# Test 2 – topics

## Math 1165: Discrete Math

Format:

- True/False, Matching, Multiple Choice
- Free Response
- proof questions
- You may be asked to show your work
- Calculators are allowed

Textbook sections: 2.1 – 2.6, 3.1 – 3.5

- Questions will be similar to examples worked in class or homework questions

Topics:

- Truth Tables
  - Be able to create one
  - Be able to use them to prove a statement
- Statements and Symbolic Logic
  - Be able to identify statements
  - Be able to change statements into symbols and vice versa
  - Be able to simplify logical statements using properties/theorems
- Proof Techniques
  - Direct
  - Indirect (contrapositive)
  - Proof by contradiction
  - Counter examples
  - Mathematical induction
- Counting
  - Permutations
  - Combinations
  - Multichoose
  - The pigeonhole principle
- Probability
  - Definition
  - Sample space
  - How to find
- Recurrence Relations
  - Fibonacci-like sequences
  - Characteristic equation

Sample Questions:

Note: below is not an exhaustive list of possible questions. It is only a sample of some of the types of questions that you may see on the exam.

- Proof Questions:
  2 proof questions will be chosen from the following 5 statements.
  - Prove that $n^2$ is odd if and only if $n$ is odd.
  - Prove that the sum of any two prime numbers (neither of which are 2) is not a prime number.
  - Prove that the square of any integer $a$ is either of the form $3k$ or of the form $3k+1$ for some integer $k$. [*Hint*: By the Division Algorithm, $a$ must be of the form $3q$, $3q+1$, or $3q+2$.]
  - Suppose that $a$, $b$, and $c$ are integers where $a|b$ and $a|c$. Prove that $a|(b-c)$
  - Prove or disprove the statement that the sum of any consecutive $k$ integers is divisible by $k$. What conditions need to be on $k$ to make this statement true?

- Mathematical Induction
  - Show that $1^2+3^2+5^2+\cdots+(2n-1)^2=\frac{n(2n+1)(2n-1)}{3}$
  - Show that $n^3<3^n$ for all $n\geq n_0$. Be sure to find the smallest $n_0$ where this works.

- Truth Tables
  - Create the truth table for $((\sim p)\wedge q)\Leftrightarrow r$
  - Show that $\sim(p\Longrightarrow q)\equiv(p\wedge\sim q)$
  - Determine whether the following statement is a tautology, absurdity, or a contingency: $\big((p\Rightarrow q)\wedge(q\Rightarrow r)\big)\Rightarrow(\sim p\Rightarrow q)$

- Other Questions
  - How many standard license plates (3 letters – 4 digits) are possible to give out in NC?
  - Suppose 25 children are told to line up in a straight line. How many ways can this be done?
  - How many ways are there to choose a 3 person committee from a group of 10 people? If there are 4 women and 6 men, how many ways are there to choose that 3 person committee if at least one of the people on the committee must be a woman?
  - How many distinguishable ways are there to rearrange the letters in the word: banana?
  - Show that if 7 colors are used to paint 50 bicycles, at least 8 bicycles are the same color.
  - What is the probability of rolling 2 6-sided dice and getting a sum of 7 from the faces that came up?
  - What is the probability of getting 3-of-a-kind in 5-card draw poker? (ie: 52 cards, 4 suits, 13 numbers. 3-of-a-kind means exactly 3 of the 5 cards must match in number.)
  - Find an explicit formula for the sequence which is defined by the recurrence relation: $a_n=2a_{n-1}-5a_{n-2}, a_0=1, a_1=3.$