MAA 3200 – INTROD TO ADV MATH                             FLORIDA INT'L UNIV.
INFORMATION SHEET  (Jan. 9th, 2024)                                                SPRING 2024

INSTRUCTOR: Prof. Ram, Office hours: 12:55pm-1:45pm and 3:30pm-4:45pm Tu &Th.

Prof Ram's homepage: <http://faculty.fiu.edu/~ramsamuj/> Prof Ram's e-mail: ramsamuj@fiu.edu

LAs Hours: Mr. Michael ILYIN (via Zoom) 10am-12pm Mon, 10am-11am Wed, & Fri. 5pm-8pm.

Mr. Michael ILYIN ZOOM’s Meeting ID: **812 959 4200** Code: **Mi2023** .

PREREQUISITE:  MAD 2104 & MAC 2312 (both with grade C or better)
A good working knowledge of Calculus I & II and significant exposure to proofs as in a course

such as MAD 2104 (Discrete Mathematics) is essential for success in this course. It’s all proofs.

TEXTBOOKS:  1. "How to Prove it," (**3rd edition**) by Daniel J. Velleman (**2019**) and
                      2. "Introduction to Analysis" (5th ed.) by Edward D. Gaughan  (1998)

SYLLABUS:  Below are the relevant sections for 95% of the course.

 From:  ***How to Prove it****.*

 Ch.1 (Propositional Logic) Sec.1,2,3,4,5. Ch.2 (Predicate Logic) Sec. 1, 2, 3.
   Ch.4 (Sets & Relations) Sec. 1, 2, 3, 6.            Ch.5 (Functions & Seq.) Sec. 1,2,3,5.
   Ch.6 (Induction & Recursion) Sec.1,2,3,4.    Ch.8 (Cardinality) Sec. 1, 2, 3.

 From: ***Introduction to Analysis****.*             Ch.0 (Real Numbers) Section 5.
   Ch.1 (Limits of sequences) Sec 1, 2, 3, 4.  Ch.2 (Limits of functions) Sec.1,2,3,4.

EXAM & ATTENDANCE  POLICIES:

 1. For each exam you are required to bring your Student ID and a blank blue exam booklet.

 (8"x11" available from FIU bookstore). No notes, calculators or cellphones are allowed.

 2. A make-up test for Exam #1 will be given - only if there is a verifiable case of illness or

 emergency. If you miss Exam #2 for one of the same reasons that test will be discounted,

 your grade will be calculated out 260, & you won’t be eligible for an INCOMPLETE grade.

 3. Any misconduct will be reported and dealt with according to the Code of Student Conduct.

 4. Sanctioned religious holidays can be accommodated with early notification (1st wk classes).

 5. Attendance & class participation (40 pts): 3 pts is deducted for each absence or missed exam.

 Attendance is mandatory. FIU will give you an automatic F for less than 60% attendance.

SCHEDULE OF EXAMS: No calculators, cell-phones, or notes are allowed in the exams.

Test #1 (**100** points): **THURSDAY, FEB. 22nd, 10:45am - 12:15pm**

Test #2 **(100** points): **THURSDAY, APR. 11th, 10:45am - 12:15pm**

Final Exam **(160** points): **THURSDAY, APR. 25th, 09:30pm - 12:00pm**\*

**(40** pts**)** Attendance & class participation: **3** pts is deducted for each absence or missed exam.

\* The final exam will be comprehensive - please note the time is earlier than the regular class.

GRADING SCHEME: The grades will be assigned as indicated below.

 F D D D C C C+ B- B B+ A- A

 | | | | | | | | | | | | |

 0% **48** 52 56 **60** 64 68 72 76 **80** 85 90 100%

 **0** **192pts** **240pts** 288pts **320pts** 360pts **400pts**

HOLIDAYS: Mon. Jan. 15th (M. L. King Day), Spring Break (Mon-Sat): Feb. 26th - Mar. 2nd.

DEADLINES: For add/drop (no liability) - Jan 16th. For DR/WI grade (no refund) - Mar. 18th.

**DETAILS FOR GETTING EXEMPT FROM AN EXAM & FOR GETTING AN “IN” GRADE.**

1. The first (and most important) rule at FIU is that each professor should treat every student in the same uniform way - unless we get documentation from an independent authority (such as the FIU Health Clinic, the FIU DRC, or an MD (medical doctor), etc.) or from a supervisor of the professor (such as the Division Chair-person, the Department Chair-person, or the Dean of the relevant College, etc.) to do otherwise. If the professor does not abide by this first rule, they can be fired.

