1. (a) Use the Laws of Logic to show: \( q \lor \neg (r \to p) \equiv (q \lor r) \land (p \to q) \)
(b) Find the negation of the following Universal Conditional:
   \[ \text{All people who like Mathematics get good jobs.} \]
(c) Use the rules of inference to show the following is a valid argument:
   \[ p \to q \quad r \land \neg q \quad p \quad r \lor s \quad \therefore s \]

2. (a) Find \( A \times B \) for the sets \( A = \{x, y\} \) and \( B = \{1, 2, 3\} \)
(b) Using the Properties of Sets, show for any sets \( A, B \) and \( C \), \((A - B) - C = (A - C) - B \).

3. (a) For \( F = \{(b,g), (d,d), (g,a), (n,b), (r,b)\} \), what Domain and Image make \( F \) a function?
(b) Why or why not is the inverse in (a) a function?
(c) Find \( F(G(x)) \) for the following Real-valued functions: \( F(x) = 2^{(2x+1)} \) and \( G(x) = 2x - 2 \).

4. (a) Use the Euclidean Algorithm to find \( \text{GCD}(154,84) \).
(b) Find Big-O of the algorithm whose complexity is \( F(n) = (3n^5)(n^6 + 5n^4)(2n^3 + 3n + 2) \).

5. Prove 1 of the 2 Theorems below:
   **Theorem 1:** Show that the function \( f: \mathbb{R} \to \mathbb{R} \) given by \( f(x) = \pi(x + e) \) is a bijection.
   **Theorem 2:** The square root of 3 is irrational. (Assume the Lemma: If 3 divides \( \text{INT}^2 \) then 3 divides \( \text{INT} \))

6. (a) Find the next 3 terms of the sequence \( s_n = 2s_{n-1} - 3s_{n-2} \) when \( s_0 = 1 \) and \( s_1 = 0 \).
(b) Find an expression for the series: \( \sum_{i=1}^{100} 3(4)^i - 2 \).

7. Prove 1 of the 2 Theorems that follow by Mathematical Induction.
   **Theorem 1:** If a set has \( n \) elements, then it has \( 2^n \) subsets.
   **Theorem 2:** Is \( s_n = s_{n-1} + s_{n-2} + s_{n-3} + s_{n-4} \) when \( s_0 = s_1 = s_2 = s_3 = 1 \) then \( s_n \) is even, for all \( n \geq 4 \).

8. (a) A restaurant serves 4 soups, 6 salads, 8 entrees, 10 desserts, and 12 beverages. How many dinners can they create if each dinner consists of a soup or salad, an entree, and a dessert or beverage?
(b) How many binary strings of length 32 have no more than 3 zeros?
(c) How many ways can judges award 1st, 2nd, and 3rd Place prizes to 25 contestants?
(d) How many distinct piles of 200 coins (pennies, nickels, dimes, quarters, half-dollars, and dollars) can I create from a vast quantity of coins, if I must have at least 10 of each in its pile?
9. Consider the following sets with corresponding number of elements indicated in each region:
(a) Find $P(B \cup C)$
(b) Find $P(A \mid (B \cap C))$

10. (a) Find the inverse relation to
$$R = \{(1,2),(1,3),(2,3),(3,1),(3,2),(3,3),(3,4),(4,1),(4,2),(5,2),(5,4)\}$$
$$R^{-1} = \text{__________}$$

(b) Show that the relation $S = \{(a,b) \mid a,b \text{ are Real and } \text{Floor}(a) = \text{Floor}(b)\}$ is an Equivalence Relation.
(c) What partition of the Reals does $S$ induce?

11. (a) Find the truth table of the Boolean Polynomial $F(x,y,z) = xy + z$
(b) Find the Disjunctive Normal Form of the polynomial in (a).