Questão 1-

(LISTA2)

$$[\dot{V}_{NED}]_b = \overset{NED}{\dot{V}_b} = \dot{V}_b + \omega_b^{b,NED} \times V_b = \begin{bmatrix} \dot{U} \\ \dot{V} \\ \dot{W} \end{bmatrix} + \begin{bmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ P & Q & R \\ U & V & W \end{bmatrix} = \begin{bmatrix} \dot{U}+QW-RV \\ \dot{V}+RU-PW \\ \dot{W}+PV-QU \end{bmatrix}$$

Questão 2-

$$\rightsquigarrow F = m\overset{II}{\ddot{r}} \longrightarrow \overset{II}{\ddot{r}} = \frac{F}{m} = \dot{V}_{NED} = \dot{V}_b + \omega_b^{b,NED} \times V_b \longrightarrow \dot{V}_b = F/m - \omega_b^{b,NED} \times V_b \;;\; \rightsquigarrow F_b = [F_{xb}, F_{yb}, F_{zb}]$$

$$\therefore \dot{V}_b = \frac{1}{m}\begin{bmatrix} F_{xb} - QW - RV \\ F_{yb} - RU - PW \\ F_{zb} - PV - QU \end{bmatrix}$$

Questão 3-

$$a'_b = \dot{V}_{NED} - g_b = \overset{II}{\ddot{r}} - D_b^{NED} g_{NED} = \frac{F_b}{m} - D_b^{NED} g_{NED} = \frac{F_{b,A}+F_{b,T}}{m} + D_b^{NED} g_{NED} - D_b^{NED} g_{NED} = \frac{F_{b,A}+F_{b,T}}{m}$$

Questão 4-

$$a'_b = \dot{V}_{NED} - g_b = \dot{V}_b + \omega_b^{b,NED} \times V_b - g_b \longrightarrow \dot{V}_b = a'_b + g_b - \omega_b^{b,NED} \times V_b$$

Questão 5-

a) $a'_b = \overset{NED}{\dot{V}_b} - g_b + \overset{NED,NED}{\ddot{r}'_b}$

$\rightsquigarrow$ Usando Coriolis: $\overset{NED}{\dot{r}'_b} = \cancelto{0}{\dot{r}'_b} + \omega_b^{b,NED} \times r'_b = \omega_b^{b,NED} \times r'_b$; Obs: $\dot{r}'_b = 0$ porque a posição é constante.

$\rightsquigarrow$ Derivando em NED: $\overset{NED,NED}{\ddot{r}'_b} = \overset{NED}{\dot{\omega}_b^{b,NED}} \cdot r'_b + (\omega_b^{b,NED} \times r'_b \cdot \omega_b^{b,NED})$

$$a'_b = \dot{V}_b + \omega_b^{b,NED} \times V_b - g_b + \overset{NED}{\dot{\omega}_b^{b,NED}} \times r'_b + (\omega_b^{b,NED} \times r'_b \times \omega_b^{b,NED})$$

b) $\dot{V}_b = a'_b - \omega_b^{b,NED} \times V_b + g_b - \overset{NED}{\dot{\omega}_b^{b,NED}} \times r'_b - (\omega_b^{b,NED} \times r'_b \times \omega_b^{b,NED})$

Questão 5 - $g_{NED} = \begin{bmatrix} 0 \\ 0 \\ g_0 \end{bmatrix}$; $\leadsto \overset{II}{\ddot{r}} = 0$

a) $a'_b = \overset{II}{\ddot{r}} - g_b = -D_b^{NED} g_{NED} = -D_b^{NED} \begin{bmatrix} 0 \\ 0 \\ g_0 \end{bmatrix} = -g_0 \begin{bmatrix} -s\theta \\ s\phi c\theta \\ c\phi c\theta \end{bmatrix}$

b) $a'_b = -9{,}81 \begin{bmatrix} -\text{sen}\,15° \\ \text{sen}\,30° \cos 15° \\ \cos 30° \cos 15° \end{bmatrix} = \begin{bmatrix} 2{,}54 \\ -4{,}738 \\ -8{,}206 \end{bmatrix}$

c) $g_0 \begin{bmatrix} s\theta \\ -s\phi c\theta \\ -c\phi c\theta \end{bmatrix} = \begin{bmatrix} a'_{bx} \\ a'_{by} \\ a'_{bz} \end{bmatrix}$ $\left.\right\}$ $\theta = \text{sen}^{-1}\left(\frac{a'_{bx}}{g_0}\right)$

$\phi = tg^{-1}\left(\frac{a'_{by}}{a'_{bz}}\right)$

d) $\theta = \text{sen}^{-1}\left(\frac{2{,}54}{9{,}81}\right) = 15{,}006° \approx 15°$

$\phi = tg^{-1}\left(\frac{-4{,}738}{-8{,}206}\right) = 30{,}001° \approx 30°$

Questão 6 -

$\leadsto \overset{I}{\dot{H}_b} = \dot{H}_b + \omega_b^{bi} \times H_b = J_b \dot{\omega}_b^{bi} + \omega_b^{bi} \times (J_b \omega_b^{bi})$; a) $T_b = \overset{I}{\dot{H}_b} = J_b \dot{\omega}_b^{bi} + \omega_b^{bi} \times (J_b \omega_b^{bi})$

b) $\dot{\omega}_b^{bi} = ? = \dfrac{T_b - \omega_b^{bi} \times (J_b \omega_b^{bi})}{J_b}$