are possible. However, note that for Mastery (two checks) at least one check must come through a Checkpoint, so you wouldn't be able for example to do an oral exam and then show me AEP work.

How your semester grade is determined

Your course grade is earned not through accumulating points but by **amassing a body of evidence from across all the work in the course that you have mastered the content and concepts of Discrete Structures**. To determine your *base grade* (the letter A,B,C, D, or F without plus or minus), look at the records of what you've completed and then consult the table below. Your base grade **the highest grade for which all the requirements are met**.

Note: In the table, numerical values indicate the minimum level needed to meet the requirement; amounts above this level also meet the requirement. Also, for AEP's, "M+" means "either M or E". Finally, "DP+CA" refers to the sum of your Daily Prep and Class Activities with a "check"; there will be 24 of each, for a maximum total of 48.

Category	D	C	B	A
Core LTs (10)	5 Proficient	5 Proficient, 5 Mastered	10 Mastered	10 Mastered
Supplemental LTs (13)	5 Proficient	7 Proficient	6 Proficient, 3 Mastered	6 Proficient, 5 Mastered
AEP (8)	2 M+	5 M+	2 E, 4 M+	4 E, 2 M+
WP (10)	3 M+	6 M+	7 M+	8 M+
DP+CA	24	34	39	44
EC (100)	25	50	60	70

Example: A student who completes the course having earned Mastery on all 10 Core Learning Targets and 4 Supplemental Learning Targets; earned Proficiency on 5 more Supplemental Targets; earned "E" grades on 5 AEPs and an "M" grade on a sixth one; earned "M" grades on 8 Weekly Practice assignments; earned a total of 42 checks on Daily Prep and Class Activities; and has 65 Engagement Credits has earned a "B" in the course for the base grade.

A grade of "F" is given if not all the requirements for a "D" are met.

Plus/minus grades: Your base grade may be modified with a plus or minus, according to these guidelines:

- A "plus" is added to the base grade if all requirements for a base grade are satisfied, *and* the LT (both Core and Supplemental) *or* AEP requirement for the next level up is also satisfied; *and* the big-picture portion of the final exam is passed.
- A "minus" is added to the base grade above in either of the following cases: (1) All requirements for a base grade are satisfied *except one*, and that one is no more than two levels below the others; **or** (2) You meet the minimum requirements for a base grade but you do not pass the big-picture portion of the final exam. In the first case, if the deficient area is more than two levels below, the penalty will be either a minus or a full letter grade, at my discretion.

Revisions and tokens

Since your work in the course is not graded with points (or is graded either 0 or 1), partial credit is not available except for occasional multi-part WeBWorK items. Instead, almost all work you do in the course can be revised and resubmitted to allow you to improve your work and raise your grade.

Checkpoint items can be revised by reattempting the item on a later Checkpoint or through one of the other means described earlier. For example if you attempt a Checkpoint problem for Learning Target A.1 and receive an "x", you can: redo the problem on a later Checkpoint (where it will be the same essential task but with different specifics); schedule an oral exam via video meeting to attempt a different version of the problem; create a video for a different version of the problem; or use work on an AEP to argue that you've met the standards for that target. Remember, though, only one check per week can be earned through non-Checkpoint methods, and Mastery level on a target requires that at least one Checkpoint problem earn a "check".

AEPs earning M, R, or N can be revised and resubmitted at any time. They will be regraded using the same standards as originally used. However, there are two important limitations on your revision and resubmission of AEP's:

> **Two-submission-per-week rule**: **No more than two submissions of AEP sets may be made per week. This can be two new sets, two revisions, or one of each.** A third submission can be purchased with a token (below) but **four or more submissions in a week are not allowed under any cirumstance.**
>
> **Revision of N grades rule**: **Students have to spend a token (below) in order to revise any AEP that was graded at "N" (Not Assessable).**

Weekly Practice sets receiving an R or N can be revised, with the limitation that work receiving an "N" costs one token to revise (same as with AEPs); and no more than one Weekly Practice set may be revised in a given week.

Daily Prep and **Class Activities** may not be revised at all; these are graded on the basis of completeness and effort only and are intended to be done once.

