1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.
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   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

   1. Recognize the system elements
   2. Use a junction to represent distinct velocities
   3. Attach the elements that experience those velocities
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.
   b) Use a 1 junction to represent distinct velocities.
   c) Attach the elements that experience those velocities.
   1. Recognize the system elements.
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

2. Recognize the system elements.
3. Use a 1 junction to represent distinct velocities.
4. Attach the elements that experience those velocities.
5. Use a zero junction for each relative velocity.
1. Chose one of the systems below.
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1. Recognize the system elements
2. Use a 1 junction to represent distinct velocities
3. Attach the elements that experience those velocities
4. Use a zero junction for each relative velocity
5. Attach elements that experience the relative velocities
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a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.
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   1. Recognize the system elements
   2. Use a 1 junction to represent distinct velocities
   3. Attach the elements that experience those velocities
   4. Use a zero junction for each relative velocity
   5. Attach elements that experience the relative velocities
1. Analysis of distinct velocities

3. Attach the elements that experience these velocities

4. Use a zero function for each relative velocity

5. Attach elements that experience the relative velocities
3. Attach the elements that experience those velocities.
4. Use a zero function for each relative velocity.
5. Attach elements that experience the relative velocities.
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
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3. Attach the elements that experience these velocities
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5. Attach elements that experience the relative velocities
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   1. Recognize the system elements
   2. Use a 1 junction to represent distant velocities
   3. Attach the elements that experience those velocities
   4. Use a zero junction for each relative velocity
   5. Attach elements that experience the relative velocities
1. Choose one of the systems below.
2. Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a 1 junction to represent distant velocities
3. Attach the elements that experience those velocities
4. Use a zero junction for each relative velocity
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1. Choose one of the systems below. a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

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5. Attach elements that experience the relative velocities
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements

- $f_{v3} = 1 \text{ N/m}$
- $f_{v4} = 1 \text{ N/m}$
- $f_{v5} = 1 \text{ N/m}$
- $f(t)$
- $M_3 = 1 \text{ kg}$
- $M_1 = 2 \text{ kg}$
- $M_2 = 1 \text{ kg}$
- $K = 2 \text{ N/m}$
- $x_1(t)$ Frictionless
- $x_2(t)$
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

   1. Recognize the system elements
   2. Use a 1 junction to represent distant velocities
   3. Attach the elements that experience those velocities
   4. Use a zero junction for each relative velocity
   5. Attach elements that experience the relative velocities
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a 1 junction to represent distant velocities
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5. Attach elements that experience the relative velocities
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1. Recognize the system elements
2. Use a 1 junction to represent distant velocities
3. Attach the elements that experience those velocities
4. Use a zero junction for each relative velocity
5. Attach elements that experience the relative velocities
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

b) Recognize the system elements.

c) Use a 1 junction to represent distinct velocities.

d) Attach the elements that experience those velocities.

e) Use a zero junction for each relative velocity.

2. Attach elements that experience the relative velocities.
1 - Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a 1 junction to represent distant velocities
3. Attach the elements that experience those velocities
4. Use a zero junction for each relative velocity
5. Attach elements that experience the relative velocities
1. Close one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a 1 junction to represent distinct velocities
3. Attach the elements that experience those velocities
4. Use a zero junction for each relative velocity
5. Attach elements that experience the relative velocities
1. Chose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

2. Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

   ![Bond Graph Diagram]

2. Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)

   ![Mechanical System Diagram]
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use & jirureus to represent distinct currents.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use direct arrows to represent distinct currents.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use & wires to represent distinct currents.
3. Attach the elements that experience those currents.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use $1$ junctions to represent distinct currents.
3. Attach the elements that experience those currents
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use & junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use o junctions to represent the current differences.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use 0 junctions to represent the current differences. Those differences also represented by 1 junctions
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use $+$ junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use $0$ junctions to represent the current differences. Those differences are also represented by $1$ junctions
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use α junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use 0 junctions to represent the current differences. Those differences also represented by 1 junctions
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use & juncitons to represent distinct currents.
3. Attach the elements that experience those currents
4. Use & juncitons to represent the current differences. Those differences also represented by $i_1$ juncitons.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use \( j \) junciters to represent distinct currents.
3. Attach the elements that experience those currents
4. Use \( o \) junciters to represent the current differences. Those differences also represented by \( i \) junciters
1. Choose one of the systems below.
   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

