Date:_____

QUESTION No.5

(a) $C(x)$: "x is the employee of cs department"

$r(x)$: "x owns a car"

$t(x)$: "everyone who owns a car has gotten atleast one motorcycle".

where x is 'Ali' in this case.

$\forall x\,(r(x) \rightarrow t(x))$

1. $r(Ali) \rightarrow t(Ali)$ ∴ Universal Instantiation
2. $r(Ali)$
3. $t(Ali)$ ∴ By Modus Ponens (1) and (2)
4. $c(Ali)$
5. $t(Ali) \wedge c(Ali)$ ∴ Rule of conjunction (3) and (4)
6. $\exists\,(t(Ali) \wedge c(Ali))$
7. $\exists x\,(t(x) \wedge c(x))$ ∴ Existential generalization

(b) $c(x)$: "x has three friends"

$r(x)$: "x has done breakfast".

$t(x)$: "x can take lunch".

~~"where x is "Each of three"~~

1. $\forall x\,(c(x) \rightarrow r(x))$
2. $c(l) \rightarrow r(l)$ ∴ Universal Instantiation
3. $\forall x\,(r(x) \rightarrow t(x))$
4. $r(l) \rightarrow t(l)$ ∴ Universal Instantiation
5. $c(l) \rightarrow t(l)$ ∴ Hypothetical Syllogism (2)(3)
6. $\forall x\,(c(x) \rightarrow t(x))$ ∴ Universal generalization.

Date:

(c) $s(x)$: "x is delivered by Sir Sanjay"
$c(x)$: "x is about insertion sort"
$w(x)$: "x is understandable"

where x is lecture (l).

1. $\exists x (s(x) \wedge c(x))$
2. $s(l) \wedge c(l)$ ∴ Existential Instantiation
3. $s(l)$ ∴ Simplification (2)
4. $\forall x (s(x) \rightarrow w(x))$
5. $s(l) \rightarrow w(l)$ ∴ Universal Instantiation
6. $w(l)$
7. $c(l)$
8. $w(l) \wedge c(l)$ ∴ Rule of conjunction (6) and (7)
9. $\exists x (w(x) \wedge c(x))$ ∴ Existential generalization

(d) $c(x)$: "x is in session 2021"
$r(x)$: "x has been to Murree".
$t(x)$: "x has visited Baltit Fort".

where x is someone (s).

1. $\exists x (c(x) \wedge r(x))$
2. $c(s) \wedge r(s)$ ∴ Existential Instantiation
3. $r(s)$
4. $c(s)$ ∴ Simplication (2)
5. $t(s)$
6. $c(s) \wedge t(s)$ ∴ Conjunction (4) and (5)
7. $\exists x (c(x) \wedge t(x))$ ∴ Existential generalization.