Mathematics 125 – 004: Discrete Mathematics I; Spring 2019

Class Schedule:	**Mon & Wed: 1:30 – 2:45 PM**	**Location:**	**Robinson B208**
Class Dates:	**Wed 23 Jan – Mon 6 May**	**Final exam:**	**WED 8 MAY 1:30 – 4:15 pm in classroom**
Instructor:	**Mr. Glenn Preston**	**Email:**	**gpresto3@gmu.edu**
Office:	**Exploratory Hall, Room 4309**	**Office Hours:**	**MW 3:30 – 5:30; TR 12:00 – 2:00; and by appt.**

Prerequisites:

- Official Course Catalog: Grade of C or better in Math 105, 108, or 113; or requisite score on Math Placement Exam
- You will need to have a SOLID foundation in basic GEOMETRY, ALGEBRA, TRIGONOMETRY, FUNCTIONS, GRAPHING

Required Textbook and Other Materials:

- **Discrete Mathematics With Graph Theory, by Goodaire and Parmenter; Pearson 3rd Edition; 9780134689555**

Course Learning Objectives:

- **GMU Catalog:** *"Introduces ideas of discrete mathematics and combinatorial proof techniques including mathematical induction, sets, graphs, trees, recursion, and enumeration."*
- **Glenn's Additional Objectives:** Prepare you to be successful in future math, physics, science, engineering, computer, and other courses; enhance your problem solving skills, intuition, and insight. Also, help you to be an effective and valued employee in your career field someday.
  Major points of emphasis will be to cultivate your skills to:
  - **(1) Obtain a solid understanding of the concepts/theory of the course, master the problem solving techniques, and execute correct and well organized/well documented solutions to problems**
    - Many students fall down in solving problems due to one or more of the following issues:
      - They don't **diagnose the problem** and develop a **strategy** BEFORE they dive in
      - They don't take an **organized approach** to problem solving
      - They make **fundamental algebra and other errors**, and/or they don't check their work along the way and at the end. You can't always tell if you answer is right, but often you can determine that it can't possibly be correct.
  - **(2) Analyze problems and solutions** to understand what they mean, how they behave, and when/how they are valid to keep out of trouble when a solution (or technique) is not valid
  - **(3) Do a "sanity check" to see if your answer makes sense** – e.g. does it have the correct properties? Does it fall within reasonable upper and/or lower bounds based on a "ball park" estimate or limiting case?

Approach: WE WILL EMPHASIZE THE FUNDAMENTALS

- **(1)** Learn how to **diagnose and "attack"** problems to **determine the problem type**, underlying **concept(s)**, appropriate problem solving **technique(s)**, and to master the **mechanics** of executing the solution
- **(2) Proofs and/or derivations of key theorems and techniques** – these are essential for learning and **understanding the "5Ws"** of what we are learning: the **"who, what, when, where, why, and how"** which is what you should focus on. We will do fewer proofs/derivations and generalized problems with parameters than "back in the day" (i.e. the Stone Age) but more than you are probably used to. It can seem painful but it is worth it.
- **(3)** Include **fundamental concepts and techniques from prerequisite courses** to ensure that you have and maintain a solid foundation in geometry, algebra, trigonometry, functions, logs/exponentials, etc.
- **(4) Emphasize graphing functions/solutions by hand** based on analysis of their properties. For almost any problem, there is an analytical (algebraic) view and a graphical (geometric) view.
- **(5) Word problems** – upper-level courses in your major (e.g. math, science, engineering, physics, economics, etc.) will be full of word problems so you need to get good at them, if not already. **Problem solving is both an art and a science.** Using an organized approach is vital to being a good problem solver. Doing enough problems of a particular type builds your intuition and insight into the best method(s) to "attack" similar problems. There is no substitute for **practice, practice, practice.**