2. So if a student is not feeling physically or mentally well before an exam, they should contact the FIU Health Clinic, or the FIU Counselling & Psychological Services (see below for the links), or your doctor – and get a signed letter that specifically says: ”Ms. X (or Mr. Y) is medically unable to take any exam on such and such a day. Please excuse Ms. X (or Mr. Y) from taking this exam on this specific day.” We are not authorized to know of the specific medical condition you may have. You will lose 3 pts for being absent - because you did not come or participate in class.

3. If this is the first exam in the course, the professor will attempt to give the student a make-up exam (if the student is able to take such an exam before the DR deadline) - so that the student can be have some feed-back about their performance before the deadline for getting a DR grade). Because of time constraints it is not possible to give a make–up exam for the second in-semester test before the final exam.

4. In order to get an “IN” grade (in which just the final exam needs to be completed during the next semester), a student must complete more than 50% of the graded material (i.e., the first two exams) and earn a passing grade so far. So if a student was exempted (for any of the reasons above) from the second exam, then that student does not qualify for an “IN” grade. Also if the student does not have a passing a grade when the first two exams are averaged, then that student does not qualify for an “IN” grade. This is an FIU rule – and all professors have to abide by it. We have to fill out a form and provide the documentation before any ”IN” grade can be entered.

5. If you missed the first test in the semester for an allowable, legitimate, verifiable reason you may be able to take a make-up exam as long as you provide adequate documentation and notify the professor at within two hours of the scheduled exam time. You must take the make-up test on the first opportunity you get to return to school. The allowable reasons are restricted to medical emergencies, traffic accidents in which your car becomes non-functional on your way to the exam, and deaths in the immediate family (parents, siblings, or children). We are not allowed to give make-up tests for work related issues. As always you must provide documentation. If you’re exempted from the 2nd exam, you will not get a make-up; your other scores will instead be used (with their corresponding weights) to produce your final grade – but in this case, please remember that you won’t qualify for an IN grade.

6. So please go & seek whatever medical treatment you may need- and get the necessary documentation - instead of telling the professor just a few minutes before the exam that you are unable to take it. Our hands are tied – we have to get documentation before we can give any make-up exam or exempt you from an exam. And if we give make-up exams or exemptions without documentation we can be fired and even be sued. If you have any questions about this matter, please contact the Math Division Director or the Math Undergraduate Program Director. Below are two useful links if you are not feeling well.

A. <https://studentaffairs.fiu.edu/health-and-fitness/student-health/>

B. <https://studentaffairs.fiu.edu/health-and-fitness/counseling-and-psychological-services/>

MAA 3200 – INTROD TO ADV MATH FLORIDA INT'L UNIV.
HOMEWORK SHEET     THIRD EDITION

**TEXTBOOKS**:   1. "How to Prove it" (3d edition) by Daniel J. Velleman  (2019)
                        and  2. "Introduction to Analysis (5th edition)" by Edward D. Gaughan (1998).

**Solutions**: See Prof. Ram's Homepage for these under Solutions to HW Problems. These are most of the homework problems for the course.  Later on in the semester, a few more problems may be added and a few may be deleted during class.

**1. HOW TO PROVE IT: (3rd EDITION) by Daniel J. Velleman (2019)**

 Ch. 1  Sec. 1 # 1, 2, 5, 7, 9.  Sec. 2 # 1, 2, 3, 4, 5, 7, 9, 10, 15, 16, 17.

  Sec. 3 # 1, 2, 3, 4, 5, 6, 8, 9.  Sec. 4 # 1, 5, 9, 10.

  Sec. 5 # 1, 2, 3, 4, 6, 9.  (Ch. 1 from 2nd edition was updated)

 Ch. 2  Sec. 1 # 1, 2, 3, 4, 8, 9.  Sec. 2 # 1, 2, 3, 4, 5, 6, 7, 8, 9.

  Sec. 3 # 1, 2, 3, 6, 8, 11, 12, 13, 14.  (Ch.2 from 2nd edition was updated)

 Ch. 4  Sec. 1 # 4, 5, 6, 7, 12.  Sec. 2 # 1, 2, 5, 8, 9

  Sec. 3 # 1, 2, 3, 4, 5, 12,13, 14, 16.  Sec. 6 # 1, 2, 3, 4, 10, 20a, 23a. (updated)

Ch. 5  Sec. 1 # 1, 2, 3, 5, 6, 11.  Sec. 2 # 5, 8, 9, 11, 13

  Sec. 3 # 3, 6, 7, 11. (Ch. 5 was updated)  Sec. 5 (after Thm 5.5.2) # 1, 2, 3, 4.

Ch. 6  Sec. 1 # 1, 2, 3, 4, 7, 9, 10, 13, 15, 20.  Sec. 2 # 11, 12, 13, 14.