   - Recognize the system elements

   ![Diagram](image_url)
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use $+$ junctions to represent distinct currents.
3. Attach the elements that experience these currents
4. Use $-$ junctions to represent the current differences. Those differences also represented by $1$ junctions
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use $+$ junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use $-$ junctions to represent the current differences. Those differences also represented by $\delta$ junctions
5. Attach the elements that experience those current differences.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use \( i \) junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use \( o \) junctions to represent the current differences.
   Those differences also represented by \( i \) junctions
5. Attach the elements that experience those current differences.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use $+$ junctions to represent distinct currents.
3. Attach the elements that experience those currents.
4. Use $-$ junctions to represent the current differences. Those differences are represented by $+$ junctions.
5. Attach the elements that experience those current differences.
a) Develop the computer model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use \( V \) junctions to represent distinct currents.
3. Attach the elements that experience those currents.
4. Use \( O \) junctions to represent the current differences. Those differences are represented by \( I \) junctions.
5. Attach the elements that experience those current differences.
6. Compute power flow and causal marks.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use 1 junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use 0 junctions to represent the current differences. Those differences also represented by 1 junctions
5. Attach the elements that experience those current differences.
6. Compute power flow and causal marks.
a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize elements
2. Use 1 junctions to represent distinct currents.
3. Attach the elements that experience those currents
4. Use 0 junctions to represent the current differences. Those differences also represented by 1 junctions
5. Attach the elements that experience those current differences.
6. Compute power flow and causal marks.
2.) Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)
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1. Choose one of the systems below.

   a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

   1. Recognize the system elements
   2. Use a 4 junction to represent distinct velocities
2.) Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)
2.) Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)

\[ f(t) \quad R \quad x(t) \]

\[ -M \quad \dot{x} \quad c \quad \dot{x} \quad f(t) \]

\[ \vec{z} : \vec{m} \]

\[ \sum F = m \ddot{x} \quad \ddot{x} - c \dot{x} - k \]
2.) Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)
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2.) Given the system below. Write the differential equations of the system. Use the individual component equations and then derive the Cauchy form. (2 first order equations)
\[ e_1 = s_e_1 \]
\[ f_1 = f_2 \]
\[ e_2 = e_1 - e_3 \]
\[ f_2 = \frac{1}{f_2} \]
\[ \frac{dp_2}{dt} = f_2 \]
\[ e_1 = 5e_1 \]
\[ f_1 = -f_2 \]
\[ e_2 = e_1 - e_3 \]
\[ f_2 = \frac{1}{4} P_2 \]
\[ \frac{dp_2}{dt} = f_2 \]
\[ e_3 = e_3 \]
\[ e_4 = e_4 \]
\[ e_5 = e_6 + e_7 \]
\[ e_6 = f_6 R_6 \]
\[ R \]
\[ e_1 = s_1 e_1 \]
\[ f_1 = f_2 \]
\[ e_2 = e_1 - e_3 \]
\[ f_2 = \frac{1}{2} p_2 \]
\[ \frac{dp_2}{dt} = \frac{f_2}{2} \]
\[ e_3 = \theta \]
\[ e_4 = e_5 \]
\[ e_5 = e_6 = e_7 \]
\[ f_6 = f_7 \]
\[ s_2 = 1(1) \]
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a 1 junction to represent distinct velocities
\[ \begin{align*}
R_1 &= \frac{1}{2} p_2 \\
R_2 &= \frac{1}{2} \theta_2 \\
\theta_3 &= \frac{1}{2} \theta_3 \\
\theta_4 &= \frac{1}{2} \theta_4 \\
e_5 &= e_{6-1} \cdot e_7 \\
e_6 &= e_{6-1} \cdot e_8 \\
e_7 &= \frac{1}{2} \theta_7 \\
e_8 &= 0 \cdot \theta_8 \\
f_6 &= f_5 \\
f_7 &= f_7 \\
f_8 &= f_8 \\
f_9 &= f_9 \\
\end{align*} \]
\[ \frac{d^2p}{dt^2} = e_1 - e_4 = e_1 - e_2 = e_1 - e_8 = e_1 - e_{13} \]

