**Problem 1**

Write NEGATION of the following statements (**Careful, NEGATION is not the same as INVERSE**)

1. If P is a square, then P is a rectangle.
2. If n is prime, then n is odd or n is 2.
3. If Aangloo is Meena's father, then Baangloo is her uncle and Bingli is her Aunt.
4. A positive integer is prime only if it has no divisors other than 1 and itself.
5. Being divisible by 3 is a necessary condition for this number to be divisible by 9.

**Problem 2**

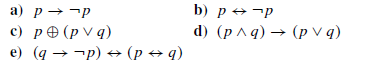
Part 1: Write CONVERSE of the following statements.

1. If P is a square, then P is a rectangle.
2. If n is prime, then n is odd or n is 2.
3. If Aangloo is Meena's father, then Baangloo is her uncle and Bingli is her Aunt.
4. A positive integer is prime only if it has no divisors other than 1 and itself.
5. Being divisible by 3 is a necessary condition for this number to be divisible by 9.

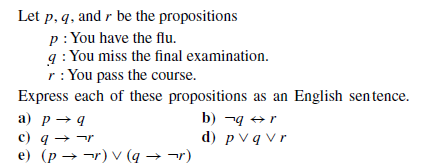
Part 2: Write CONTRPOSITIVE of the following statements.

1. If P is a square, then P is a rectangle.
2. If n is prime, then n is odd or n is 2.
3. If Aangloo is Meena's father, then Baangloo is her uncle and Bingli is her Aunt.
4. A positive integer is prime only if it has no divisors other than 1 and itself.
5. Being divisible by 3 is a necessary condition for this number to be divisible by 9.

Part 3: Construct a truth table for each of these compound propositions.



**Problem 3**



**Problem 4**

Part 1: Express the following statements using quantifiers, variables, and the predicates, with following information:

is set of all students

is a math major student

is a computer science major student

is an engineering major student

1. There is an engineering student who is a math major.
2. Every computer science student is an engineering student.
3. No computer science students are engineering student.
4. Some computer science students are also math majors.
5. Some computer science students are engineering students and some are not.

Part 2: Translate each of these nested quantifications into an English statement that expresses a mathematical fact. The domain in each case consists of all real numbers.

**a)**

**b)**

**c)**

**d)**

Part 3: Rewrite each of these statements so that negations appear only within predicates (that is, so that no negation is outside a quantifier or an expression involving logical connectives).

**a)**

**b)**

**c)**

**d)**

**e)**

**Problem 5**

Part 1: **Give a direct proof of the following:**

1. If is an odd integer and is even, then is odd.
2. For any integer , is not a prime.
3. Any product of four consecutive integers is one less than a perfect square.(Hint: Take four consecutive integers as )
4. is odd. (**Hint:** *consider 2 cases: i) if is even, ii) if is odd, and then chenck whether the given expression is even or odd*)

Part 2: **Give counter-examples of the following claims to dis-prove these:**

1. For all integers , is a prime number.
2. For any integer , is prime.
3. For all prime numbers , is prime number. (*Such prime numbers are called Mersenne primes*)

Part 3: **Prove the following using contraposition:**

1. If and are both odd, then is even. (**Be careful:** *You are asked to prove by Contraposition, although Direct Proof is easier.*)
2. If is irrational, then is irrational.
3. If is a multiple of 3, then is a multiple of 3.