# AEEM5063 HW#7

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## 4.10

$$\alpha = 40°; \quad \beta = 25°$$

$$R_1(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & \sin\alpha \\ 0 & -\sin\alpha & \cos\alpha \end{bmatrix}$$

$$R_2(\beta) = \begin{bmatrix} \cos\beta & 0 & -\sin\beta \\ 0 & 1 & 0 \\ \sin\beta & 0 & \cos\beta \end{bmatrix}$$

solve for Q with matlab:

$$Q = [R_2(\beta)][R_1(\alpha)] = \begin{bmatrix} 0.9063 & 0.2717 & -0.3237 \\ 0 & 0.7660 & 0.6428 \\ 0.4226 & -0.5826 & 0.6943 \end{bmatrix}$$

## 4.11

$$Q = \begin{bmatrix} 0.086824 & -0.77768 & 0.62264 \\ -0.49240 & -0.57682 & -0.65178 \\ 0.86603 & -0.25000 & -0.43301 \end{bmatrix}$$

## (a)

$$\alpha = \tan^{-1} \frac{Q_{31}}{-Q_{32}}$$

because num and denom +, $\alpha$ in first quad:

$$\boxed{\alpha = 73.9°}$$
$$\beta = \cos^{-1} Q_{33}$$
$$\boxed{\beta = 115.7°}$$

$$\gamma = \tan^{-1} \frac{Q_{13}}{Q_{23}}$$

because num + and denom -, $\gamma$ in 2nd quad:

$$\gamma = 180 + \tan^{-1} \frac{Q_{13}}{Q_{23}}$$
$$\boxed{\gamma = 136.31°}$$

## (b)

$$\alpha = \tan^{-1} \frac{Q_{12}}{Q_{11}}$$

because num - and denom +, $\alpha$ in 4th quad:

$$\alpha = 360 + \tan^{-1} \frac{Q_{12}}{Q_{11}}$$
$$\boxed{\alpha = 276.37°}$$
$$\beta = \sin^{-1} -Q_{13}$$
$$\boxed{\beta = -38.51°}$$

$$\gamma = \tan^{-1} \frac{Q_{23}}{Q_{33}}$$

because num - and denom -, $\gamma$ in 3rd quad:

$$\gamma = 180 + \tan^{-1} \frac{Q_{23}}{Q_{33}}$$

$$\boxed{\gamma = 236.4°}$$

## 4.13

$$\alpha = 300°; \quad \beta = -80°; \quad \gamma = 30°$$

$$R_1(\gamma) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\gamma & \sin\gamma \\ 0 & -sin\gamma & \cos\gamma \end{bmatrix}$$

$$R_2(\beta) = \begin{bmatrix} \cos\beta & 0 & -sin\beta \\ 0 & 1 & 0 \\ \sin\beta & 0 & \cos\beta \end{bmatrix}$$

$$R_3\alpha = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$Q = [R_1][R_2][R_3] = \begin{bmatrix} 0.086824 & -0.15033 & 0.98481 \\ 0.5038 & 0.85945 & 0.086824 \\ -0.85945 & 0.48861 & 0.15038 \end{bmatrix}$$

$$\alpha = \tan^{-1} \frac{Q_{31}}{-Q_{32}}$$

because num and denom -, $\alpha$ in 3rd quad:

$$\alpha = 180 + \tan^{-1} \frac{Q_{31}}{-Q_{32}}$$

$$\boxed{\alpha = 240.38°}$$

$$\beta = \cos^{-1} Q_{33}$$

$$\boxed{\beta = 81.351°}$$

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$$\gamma = \tan^{-1}\frac{Q_{13}}{Q_{23}}$$

because num + and denom +, $\gamma$ in 2nd quad:

$$\boxed{\gamma = 84.962°}$$

## 4.27

$$h = 180\text{km}; \quad i = 30°$$

$$T = \frac{2\pi}{\sqrt{\mu}}r^{3/2} = \frac{2\pi}{\sqrt{398600}}(6378 + 180)^{3/2} = 5285.3\text{s}$$

$$\dot{\Omega} = -\frac{3}{2}\frac{\sqrt{\mu}J_2 R_e^2}{r^{7/2}}\cos i = -\frac{3}{2}\frac{\sqrt{398600}*0.0010826*6378^2}{(6378 + 180)^{7/2}}\cos 30 = -1.5814E - 6\text{rad/s}$$

$$\omega_e = \frac{2\pi + \frac{2\pi}{365.26}}{24*3600} = 7.2921E - 5\text{rad/s}$$

$$\Delta\lambda = (\omega_e - \dot{\Omega})T = 0.39377\text{rad}$$
$$s = R_e\Delta\lambda = 6378*0.39377$$
$$\boxed{s = 2511.4 \text{ km}}$$

## 4.17