Tokens: Tokens are a fake currency that are used to "purchase" exceptions to course policies and other advantageous items in the course. Every student starts with five of these. One token can be spent for any of the following at any time:

- Attempt a second Learning Target in a given week through non-Checkpoint means
- Submit a third AEP (either revision or new submission) in a given week
- Revise and resubmit an AEP graded "N"
- Revise and resubmit a Weekly Practice graded "N"
- Extend the deadline on a Checkpoint by 12 hours (request must be submitted prior to the original deadline)
- Extend the deadline on a Weekly Practice set by 24 hours (request must be submitted prior to the original deadline)
- Purchase 3 engagement credits

With the exception of the last item, tokens may not be "stacked", for example by spending 3 tokens to get a 72-hour WeBWorK deadline extension. You can stack tokens to purchase engagement credits (e.g. spend 3 to get 9 EC's).

Academic integrity in MTH 225

The university's academic integrity policy is described in the GVSU Student Code, Section 3.1 which you can read online here: http://bit.ly/gvsuacademicintegrity. **Every student has the responsibility of reading and understanding these policies, especially the consequences for engaging in academically dishonest activities.**

Some of the work you will do in the course involves collaboration; at other times collaboration may be allowed but not required; while at others it may not be allowed. Here are the rules for collaboration on each kind of work you do:

- *Daily Prep and Followup Activities*: You may collaborate with others, but your writeup must be in your own words. You may not copy someone's work and submit it as your own, nor may you copy the ideas from someone and simply change the wording.
- *Checkpoints* and other work done on Learning Targets: No interations at all with another person or with unauthorized sources on the internet is allowed. Any evidence of using information from another person or source will be investigated as academic dishonesty.

- *AEPs*: Similarly, no interations at all with another person or with unauthorized sources on the internet is allowed.
- *Weekly practice*: You may discuss the general, broad ideas of Weekly Practice problems with others (including on Campuswire) but you may not use other people's work as your own. You may also not ask for specific details of a solution, either in person or on Campuswire.

In particular, use of "study" sites such as Chegg or Coursehero, or Q&A sites like Stack Exchange or Quora, to obtain help on graded work other than Daily Prep or Class Activities is forbidden and will automatically constitute academic dishonesty.

All suspected instances of academic dishonesty will be thoroughly investigated, and whether a student has committed academic dishonesty is my determination to make based on the evidence. If I determine academic dishonesty has been committed, a report will be filed with the Dean of Students office, and the minimum penalty will be:

- Daily Prep and Class Activities: A grade of "x"
- Checkpoints and other Learning Target work: A grade of "x" and required expense of two tokens to reattempt; for severe cases, you may be barred from reattempting.
- AEP's and Weekly Practice: A grade of "N", and you will not be allowed to revise or resubmit the AEP for the rest of the semester.

Note these are *minimum* penalties; additional penalties may be given including reduction of course grades and potential suspension from the university.

Please note: **There is no need to commit academic dishonesty in this class since you can revise and resubmit almost anything**. If you come to believe that cheating or plagiarism is necessary given your situation: DON'T DO IT. Get some help instead and take comfort in the fact that you can just submit your best effort, get feedback, and try again later.

Additional course expectations and information

Below are some additional important information about the course. Please note there is a separate section following this one, with course policies specific to the Covid-19 pandemic and how the class will be conducted.

Attendance: Each meeting is set up so that you have the option to attend F2F if it's your group's day to meet; or you can participate synchronously online; or you can participate asynchronously. **You will learn best if you participate F2F or synchronously. Please reserve asynchronous participation for cases where synchronous participation is impossible.** Also please note: **You may not attend the F2F meeting for the group other than your own** due to social distancing requirements; on your group's "off day" you are expected to participate online, again preferably synchronously.

You will be responsible for all announcements made in the F2F meetings and for all material covered in those meetings. Each meeting will begin on the hour; please be on time for your meetings. If circumstances beyond your control prevent you from attending F2F *or* participating remotely, please let me know so I can help you stay current.