\[ f_6 = f_5 \]

\[ e_1 = e_1 \]

\[ f_2 = f_2 \]

\[ e_2 = e_1 - e_3 \]

\[ f_7 = f_7 \]

\[ e_3 = e_3 \]

\[ \frac{d^2p}{dt^2} = \frac{1}{I_2} \]

\[ e_8 = 0.4 \]

\[ f_8 = f_8 = 5 \pm 8 \]
\[ \frac{dp_2}{dt} = e_1 + e_2 - 5e_1 - e_5 - 5e_1 - e_6 - e_7 \]

\[ e_1 = 5e_1 \quad f_1 = f_2 \]
\[ e_2 = e_1 - e_3 \quad f_2 = f_2 \quad e_4 = 0.4 \]
\[ f_3 = f_3 \quad e_8 = 5 \# e_8 \]
\[ \frac{dp_2}{dt} = f_4 \quad e_3 = 0 \]
\[
\frac{dP_i}{dt} = e_i - e_A = 5e_i - 5e_5 = 5e_i - e_6 - e_7
\]

\[
= 5e_i - f_6 e_6 - \frac{1}{C_7} f_7
\]

\[
f_6 = f_i.
\]
\[
\frac{dp_2}{dt} = \delta_1 - \delta_4 = \delta_1 - \delta_5 = \delta_1 - \delta_6 - \delta_7
\]
\[
= \delta_1 - \frac{f_6 + \delta_6 - 1}{\delta_7}
\]
\[
f_6 = f_5 = f_3 - f_4 = f_2 - f_8
\]
\[
= \frac{1}{J_2} p_2 - s f_8
\]
\[
\frac{dp_2}{dt}
\]
\[ \frac{dp_2}{dt} = e_1 - e_4 + 5e_1 - e_5 = 5e_1 - e_6 - e_7 = 5e_1 - \frac{f_6 R_6 - \frac{1}{C_7}}{C_7} \]
\[ f_6 = f_5 = f_3 - f_4 = f_2 - f_8 = \frac{1}{J_2} p_2 - 5e_8 \]
\[ \frac{dp_2}{dx} = 5e_1 - \left( \frac{1}{J_2} p_2 - 5e_8 \right) R_C - \frac{1}{C_7} q_7 \]
\[ \frac{dp_2}{dx} = 5e_1 - 5e_8 R_C - \frac{1}{C_7} q_7 \]
\[
\begin{align*}
\Delta t &= t_6 - t_0 - \frac{1}{c_2} q_7 \\
&= t_6 - t_5 - t_3 - t_4 = f_2 - f_8 \\
&= \frac{1}{J_2} \frac{d}{dt} P_2 - 5 \# 8 \\
\frac{dP_2}{dt} &= sE_1 - \left(\frac{1}{J_2} \frac{d}{dt} P_2 + 5 \# 8\right) R_6 - \frac{1}{c_2} q_7 \\
\frac{dP_2}{dt} &= sE_1 - \frac{1}{J_2} P_2 + 5 \# 8 R_6 - \frac{1}{c_2} q_7 \\
\frac{dQ_4}{dt} &= t_7 = f_5 = f_3 - f_4 \\
&= \frac{1}{J_2} \frac{d}{dt} P_2 - 5 \# 8 \\
\frac{dQ_4}{dt} &= \frac{1}{J_2} P_2 - 5 \# 8
\end{align*}
\]
\[ \frac{dp_2}{dt} = sE_1 - \left(\frac{1}{L_2 - sF_8}\right) R_6 - \frac{1}{C_7} \]
\[ \frac{dp_2}{dt} = sE_1 - \frac{E_2}{I_2} + sF_8 R_6 - \frac{1}{C_7} \]

