

- Book and notes are prohibited except for a single sheet (back and front) with hand-written formulae/notes. Submit formula sheet with your exam for up to 5 extra pts.
 - You may write on test page. However, put all your work and answers into the blue book.
 - No credit will be given for any answer that is not backed up with work.
 - The use of any electronic devices except a graphing calculator is strictly prohibited.
 - Each problem is worth 10 points (Some of the problems on the actual exam will have fewer parts)
1. Let $C(x, y)$ be the statement "x finds y charming," where the domain for x and y consists of all people in the world. Use quantifiers to express each of the following statements.
 - (a) Everyone finds themselves charming.
 - (b) Someone finds Jerry charming.
 - (c) There is a person that finds everyone charming.
 - (d) If you find Max charming, then you will also find Gina charming.
 2. Answer each of the following questions.
 - (a) Show that $p \rightarrow q$ is logically equivalent to $\neg q \rightarrow \neg p$ using a truth table.
 - (b) Show that $\neg p \rightarrow (q \rightarrow r) \equiv q \rightarrow (p \vee r)$ without using a truth table.
 - (c) Show that $\neg (p \rightarrow q) \rightarrow \neg q$ is a tautology without using a truth table.
 3. Prove that for all integers n, n is even if and only if $5n + 3$ is odd.
 4. Translate the following specifications into English where:
 $F(p)$: "printer p is out of service" $B(p)$: "printer p is busy" $Q(j)$: "print job j is queued"
 (a) $\exists j Q(j) \rightarrow \exists p (F(p) \vee B(p))$ (b) $\forall j Q(j) \rightarrow \forall p F(p)$
 NOTE: assume that a print job that is being processed is no longer queued.
 5. (a) Determine cardinality of the set $A = \{\emptyset, \{a\}, \{\emptyset, a\}\}$ as well as each member of set A.
 (b) Draw the Venn diagram for the following combination of the sets A, B, and C.
 $A \cap (B - C)$ (shade A and $B - C$ as intermediate steps and use a legend)
 (c) Is it true that $A \cap (B - C) = (A \cap B) - (A \cap C)$? Use a truth table.
 6. Determine if the following functions are 1-1 and/or onto:
 - (a) $f: Z \rightarrow Z, f(x) = 3x^3 - 2$
 - (b) $g: R \rightarrow Z, g(x) = \lfloor x/2 \rfloor + 6$
 7. Use insertion sort with input 2, 6, 1, 4, 3, 5, showing as separate steps the comparisons, rotations and insertions. You should have approximately $6+5+4+3+2+1$ steps, each showing all or a portion of the list.
 8. The ISBN-10 of *Mathematical Modeling and Computer Simulation* is 0-534-Q8478-1, where Q is a digit. Find the value of Q. Use the Euclidean Algorithm (EA) to find the appropriate inverse.
 9. If encryption function is $f(p) = (7p + 13) \bmod 26$, decrypt TZURCQKIDB: translate letters into #s, apply appropriate decryption function (use EA to find inverse of 7) & then translate #s back into letters.
 10. Choose ONE of the following 2 INDUCTION proof problems:
 - (i)(a) Find formula for $\frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \dots + \frac{1}{n(n+1)}$ by examining values of this expression for small values of n
 (b) Prove the formula you conjectured in part (a).
 - (ii) Prove that $3^n < n!$ if n is greater than 6.