$\equiv \sigma \models (\Diamond\Box\Diamond F \Leftrightarrow \Box\Diamond F)$

$\equiv (\sigma \models \Diamond\Box\Diamond F) \Leftrightarrow (\sigma \models \Box\Diamond F)$

$\equiv$ . . . . . .

$\equiv \quad \therefore \exists m \in \mathbb{N} : \forall n \in \mathbb{N} : \exists k \in \mathbb{N} : \sigma^{+(m+n+k)} \models F$

$\Leftrightarrow \forall n \in \mathbb{N} : \exists k \in \mathbb{N} : \sigma^{+(n+k)} \models F$

$\equiv$ TRUE

c) $\Box [A \wedge B]_v \Leftrightarrow \Box [A]_v \wedge \Box [B]_v$

$\equiv \sigma \models (\Box[A \wedge B]_v)$

$\equiv \forall n \in \mathbb{N} : \sigma^{+n} \models A \wedge B$

$\equiv \forall n \in \mathbb{N} : (\sigma^{+n} \models A) \wedge (\sigma^{+n} \models B)$

$\equiv$ ~~TRUE~~ $\forall n \in \mathbb{N} : \Box[A]_v \wedge \Box[B]_v$.

$\Rightarrow$ It is tautology.

b) $\neg \Box (F \vee G) \Rightarrow \Diamond \neg F \wedge \Diamond \neg G$

~~$\equiv \neg \Box (F \vee G) \Box \neg (F \vee G) \Rightarrow \Diamond \neg F \wedge \Diamond \neg G$~~

$\equiv \sigma \models (\neg \Box (F \vee G)$

$\equiv \neg (\forall n \in \mathbb{N} : \sigma^{+n} \models F \vee G)$

$\equiv \exists n \in \mathbb{N} : \neg (\sigma^{+n} \models F \vee G)$

$\Rightarrow$ It is not tautology

Example: If $\Box F$ is False and $\Box G$ is False. The $\sigma \models \neg \Box (F \vee G)$ is TRUE but $\sigma \models \Diamond \neg F \wedge \Diamond \neg G$ is False ~~and~~

~~$\sigma \models \Box (F \vee G)$~~

(Note

d) $\Box \Diamond \langle A \wedge B \rangle_v \Leftrightarrow \Box \Diamond \langle A \rangle_v \wedge \Box \Diamond \langle B \rangle_v$

$\sigma \models (\Box \Diamond \langle A \wedge B \rangle)$

$\equiv \forall n \in \mathbb{N} : \sigma^{+n} \models \Diamond \langle A \wedge B \rangle_v$

$\equiv \forall n \in \mathbb{N} : \exists m \in \mathbb{N} ; \sigma^{+(n+m)} \models \langle A \wedge B \rangle_v$

$\equiv \sigma \models \Box \Diamond \langle A \rangle_v \wedge \Box \Diamond \langle B \rangle_v$

$\equiv \Box [A \wedge B]_v$

$\equiv \Box [A]_v \wedge \Box [B]_v$

$\Rightarrow$ It is tautology