  Sec. 3 # 1, 3, 6, 10, 12, 15, 16.  Sec. 4 # 4, 11, 17, 18. (Ch.6 was updated)

Ch. 8  Sec. 1 # 1, 3, 4, 5, 12, 17.  Sec. 2 # 1, 5, 6 (old #7 deleted in 3rd ed.)

  Sec. 3 # 1, 3, 4, 9, 12.  (Ch.7 from 2nd edition was updated)

**2.  INTRODUCTION TO ANALYSIS (5th edition)  by  Edward D. Gaughan (1998)**

        Chapter 0   Sec. 5    Nos.  39, 40, 41, 42, 43, 44, 45.

         Chapter 1   Sec. 1    Nos    1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
                           Sec. 2    Nos.   14, 15, 16, 17, 18, 19, 20, 21, 22, 24
                           Sec. 3    Nos.   25, 26, 27, 28, 30, 32, 33,
                           Sec. 4    Nos.   34, 35, 36, 37, 38, 40, 43, 44, 47.

         Chapter 2   Sec. 1    Nos.   1, 2, 3, 4, 5, 6, 7, 8
                           Sec. 2    Nos.   10, 11, 12, 14
                          Sec. 3    Nos.   16, 18, 19, 22
                           Sec. 4    Nos.    23, 24, 25.   END OF HW.

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**TEXTBOOKS**:   1. "How to Prove it" (2nd edition) by Daniel J. Velleman  (2006)

 is still very useful – but it is not the official textbook for the course.

**Solutions**: See Prof. Ram's Homepage for these under Solutions to HW Problems. These are most of the homework problems for the course.  Later on in the semester, a few more problems may be added and a few may be deleted during class.

**1.  HOW TO PROVE IT:  (2nd EDITION)  by  Daniel J. Velleman (2006)**

 Ch. 1   Sec. 1 #  1, 2, 4, 5, 6, 7. Sec. 2 #  1, 2, 3, 4, 5, 7, 9, 10, 15, 16, 17

           Sec. 4 #  1, 3, 4, 5, 8, 9. Sec. 3 #  1,  2, 3, 4, 5, 6, 8
          Sec. 5 #  1, 2, 3, 4, 5, 8.

 Ch. 2  Sec. 1 #  1, 2, 3, 4, 7, 8. Sec. 2 #  1, 2, 3, 4, 5, 6, 7, 8, 9

         Sec. 3 #  1, 2, 3, 6, 8, 10, 11, 12, 13.

 Ch. 4   Sec. 1 # 4, 5, 6, 7, 10. Sec. 2 # 1, 2, 4, 7, 9
            Sec. 3 # 1, 2, 3, 4, 5, 12,13, 14, 16. Sec. 6 # 1, 2, 3, 4, 10, 19a, 24a.

Ch. 5   Sec. 1 # 1, 2, 3, 5, 6, 8. Sec. 2 # 5, 6, 7, 9, 10
          Sec. 3 # 3, 6, 7, 11. Sec. 4 # 1, 2, 3, 4.

Ch. 6 Sec. 1 # 1, 2, 3, 4, 7, 9, 10, 12, 14, 19. Sec. 2 # 10, 11, 12, 13
      Sec. 3 # 1, 3, 6, 10, 12, 15, 16. Sec. 4 # 3, 10, 19, 20.

Ch. 7   Sec. 1 # 1, 3, 4, 5, 12, 15.                        Sec. 2 # 1, 4, 5, 7
            Sec. 3 # 1, 3, 4, 9, 12.

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Review for Test #1      REMEMBER TO BRING AN 8’’x11”  BLUE EXAM BOOKLET

KEY CONCEPTS AND MAIN DEFINITIONS:

Propositional logic, propositional symbols, logical connectives: ¬ (negation), ˅ (or), ˄ (and), → (conditional), ↔ (bi-conditional), ⊕ (exclusive or); propositional formula, tautology, contradiction, ⇔ (logically equivalent),  ⇒ (logically implies), Predicate logic, for all quantifier (∀x), there exists quantifier (∃x), formulas of  predicate logic, logically valid formulas, Bounded quantifiers (∀x∈A) and (∃x∈A), Uniqueness quantifier (∃!x); Axioms of Set Theory; membership relation x∈A, Empty set ∅, subset relation A⊆B, power set P(A), intersection A***∩***B, union A∪B, relative complement A−B, symmetric difference AΔB = (A-B)∪(B-A), universal set U, complement Ac = U-A, (natural numbers), ℤ, ℚ, (real numbers), (complex numbers); Families of sets, Indexed families of sets, union and intersection of indexed families of sets, proof strategies, proof by contradiction, counter-examples, Pairs & ordered pairs, Cartesian product A×B of two sets, Relations; domain & range of a relation, inverse of a relation, compositions of relations;  Relations from A to B & Relations on A; Reflexive, symmetric, anti-symmetric, transitive, & circular relations; Equivalence relation R on a set A, equivalence classes of R, A modulo R, Partitions of A,  Functions; Domain & range of a function, Codomains of a function, Functions from A to B & Functions on A, Partial functions from A to B, Injective functions (one-to-one functions, injections), Surjective functions (onto functions, surjections), Bijective functions (one-to-one & onto functions, bijections), composition of functions. ∀ ∃ Δ ⊕ ⊆ ∈ ∉ ⊂ → ¬ ≠ ∞ ∅ ≡ ≈ ↔ ≤ ⁄ × ℵ √ ∇ ⇔ ⇒ ≅ # ⊥ ± ≥ ≤ ° ↑ ↓ ∪ ∪ − ***∩*** P ⊗