Tech support: Please note that **I (Prof. Talbert) am not able to provide support for technological issues**. If you encounter issues with technology, please use the appropriate source of help:

- *For help with Blackboard*: Email the Blackboard Help Desk at bbadmin@gvsu.edu or call (616) 331-8526. For hours of operation and more information see https://www.gvsu.edu/elearn/help/.
- *For help with the GVSU network, email, or printing*: Email the GVSU IT Help Desk at helpdesk@gvsu.edu; or call (616) 331-2101 or toll free (855) 435-7488. For hours of operation and more information see https://www.gvsu.edu/it/.

- *For specific help with your computer*: Try the GVSU IT Help Desk (see previous bullet) or contact your equipment manufacturer or computer store.
- *For help with course tools such as Desmos and Campuswire*: Ask a question on the `#tech` channel on Campuswire, seek out the help documentation in the tool, or do a targeted Google search.

Deadlines and late work: Deadlines for course work are clearly indicated on the Course Calendar; in cases of apparent conflict between dates, always assume that the Course Calendar is right.

- *For Daily Prep and Followup Activities*: No extensions to deadlines are available. Simply submit a good faith effort on all items by the deadline.
- *For Checkpoints and Weekly Practice*: Deadlines may be extended 12 and 24 hours, respectively, by spending a token. No other extensions are available.
- *For AEPs*: There is only one deadline for AEP's, namely the last day of classes (11:59pm ET, Friday December 11). Otherwise you simply submit your work when it is ready to be graded (subject to the Two-Item-Per-Week Rule). This deadline will not be extended.

Math Center: GVSU's Math Tutoring Center is online with Blackboard Collaborate this semester. You can access virtual drop-in tutoring through a link in your Blackboard course called Math Tutoring Center or on our website at http://gvsu.edu/tutoring/math/. Then you need to click on the "Online Math Tutoring Center" button, which will require a GVSU login. There will be tutors online, ready to help, Monday through Thursday 10a – 9p, Friday 10a – 2p and Sunday 6p – 9p starting Wednesday, September 2nd. Bring questions about your technology, on methods and concepts, or on specific problems. All Math Center tutoring is FREE, so stop by early and often. When you enter the Collaborate room, please type your first and last name so you can get you signed in and connected with a tutor.

Special learning needs: If you have special needs because of learning, physical or other disabilities, it is your responsibility to contact Disability Support Resources (DSR) at 616-331-2490 or http://www.gvsu.edu/dsr/ . DSR will help you arrange accommodations. Then, speak with me in person about making those accommodations and ensure that they are consistent with your arrangements with DSR.

Basic needs security: If you have difficulty affording groceries or accessing sufficient food to eat every day, or if you lack a safe and stable place to live, I encourage you to visit Replenish, a food resource for GVSU students. If you are comfortable doing so, please speak with me about your circumstances so that I can advocate for you and to connect you with other campus resources.

Gender identity and expression: If, for purposes of gender identity and expression, your official name (in Banner) does not match your preferred name, your name can be updated in Blackboard. Please contact the registrar's office to submit this request. The registrar's office will contact the Blackboard administrator to make the change and will also contact your professors to inform them that your name in Banner will not match the name in Blackboard.

Changes to this syllabus: Changes to this syllabus may occur during the semester. In those cases, the changes will be announced in class and online, and if appropriate, students will be given a voice on how the changes will be implemented. It is your responsibility stay abreast of the information passed along in course announcements so that you will be aware of any changes that take place.

Credits: Portions of the language of this syllabus were adapted from the syllabi of Prof. Matt Boelkins and Prof. David Clark, both of GVSU.

MTH 225 COVID-19 Policies

As you are well aware, we will be having class this semester while trying to navigate a global pandemic that seems to change every day. While we can't predict even the near future, the following are general guidelines and plans for how we can work productively together in the course.

Taking care of yourself

Above all else, **take care of your own physical and mental health** during these difficult times. Make sure you are getting sufficient rest, staying connected to friends and family, and giving yourself time and space to do things you enjoy outside of college. This website lists several good tips for maintaining good self-care in our situation.