- **(6) Solve problems parametrically –** in applications and in "real world" problems it is crucial to be able to solve a problem in terms of unknown parameter(s) (e.g. density of a fluid or solid, the dimension(s) of a region). This allows you to obtain a GENERAL solution and then evaluate the behavior of your solution as the parameter(s) are varied to understand how the solution behaves (e.g. proportional, inversely proportional, linear, non-linear)

Grades: Course Average Computation and Grade Scale

	Nominal	Max Final	Max Mid-term
3 Mid-term Exams	60% (*All 3 @ 20% each*)	40% (*Best 2 @ 20% each*)	75% (*All 3 @ 25% each*)
Final Exam	40%	60%	25%
EXTRA CREDIT: In-Class Quizzes	5%	5%	5%
TOTAL	105%	105%	105%

- A course average will be calculated for each student using all three weightings. For each student, on an individual basis, I will use the highest average to determine the overall course grade using the grading scale below.

F (0.0)	D (1.0)	C- (1.67)	C (2.0)	C+ (2.33)	B- (2.67)	B (3.0)	B+ (3.33)	A- (3.67)	A (4.0)	A+ (4.0)	Letter Grade (Grade Points)
< 60	≥ 60	≥ 70	≥ 72	≥ 78	≥ 80	≥ 82	≥ 88	≥ 90	≥ 92	≥ 100	Course Average

- **Grades are based on an absolute scale NOT a "curve".** Your performance will be evaluated relative to what you need to achieve in order to be successful in future courses rather than relative to your classmates' performance.
- **All exams, quizzes, and the two Mathematica projects will have built-in extra credit opportunities**.
- **Speaking of Extra Credit: There are no extra credit assignments or other additional work during or at the end of the semester that can be done to boost your grade.** I still get asked every semester – and the answer is still "no".

QUIZZES & EXAMS – GENERAL INFO:

- **MAKEUP QUIZZES & EXAMS: NONE EXCEPT CONSISTENT WITH GMU POLICY AS STATED BELOW**
  - **Missed quizzes and exams will receive a score of 0. There will be no makeup quizzes or exams except under special circumstances described below.**
  - **Per GMU Academic Policy A.P.1.6.1,** you may be able to take a quiz or mid-term exam at an alternate time **WITH PRIOR ARRANGEMENT**. This applies only to situations involving:
    (1) Religious Observance - I have done my best to deconflict the course schedule with religious holidays. However, if the schedule changes or there is a situation/conflict I am not aware of, please let me know.
    (2) Mandatory Participation in Official University Activities (e.g. intercollegiate athletics, GMU orchestra)
  - My strong preference is to arrange the alternate day/time to be before the quiz/exam is given to the class.
  - If you have a conflict, please let me know ASAP. **Last minute requests (< 48 hours) will not be considered regardless of circumstances**. Planning ahead is an important survival skill in the "real world".
  - **If you have truly extraordinary circumstances – see me**. I'll listen, but it needs to be a very good reason.
- **NO NOTES OR REFERENCES:** All exams and quizzes will be closed book. No notes or other reference material of any kind will be allowed. I **may** provide a reference sheet with some formulas, but most formulas, theorems, etc. I will let you know prior to the exam what, if any, reference material/formulas will be provided.
- **NO CALCULATORS OR ELECTRONIC DEVICES OF ANY KIND WILL BE ALLOWED DURING EXAMS AND QUIZZES**. Please turn-**off** (not just vibrate mode) and put away all cell phones, mp3 players, and any other electronic devices during quizzes and examinations.
- **NO LEAVING THE ROOM AND RETURNING**: If you leave, you're done and need to turn in your exam or quiz.

QUIZ-SPECIFIC INFORMATION:

- There will be occasional unannounced short (~10-15 min) EXTRA CREDIT in-class quizzes (perhaps 8 to 10 or so).