State Space Form:
\[ \begin{bmatrix} \frac{dp_2}{dt} \\ \frac{dp_1}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} p_2 \\ p_1 \end{bmatrix} + \begin{bmatrix} \frac{1}{L_2} \end{bmatrix} F_2 - \begin{bmatrix} sF_8 \end{bmatrix} \]
\[ e_1 = s_1 \]
\[ f_1 = f_2 \]
\[ e_2 = e_1 - e_3 \]
\[ f_2 = \frac{1}{2} P_2 \]
\[ \frac{df_2}{dt} = f_2 \]
\[ e_3 = r_3 \]
\[ e_4 = e_5 \]
\[ e_5 = e_6 + e_7 \]
\[ e_6 = f_6 r_6 \]

\[ f_1 = f_2 \]
\[ \frac{df_2}{dt} = f_7 \]
\[ e_7 = 0.4 \]
\[ f_8 = s_8 \]

State Space Form

\[ \frac{dP_2}{dt} = \begin{bmatrix} \frac{dP_2}{dt} \\ \frac{df_7}{dt} \end{bmatrix} = \begin{bmatrix} J \end{bmatrix} P_2 + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \]
\[
\begin{align*}
    e_1 &= e_1 \\
    f_1 &= f_2 \\
    e_2 &= e_1 - e_3 \\
    f_2 &= \frac{1}{2} P_2 \\
    \frac{df_2}{dt} &= f_2 \\
    e_3 &= e_5 \\
    e_4 &= e_6 \\
    e_5 &= e_4 + e_7 \\
    e_6 &= f_6 + R_6 \\
    f_7 &= f_3 - f_4 \\
    \frac{df_1}{dt} &= f_7 \\
    e_8 &= 0 \quad \text{State Space form} \\
    f_8 &= s = 8 \\
    \frac{df_4}{dt} &= \frac{1}{1} = P_2 - s = 8 \\
    \frac{df_5}{dt} &= \frac{1}{2} = P_2 - s = 8 \\
\end{align*}
\]
Below:

1. Recognize the system elements
2. Use a 1 junction to represent distant velocities

You do not need to conduct the numerical simulation.
\[ \frac{dE_1}{dt} = f_1 + f_2 \]
\[ E_1 = -E_1 \]
\[ f_1 = f_2 \]
\[ E_2 = E_1 - E_3 \]
\[ f_2 = \frac{1}{2} P_2 \]
\[ E_3 = E_3 \]
\[ f_3 = f_2 \]
\[ \frac{dP_2}{dt} = 1 \]
\[ E_4 = E_4 \]
\[ f_4 = 0 \]
\[ E_5 = E_6 E_7 \]
\[ f_5 = f_6 + f_6 \]
\[ \frac{dE_6}{dt} = \frac{1}{2} P_2 - 8 \]

State space form:
\[
\begin{bmatrix}
\frac{dE_1}{dt} \\
\frac{dE_2}{dt} \\
\frac{dE_3}{dt} \\
\frac{dE_4}{dt} \\
\frac{dE_5}{dt} \\
\frac{dE_6}{dt}
\end{bmatrix} = \begin{bmatrix}
1 & 1 \\
-1 & 1 \\
0 & 1 \\
0 & 0 \\
0 & 0 \\
0 & 0
\end{bmatrix} \begin{bmatrix}
E_1 \\
E_2 \\
E_3 \\
E_4 \\
E_5 \\
E_6
\end{bmatrix} + \begin{bmatrix}
0 \\
0 \\
0 \\
0 \\
0 \\
1
\end{bmatrix} P_2
\]
\[ \frac{dR}{dt} = \setminus \frac{1}{R} - \frac{1}{C} R \]
\[ \frac{dC}{dt} = f_6 \]
\[ f_6 = f_5 \]
\[ e_1 = \setminus \]
\[ f_1 = f_2 \]
\[ e_2 = e_1 - e_3 \]
\[ f_2 = \frac{1}{T_2} P_2 \]
\[ \frac{dp_2}{dt} = \frac{1}{T_2} \]
\[ e_3 = 0 \]
\[ f_3 = e_5 \]
\[ e_4 = e_5 \]
\[ f_4 = e_6 \]
\[ e_5 = e_6 - e_7 \]
\[ e_6 = f_6 - p_2 \]
\[ \frac{dP_2}{dt} = \frac{1}{T_2} P_2 - s \]
\[ s = 8 \]

