* Problem 1

(a) Solved using MATLAB.

R_{zyz} : (relative)

$\phi = -0.7137$ rad	$\phi = 2.4279$ rad
$\theta = 1.0472$ rad	$\theta = -1.0472$ rad
$\psi = 2.3562$ rad	$\psi = -0.7854$ rad.

(b) Solved using MATLAB

RPY : (absolute)

$\phi = 0.0717$ rad	$\phi = -3.0699$ rad
$\theta = -0.5404$ rad	$\theta = -2.6012$ rad
$\psi = 0.8571$ rad	$\psi = -2.2845$ rad

(c) ~~Axis~~ Solved using MATLAB

Axis-Angle : (absolute)

$\theta = 2.0310$ rad

$$k = \begin{bmatrix} 0.5834 \\ -0.0768 \\ 0.8086 \end{bmatrix}$$

* Problem 2

Solved using MATLAB

$$H = \begin{bmatrix} 0.4698 & 0.1107 & 0.8758 & 0.5000 \\ -0.8660 & 0.2500 & 0.4330 & 0.0000 \\ -0.1710 & -0.9619 & 0.2133 & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 1.0000 \end{bmatrix}$$

* Problem 3

solved using MATLAB.

NOTE: The given matrix is NOT a generic rotation matrix.

$|R| = 2\sin^2\varphi \cdot \sin^2\theta - 2\sin^2\theta + 1$

$$R \cdot R^T = \begin{bmatrix} 1 & 0 & -2c^2\varphi\, c\theta\, s\theta \\ 0 & 1 & -2c\varphi s\varphi s\theta \\ -2c^2\varphi \cdot c\theta s\theta & -2c\varphi s\varphi s\theta & 1 \end{bmatrix}$$

However, observing closely, we see that if $\theta = n\pi$ for $n = 0, 1, 2 \ldots$, $s\theta = 0$

$\therefore |R| = (2s^2\varphi) \cdot 0 - 2(0) + 1 = 1$

and $R \cdot R^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$

Hence in this case, R can be a rotation matrix.

* Problem 4

Solved using MATLAB.

There is no feasible sol^n to satisfy the conditions of rotation matrix for the given matrix.

NOTE: If the last element (r_{33}) of the given matrix was also unknown, it could have the followin possible $sol^n s$ so as to satisfy the conditions of a generic rotation matrix:

$r_{33} = \{-1/\sqrt{2}, -1, 1\}$ ← any of these values ~~solves~~ satisfies the conditions of a rotation matrix (with given matrix $r_{12} = r_{21} = 0.707 = 1/\sqrt{2}$).

* Problem 5

Solved using MATLAB.

* Problem 6

Proved using MATLAB.