EXAM-SPECIFIC INFORMATION:

- **On all exams, regardless of topic, I will be looking for you to demonstrate:**

1) **Good problem solving skills:** The ability to DIAGNOSE a problem to determine the type of problem, recognize and understand the FUNDAMENTAL CONCEPT(S) INVOLVED, determine and properly apply the APPROPRIATE PROBLEM SOLVING TECHNIQUE(S), and correctly EXECUTE THE MECHANICS of those techniques
2) **Correct analysis, understanding, and interpretation of the solution:** For example:
   - Analyzing the properties/behavior of a solution to understand what it means, seeing if the solution passes a "sanity check" and/or estimating upper and/or lower bounds for the answer
   - Does the solution match given conditions and/or satisfy physical constraints of the problem?
   - Is the solution defined over the appropriate domain and does it produce the appropriate range?
   - Estimate "ball park" values using simpler conditions (e.g. round numbers, simpler curves/shapes)
3) **Ability to graph/sketch the solution** – deduce properties of the solution and correctly draw it; relate the graphical behavior of the solution to expected results based on the type of problem, specified conditions/parameters, physical constraints, etc.
4) **A well-organized solution with a mathematically correct progression from each step to the next**
   - **SHOW YOUR WORK ➔ LITTLE OR NO WORK = LITTLE OR NO CREDIT REGARDLESS OF YOUR ANSWER.** Don't leave large gaps between steps, be careful with use of an equal sign ➔ both sides must truly be equal or else it is an incorrect statement; be careful to use correct notation.
   - **WHAT YOU WRITE DOWN MATTERS** - even if you understand what you are doing, you need to properly communicate that understanding to me (and later to coworkers, customers, your boss, etc.)

COMPREHENSIVE FINAL EXAM:

- The emphasis will be on key concepts/techniques, particularly putting them together to solve "compound" problems, applications, and understanding of the "big picture" and "the 5W's"
  - **IMPORTANT NOTE:** Per GMU Policy A.P.3.10, you must take the final exam at the regularly scheduled date and time unless you have **excused absence in writing signed by your Dean or Academic Director.**
  - GMU policy allows you to arrange an alternate day/time if you have a conflict between final exams or more than two final exams on one day. If so, **let me know SEVERAL WEEKS PRIOR to the final exam.**

Homework Exercises:

- **WORD TO THE WISE: If you don't do a thorough and comprehensive job on the homework exercises, you will almost certainly fail the course – it is that simple. Many have tried (myself included) to short-change the homework process and it always ends VERY badly. Don't learn this lesson the hard way.**

Class Web Page/Communication:

- I will post all class materials, announcements, scores/grades on **Blackboard** and send some things via GMU email.
- **The primary way to contact me is via GMU email (gpresto3@gmu.edu)**
  - To comply with GMU policy and protect your privacy, I will try to only send email to your GMU email address. **Please only send email to me from your GMU email so I can use the "reply" function in responding to you**.
  - I will try to reply to each email ASAP, but please bear in mind that with 130 students between 2 classes it may not be right away. In case of emergency you can text me at (703) 405-0344 (text only please, no calls)

Honor Code: THIS IS VERY IMPORTANT

- **It is expected that each student in this class will conduct himself or herself within the guidelines of the Honor Code.** Among other things, this means that sharing information of any kind about exams or quizzes (either before or during the exam) is forbidden. Any alleged issues related to the honor code will be brought to the attention of the Office of Academic Integrity. Please reread the University Honor Code and abide by it.

Other Topics:

- **Class Schedule:** The last page shows the nominal schedule for lecture topics, quizzes, exams, etc. Modifications to the schedule may be required. **You are responsible for being aware of any announced, emailed, and/or posted changes. Please check the syllabus before asking "what is on the quiz this week?"**