State Space Form:
\[ \begin{bmatrix} \frac{dR}{dt} \\ \frac{dC}{dt} \end{bmatrix} = \begin{bmatrix} \frac{1}{T_2} & -\frac{1}{C} \\ \frac{1}{T_2} & 0 \end{bmatrix} \begin{bmatrix} R \\ C \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} \]
\[ \begin{bmatrix} \frac{dP_2}{dt} \\ \frac{dE_4}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\frac{1}{C} & 0 \end{bmatrix} \begin{bmatrix} P_2 \\ E_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \]
\( e_1 = s e_1 \)

\( f_1 = f_2 \)

\( e_2 = e_1 - e_3 \)

\( f_2 = e_2 \)

\( e_3 = 0 \)

\( e_4 = e_5 \)

\( e_5 = e_6 + e_7 \)

\( e_6 = f_6 + v_6 \)

\( \frac{dC}{dt} = \frac{e_1 - (\frac{e_2}{12} + \frac{e_3}{8})}{R_1} - \frac{e_7}{C_7} \)

\( \frac{dP_2}{dt} = \frac{s e_1 - \frac{P_2}{12} + 5 + 8 R_1}{C_1} - \frac{e_7}{C_7} \)

\( \frac{dQ_1}{dt} = f_7 \)

\( \frac{dP_1}{dt} = f_6 = f_5 \)

\( e_7 = \frac{1}{C_7} \)

\( e_8 = 0 \)

\( f_8 = s = 8 \)

\( \frac{dP_2}{dt} = \frac{1}{12} P_2 - s = 8 \)

State Space Form:

\[
\begin{bmatrix}
\frac{dP_2}{dt} \\
\frac{dQ_1}{dt} \\
\frac{dP_1}{dt}
\end{bmatrix} = \begin{bmatrix}
\frac{e_6}{12} & -\frac{1}{C_7} & P_2 \\
\frac{1}{12} & 0 & 0 \\
1 & 0 & 0
\end{bmatrix} + \begin{bmatrix}
1 \\
0 \\
0
\end{bmatrix} \cdot \begin{bmatrix}
e_1 \\
e_2 \\
e_3
\end{bmatrix}
\]
\[ \begin{align*}
\dot{e}_1 &= s = 1 \\
\dot{f}_1 &= f_1 \\
\dot{e}_2 &= e_1 - e_2 \\
\dot{f}_2 &= \frac{1}{2} p_2 \\
\dot{p}_2 &= \frac{1}{2} \\
\dot{e}_3 &= e_3 \\
\dot{e}_4 &= e_4 \\
\dot{e}_5 &= e_3 e_7 \\
\dot{e}_6 &= f_6 + e_6 \\
\dot{p}_1 &= s = 1 - \frac{1}{2} f_2 + s = 8 R_6 - \frac{1}{2} q_7 \\
\dot{q}_7 &= s = 1 - \frac{1}{2} f_2 + s = 8 R_6 - \frac{1}{2} q_7 \\
\frac{d q_7}{d t} &= f_7 = f_5 = f_3 - f_4 \\
\frac{d f_2}{d t} &= f_2 = f_7 \\
\frac{d p_2}{d t} &= f_6 + p_2 \\
\frac{d p_2}{d t} &= f_6 + p_2 \\
\frac{d e_3}{d t} &= e_3 \\
\frac{d e_4}{d t} &= e_4 \\
\frac{d e_5}{d t} &= e_5 e_7 \\
\frac{d e_6}{d t} &= f_6 + e_6 \\
\end{align*} \]

