Q-1- The state-space representation of a system is given by the following set of equations:

\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2 \\
\dot{x}_3
\end{bmatrix} = \begin{bmatrix}
1 & 1 & 0 \\
1 & 1 & 0 \\
0 & 0 & -5
\end{bmatrix} \begin{bmatrix}
x_1 \\
x_2 \\
x_3
\end{bmatrix} + \begin{bmatrix}
0 \\
0 \\
1
\end{bmatrix} u \\
y = \begin{bmatrix}
1 & 0 & 1
\end{bmatrix} \begin{bmatrix}
x_1 \\
x_2 \\
x_3
\end{bmatrix}
\]

a) Find the transfer function of this system.
b) Find the eigenvalues of this system.
c) Is this system bounded input-bounded output stable?
d) Is this system stable in the sense of Lyapunov?
e) What is the degree of the transfer function?
f) Is this system completely controllable?
g) Is this system completely observable?
h) Show that it is not possible to use state-feedback for this system in order to bring the system poles to new locations as $p_1=p_2=p_3=-5$.
i) Show that it is possible to design a Luenberger observer for this system with the observer poles located at $p_1=p_2=p_3=-5$. 