MAIN PROBLEM SOLVING TECHNIQUES & TYPES OF PROOFS:

 1. (a) Determining if A is logically equivalent to B by using truth tables in Prop. Logic.

       (b) Determining A logically implies B by using truth tables in Propositional Logic.

 2. (a) Translating English & Mathematical statements into formulas of Propositional Logic.

 (b) Determining whether or not an argument is logically valid using truth tables.

 3. (a) Translating English & Mathematical statements into formulas of Predicate Logic.

 (b) Determining if a formula A is logically equivalent to B or if A logically implies B.

 (c) Moving the ¬ sign so that it governs no quantifiers & other connectives in Pred. Logic.

 4. (a) Proving that certain identities and subset relations involving sets are true.

 (b) Proving that certain identities and subset relations involving indexed families of sets.

 5. (a) Proving identities or subset relations involving the Cartesian products.

 (b) Proving results about properties involving inverses and compositions of relations.

 6. (a) Proving that a given relation R is an equivalence relation on A.

 (b) Finding the equivalence classes into which A is partitioned by an equiv. relation R on A.

 7.  (a) Finding the domain and the range of a function.

 (b) Proving facts about functions and compositions of functions.

 8.   (a) Determining if a function is injective, surjective, bijective, or none of these.

 (b) Proving facts about injective, surjective & bijective functions – and finding inverses.

MAA 3200 – INTROD TO ADV MATH                              FLORIDA INT'L UNIV.

Review for Test #2     REMEMBER TO BRING AN 8’’x11”  BLUE EXAM BOOKLET

KEY CONCEPTS AND MAIN DEFINITIONS:

Injective (one-to-one), surjective (onto), and bijective functions; compositions and inverses of functions, images and inverse-images of a set under a function,  Generalized Cartesian product, Finite sequences, n-ary relations, n-ary functions, vector valued functions, First Principle of  Mathematical Induction, Basis, Induction step, Conclusion, Second (Strong) Principle of Mathematical Induction, Definition of a function by Recursion, Construction of the Natural numbers as special sets, Operations & relations on the natural numbers, Construction of the Integers as equivalence classes of ordered pairs of natural numbers, Operations & relations on the integers, Construction of the Rational numbers as equivalence classes of ordered pairs integers with the second element being non-zero, Operations & relations on the rational numbers, Equi-numerous sets, finite and infinite sets; countable and uncountable sets, denumerable (countably infinite) sets, Cantor’s Diagonal theorem, Cantor-Schroeder Bernstein theorem; upper bounds and lower bounds of a set of real numbers; least upper bound (l.u.b., supremum) and greatest lower bound (g.l.b., infimum) of a non-empty sets, infinite sequences, the epsilon-N method, convergent & divergent sequences, bounded sequences, arithmetical properties of limits of sequences. Increasing & decreasing functions, subsequences, Cauchy sequences, Construction of the Real numbers …. [accumulation points of a set of real numbers, the limit of a function as x approaches an accumulation point, the epsilon-delta method, the algebra of limits].

MAIN PROBLEM SOLVING TECHNIQUES:

 1. Proving results about compositions of functions & finding inverses of bijections.

 2.   Proving results about the images and inverses images of a set under a function.

 3. Proving results by using the First Principle of Mathematical Induction.

 4. Proving results by using the Second Principle of Mathematical Induction and defining

 functions by using the Recursion Principle.

 5.   Proving certain results about equi-numerous, finite, and infinite sets.

 6.   Proving certain results about countable, denumerable, and uncountable sets.

 7.    Finding the supremum and infimum and proving results about supremum and infimum

        of non-empty sets of real numbers.

 8.  Proving results about infinite sequences and arithmetical operations on infinite

      sequences by using the epsilon-N method.

 9.  Proving results about increasing, decreasing, and Cauchy sequences by using the

      epsilon-N method.
 [10. Proving results about accumulation points, about limits of functions, and about the

         algebra of limits by using the epsilon-delta method.]