**Tutorial 1**

Q3. (p -> q) -> r is not logically equivalent to p -> (q -> r)

Q7. There exist x,y,z ∈ ℤ>10 such that x2+y2=z2 (Proving Pythagorean triples by construction)

Q9. The product of any two odd integers is an odd integer. (Direct proof)

Q10. If a, b, c are integers such that a2+b2=c2, then a, b cannot both be odd. (Proof by contraposition)

**Tutorial 2**

Q3. ∀a,b,c ∈ ℤ, if a – b is even and a – c is even, then b – c is even (Direct proof)

Q8. a. (∀𝑥 ∈ 𝐷 𝑃(𝑥)) ∧ (∀𝑥 ∈ 𝐷 𝑄(𝑥)) is true if and only if ∀𝑥 ∈ 𝐷 (𝑃(𝑥) ∧ 𝑄(𝑥)) is true.

b. (∃𝑥 ∈ 𝐷 𝑃(𝑥)) ∧ (∃𝑥 ∈ 𝐷 𝑄(𝑥)) and ∃𝑥 ∈ 𝐷 (𝑃(𝑥) ∧ 𝑄(𝑥)) are not equivalent.

Q9. ∀𝑥, 𝑦 ∈ ℝ (𝑥 > 𝑦 → x2 > y2) is false

**Tutorial 3**

Q4. A = {2n + 1 : n ∈ ℤ } and B = {2n - 1 : n ∈ ℤ }. [A=B]

Q5. A = {x ∈ ℤ : 2 ≤ x ≤ 5} and B = {x ∈ ℚ : 2 ≤ x ≤ 5}. [A =/= B]

Q7. A \ (B C) = (A \ B) C

Q8. (A U ) ( U B) = (A B) U ( )

Q9. A ⊆ B <-> A U B = B.

**Tutorial 4**

4. Let f : B -> C.

(a) Suppose f is injective. Show that g o f is injective whenever g is an injective function with domain C.

(b) Suppose we have a function g with domain C such that g o f is injective. Show that f is injective.

5. L et f : B -> C.

(a) Suppose f is surjective. Show that f o h is surjective whenever h is a surjective function with codomain B.

(b) Suppose we have a function h with codomain B such that f o h is surjective. Show that f is surjective.

7. Let A,B,C be sets. Show that (g o f)-1 = f-1 o g-1 for all bijections f : A -> B and all bijections g : B -> C.