Before coming to campus, **perform a self-evaluation each time** and **if you feel even the slightest bit of sickness or Covid-19 symptoms, stay home and participate remotely**. You should be on campus only if you feel *completely healthy*.

Remember that **at any time this semester if you feel unable or unwilling to be present for a F2F meeting, you can opt out of the meeting and participate remotely or asynchronously. No questions asked, no permission needed, no penalty incurred**. Also note that *there are no graded assessments done in class* so you will never have to make up work that was turned in during class.

Keeping our class meetings safe

When you are present in a F2F meeting, please observe the following:

Wear a mask at all times. Face coverings, such as masks, are required to be worn in the classroom. Students who have forgotten their face coverings may get a disposable mask at a campus office. The evidence is clear that face coverings are a crucial part of keeping coronavirus at bay and support the university's commitment to providing all members of its community with an inclusive living and learning environment with equitable opportunities for success. GVSU's policy on face coverings is posted on the Lakers Together web site. Students who are not able to wear a face covering due to a medical condition should contact Disability Support Services (DSR) to discuss their individual situation.

Please note, students who remove their masks during class, wear the mask incorrectly (for example, with the nose exposed), or refuse to wear mask at all will be reminded of this policy once, and then asked to leave if non-compliance continues.

Observe proper social distancing. Your classroom has been specially arranged so that students are 6 feet apart from each other and from the professor at all times. This is sufficient for social distancing and close enough so that 2-3 students can turn to each other and discuss a concept. We will also leverage technology to allow for more remote communication, for example using the chat rooms in Campuswire. **Please do not encroach on the space of another person or share physical objects with another such as pens, calculators, or paper**.

Practice appropriate personal hygiene. Wash your hands regularly or use hand sanitizer. If you must cough or sneeze, do so facing away from other people and use the inside of your elbow to cover your mouth, even if you have a mask on. You may wish to bring sanitizing wipes to wipe down your desk and seat before and after class.

If you expect any difficulties in abiding by these terms, you should plan on exercising your options to participate in the course online.

Contingency plans for the semester

We will begin the semester in "staggered hybrid" mode, but several things could happen during the semester that might alter this setup. The details for how we respond to events of the next 14 weeks depend on the situation, but please rest assured that I (Talbert) have plans in reserve for all likely scenarios including if the university goes fully online or if I cannot be present due to self-quarantine or infection. **Remember to check your email, Blackboard announcements, and Campuswire daily to stay notified of all course information**.

Encouragement

Although these plans can be scary and demoralizing, I want you to know that **GVSU is doing everything in its power to keep people safe from Covid-19**. In my view, GVSU's campus is at least as safe from Covid-19 as the average large supermarket, which many of us visit on a regular basis now without much trepidation. Furthermore I believe that **if we observe reasonable precautions like the ones described here, then while the risk of Covid-19 is still present, there's no reason to be afraid.** We will still learn and grow intellectually just as in "normal" times if we stay focused and work together.

Appendix

Course modules

Module	Focus	Topics	Text
1	Integer representation by computers	Representation base 2, 8, 10, 16; two's complement; binary arithmetic	Professor Talbert's notes
2	Modular arithmetic	The Division Algorithm, the % operator, modular arithmetic	Professor Talbert's notes
3	Symbolic logic 1	Propositions, conditional statements, logical operations, truth tables	Levin 0.2 and 3.1 for part, plus Professor Talbert's notes
4	Symbolic logic 2	Logical equivalence, predicates, quantification	Levin 0.2 for part plus Professor Talbert's notes
5	Sets	Set notation; subset and element relations; union, intersection, and complement; Venn diagrams; cardinality and power sets; Cartesian products	Levin 0.3
6	Functions	Functions and non-function; injective, surjective, and bijective functions; special functions for CS (floor, ceiling, etc.)	Levin 0.4 + Professor Talbert's notes for special functions
7	Basic advanced counting	Additive and multiplicative principles; binomial coefficients (intro to recurrence relations and recursion)	Levin 1.1, 1.2
8	Combinations and permutations	Combinations and permutations, combinatorial proof	Levin 1.3, 1.4
9	Advanced advanced counting	Principle of Inclusion and Exclusion, stars and bars methods	Levin 1.5, 1.6