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- **Attendance: Will not be taken and there is no "participation" component to your grade.** It is your choice/responsibility to show up for class, be prepared, and get something out of it. **REGARDLESS, IT IS VITAL THAT YOU KEEP PACE WITH THE COURSE SCHEDULE.**
- **Electronic devices: Please be courteous and silence all cell phones, pagers, iPods, and other devices during class.** You may use a laptop, smartphone, or other electronic device for capturing notes or other legitimate class related use (but NOT during an exam or quiz).
- **University Policies:** Please familiarize yourself with university policies. The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. All members of the university community are responsible for knowing and following established policies and procedures. (See also https://catalog.gmu.edu/policies/)

Getting Help: Don't Let a Small Problem Turn into a big one ➔ DON'T GET BEHIND

- **Contact me** via email and/or come see me during regular office hours or make an appointment.
- **The Math Tutoring Center**, Johnson Center, Room 344: http://math.gmu.edu/tutor-center.php
- **Find a buddy and/or form a study group** – There is nothing wrong with working collaboratively. However, just make sure that you don't simply "go along for the ride" when working with someone. **Watching someone else do a problem – even if you understand what they are doing – is not the same as doing it yourself**
- **Internet Resources:** There are tons of good resources out there (and a lot of crap too). I like:
  - **MIT Open Courseware (OCW)**
    - There are several classes in Discrete Mathematics. Here are links to a couple examples:
      - "*Principles of Discrete Applied Mathematics*" https://ocw.mit.edu/courses/mathematics/18-310-principles-of-discrete-applied-mathematics-fall-2013/
      - *"Mathematics for Computer Science"* https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/
  - **The Khan Academy Tutorials**
    - Unfortunately the Khan Academy does not have a "Discrete Math" page. However, they do have videos on some relevant topics such as Permutations and Combinations, Inductive and Deductive Reasoning, etc.

Other University Resources and Links:

- **Office of Disability Services** (ODS): Student Union Building I, Room 211, (703) 993-2474**. All academic accommodations must be arranged through ODS**. If you are a student with a disability and need academic accommodations, please contact ODS as soon as possible and do not hesitate to speak confidentially with me.
- **Counseling And Psychological Services** (CAPS): Student Union Building I, Rm 3129, (703) 993-2380
- **Veterans: Office of Military Services:** SUB I, Suite 1510 (next to Chik-Fil-A) , (703) 993-1316
- **Mathematical Sciences Department**: Exploratory Hall room 4400, (703) 993-1460

My Commitment to You:

- So far all of the rules/policies have been imposed on you. However, you have a right to expect certain things from me. I have responsibilities to each student and to the class as a whole. My commitment to the class is that I will:
  - Do my best to follow my own advice/rules and lead by example – i.e. I will try to "practice what I preach"
  - Be as honest, open, and transparent as possible in how I conduct the class, consistent with maintaining proper student privacy/confidentiality and the academic integrity of the course.
  - Treat every student with respect and as an individual having individual talents and needs, within the constraints of doing what is best for the class as a whole. Everyone learns a little differently and some students need more and/or different types of help than others.
- **Bottom line:** To be successful in this course you will need to do more than just the bare minimum. Therefore, **I** am ready, willing, and able to do more than the minimum required of me *(e.g. extra office hours, review sessions, provide supplemental material, whatever I can do to help students realize their potential).* I will help you in any appropriate way, however, **just remember that you learn by doing and "only you can do the doing"**.

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*** Class Lecture/Exam/Homework Schedule (Subject to Change) ***

Unless there are class cancellations we will stick to this schedule. Exams will cover scheduled sections regardless of how much of any particular chapter section we cover during each lecture.

Prior to Each Class:

- **GOOD:** Make sure you have completed homework from all prior chapter sections. Seek help as needed.
- **BETTER:** Read upcoming section(s). WORK THROUGH THE EXAMPLES IN THE TEXT PRIOR TO CLASS
- **BEST:** Try the homework for the upcoming section(s): Do what you can, make a list of questions for the rest.

Course Schedule

WK	MON	WED
1	21 JAN	23 JAN
	NO CLASS	Intro, 2.1
2	28 JAN	30 JAN
	2.2, 2.3	2.3, 2.4
3	4 FEB	6 FEB
	2.5, 3.1	3.1, 3.2
4	11 FEB	13 FEB
	Review	EXAM-1: Ch. 2 & 3
5	18 FEB	20 FEB
	4.1, 4.2	4.2, 4.3
6	25 FEB	27 FEB
	5.1, 5.2	5.2, 5.3
7	4 MAR	6 MAR
	6.1, 6.2	6.2, 6.3
8	11 MAR	13 MAR
	SPRING BREAK	
9	18 MAR	20 MAR
	Review	EXAM-2: Ch. 4 - 6
10	25 MAR	27 MAR
	7.1, 7.2	7.2, 7.3
11	1 APR	3 APR
	7.4, 7.5	7.5, 7.6
12	8 APR	10 APR
	7.7	Review
13	15 APR	17 APR
	EXAM-3, Ch. 7	9.1, 9.2
14	22 APR	24 APR
	9.2, 9.3	12.1, 12.2
15	29 APR	1 MAY
	12.2, 12.3	TBD
16	6 MAY	8 MAY
	Review	NO CLASS

COMPREHENSIVE FINAL EXAM
WED 8 MAY 1:30 – 4:15 pm
Robinson B 208

Homework Exercises

Ch	Chapter / Section Title	Exercises
	2: Sets and Relations	
2.1	Sets	1, 3, 9, 10
2.2	Operations on Sets	1, 4, 5, 8, 10, 13, 18, 20, 22, 26, 30
2.3	Binary Relations	3, 5, 7, 9, 11
2.4	Equivalence Relations	2, 3, 5, 6, 7, 10, 11, 12, 17, 20, 21
2.5	Partial Orders	1a, 1b, 2a, 3, 4
	3: Functions	
3.1	Basic Terminology	1, 2, 3, 4, 12, 17
3.2	Inverses and Composition	1, 2, 3, 7, 8, 9, 10
	4: The Integers	
4.1	The Division Algorithm	4a, 5a, 6a, 7, 8, 9, 11
4.2	Divisibility & the Euclidean Algorithm	1, 2, 3a, 5, 6, 9
4.3	Prime Numbers	3, 4a, 5, 10, 26, 27
	5: Induction and Recursion	
5.1	Mathematical Induction	4a-f, 5, 6a&e, 12, Exercise from Sum of odd integers handout
5.2	Recursively Defined Sequences	1, 7, 31, 45, 49, 51
5.3	Solving Recurrence Relations; The Characteristic Polynomial	1, 3, 16, 21, 26
	6: Principles of Counting	
6.1	The Principle of Inclusion-Exclusion	1, 4, 7, 11, 13, 16
6.2	The Addition and Multiplication Rules	1, 3, 5, 11, 12, 19, 25
6.3	The Pigeonhole Principle	1, 3, 6, 15, 16, 24
	7: Permutations and Combinations	
7.1	Permutations	1, 3, 5, 6, 16
7.2	Combinations	1, 3, 4, 8, 10, 12, 20, 24
7.3	Elementary Probability	1, 5, 7, 9, 11, 19
7.4	Probability Theory	1, 3, 4, 9, 11, 16, 22, Exercises from card probabilities handout
7.5	Repetitions	1, 3, 5, 10, 14, 17
7.6	Derangements	1, 3, 4, 5
7.7	The Binomial Theorem	2, 4, 6, 8, 9, 13, 16, 21
	9: Graphs	
9.1	A Gentle Introduction	1, 2, 5, 6, 9, 10
9.2	Definitions and Basic Properties	1, 3, 4, 6, 7, 13, 21, 29, 30, 31
9.3	Isomorphism	1, 2, 3, 4, 10
	12: Trees	
12.1	Trees and Their Properties	1, 2, 4, 5, 7, 16
12.2	Spanning Trees	7, 12
12.3	Minimum Spanning Tree Algorithm	1a&b, 2a&b, 10