Module	Focus	Topics	Text
10	Sequences and recursion	Closed-formula and recursive definitions of sequences; arithmetic and geometric sequences	Levin 2.1, 2.2
11	Solving recurrence relations	Polynomial fitting; solving recurrence relations	Levin 2.3, 2.4
12	Mathematical induction	Idea of proof; weak mathematical induction	Levin 2.5

Learning Targets

Mastery of Learning Targets in groups A, L, SF, C, SR, and P are assessed using Checkpoints and the alternatives to Checkpoints described earlier. Learning Targets in group CS are assessed on the Final Exam.

- **Group A**: **Represent integers using different number bases**, **and perform integer arithmetic using different bases and modular arithmetic**.
  - A.1: I can represent an integer in base 2, 8, 10, and 16.
  - A.2 **(Core)**: I can add, subtract, multiply, and divide two integers written in binary.
  - A.3: I can compute `a % b` given integers `a` and `b` and perform arithmetic mod `n`.
- **Group L**: **Formulate**, **manipulate**, **and determine the truth of logical expressions using symbolic logic**.
  - L.1: I can use propositional variables and logical connectives to represent statements; and interpret symbolic logical statements in plain language.
  - L.2 **(Core)**: I can write the negation, converse, and contrapositive of a conditional statement and use DeMorgan's Laws to simplify symbolic logical expressions.
  - L.3: I can determine whether a quantified statement is true, false, or underdetermined, and state its negation.
  - L.4 **(Core)**: I can write the truth table for a logical statement.
  - L.5: I can determine if a statement is a tautology and whether two statements are logically equivalent.
- **Group SF**: **Formulate and solve computational problems using sets and functions**.
  - S.1 **(Core)**: I can represent a set in roster notation and set-builder notation; determine if an object is an element of a set; and determine set relationships (equality, subset).
  - S.2: I can perform operations on sets (intersection, union, complement, Cartesian product) and determine the cardinality of a set.
  - S.3 **(Core)**: I can determine whether or not a given relation is a function, determine the domain and codomain of a function, and find the image and preimage of a point using a function.
  - S.4: I can determine whether a function is injective, surjective, or bijective.
- **Group C**: **Formulate and solve complex counting problems using computational thinking and the tools of combinatorics**.
  - C.1 **(Core)**: I can use the additive and multiplicative principles and the Principle of Inclusion and Exclusion to formulate and solve counting problems.
  - C.2: I can calculate a binomial coefficient and correctly apply the binomial coefficient to formulate and solve counting problems.
  - C.3 **(Core)**: I can compute combinations and permutations and apply these to formulate and solve counting problems.
  - C.4: I can use the "Stars and Bars" technique to formulate and solve counting problems.

- **Group SR**: Evaluate numerical and other sequences using recursion, and solve simple recurrence relations.
  - SR.1 **(Core)**: I can generate several values in a sequence defined using a closed-form expression or using recursion.
  - SR.2: I can use sigma notation to rewrite a sum and determine the sum of an expression given in sigma notation.
  - SR.3 **(Core)**: I can find closed-form and recursive expressions for arithmetic and geometric sequences and find their sums.
  - SR.4: I can determine if a given sequence is Δ^k-constant and find a polynomial fit if it is.
  - SR.5: I can use iteration and characteristic roots to solve a recurrence relation.
- **Group P**: **Write clear**, **correct**, **and convincing arguments to explain the correctness of a solution using combinatorial proof and mathematical induction**.
  - P.1: I can analyze and write a combinatorial proof of a combinatorial identity.
  - P.2 **(Core)**: Given a statement to be proven by (weak) induction, I can state and prove the base case, state the inductive hypothesis, and outline the proof.
- **Group CS**: **Demonstrate problem solving**, **communication**,**and learning skills appropriate for computer science**.
  - CS.1: I can explain the reasoning behind solutions to computational problems clearly to an appropriate audience.
  - CS.2: I can apply computer programming and computational thinking to frame and solve mathematical and computational problems.
  - CS.3: I can self-assess my work and apply feedback from others to make improvements in my work.