State space form:

\[ \begin{pmatrix} \frac{d p_2}{d t} \\ \frac{d f_2}{d t} \end{pmatrix} = \begin{pmatrix} R_6 & -\frac{1}{2} \\ \frac{1}{2} & 0 \end{pmatrix} \begin{pmatrix} p_2 \\ q_7 \end{pmatrix} + \begin{pmatrix} 1 \\ + R_6 \end{pmatrix} s = 1 \]
\[ \begin{align*}
R & \quad C \\
\mathbf{e}_1 & = \mathbf{s} \mathbf{e}_1 \\
\mathbf{f}_1 & = \mathbf{f}_2 \\
\mathbf{e}_2 & = \mathbf{e}_1 - \mathbf{e}_3 \\
\mathbf{f}_2 & = \mathbf{f}_1 - \mathbf{p}_2 \\
\frac{\mathbf{d} \mathbf{p}_2}{\mathbf{d} \mathbf{t}} & = \frac{1}{\mathbf{I}_2} \\
\mathbf{e}_3 & = \mathbf{e}_4 - \mathbf{e}_5 \\
\mathbf{e}_4 & = \mathbf{e}_5 \\
\mathbf{e}_5 & = \mathbf{e}_6 \mathbf{e}_7 \\
\mathbf{e}_6 & = \mathbf{f}_6 \mathbf{p}_6 \\
\end{align*} \]

\[
\begin{align*}
\mathbf{a}_1 & = \mathbf{e}_1 - \left( \frac{\mathbf{f}_2}{\mathbf{I}_2} \right) \mathbf{R}_c - \frac{1}{\mathbf{C}_q} \\
\mathbf{a}_2 & = \mathbf{e}_1 - \frac{\mathbf{p}_2}{\mathbf{I}_2} + 8 \mathbf{F}_c - \frac{1}{\mathbf{C}_q} \\
\frac{\mathbf{d} \mathbf{p}_2}{\mathbf{d} \mathbf{t}} & = \mathbf{e}_1 - \frac{\mathbf{p}_2}{\mathbf{I}_2} + 8 \mathbf{F}_c - \frac{1}{\mathbf{C}_q} \\
\frac{\mathbf{d} \mathbf{q}_1}{\mathbf{d} \mathbf{t}} & = \mathbf{f}_1 = \mathbf{f}_5 = \mathbf{f}_3 - \mathbf{f}_4 \\
\frac{\mathbf{d} \mathbf{q}_2}{\mathbf{d} \mathbf{t}} & = \frac{1}{\mathbf{I}_2} \mathbf{p}_2 - 8 \mathbf{F}_c \\
\end{align*} \]

State Space form:

\[
\begin{align*}
\frac{\mathbf{d} \mathbf{p}_2}{\mathbf{d} \mathbf{t}} & = \left[ \begin{array}{cc}
\frac{\mathbf{R}_c}{\mathbf{I}_2} & -\frac{1}{\mathbf{C}_q} \\
\frac{1}{\mathbf{I}_2} & 0 \\
\end{array} \right] \mathbf{p}_2 + \left[ \begin{array}{c}
\frac{1}{\mathbf{I}_2} \\
0 \\
\end{array} \right] \mathbf{e}_1 \\
\frac{\mathbf{d} \mathbf{q}_1}{\mathbf{d} \mathbf{t}} & + \left[ \begin{array}{c}
\frac{1}{\mathbf{I}_2} \\
0 \\
\end{array} \right] \mathbf{p}_2 \\
\end{align*} \]
\[
\begin{align*}
\dot{e}_1 &= f_1 = e_2 \\
\dot{e}_2 &= e_1 - e_3 \\
\dot{e}_3 &= e_4 \\
\dot{e}_4 &= e_5 \\
\dot{e}_5 &= e_6 \\
\dot{e}_6 &= f_6 = f_5 \\
\dot{e}_7 &= \frac{I_2}{R_C} \\
\dot{e}_8 &= s + 8 \quad R_C - \frac{1}{C_7} \\
\end{align*}
\]

\[
\begin{align*}
\dot{p}_2 &= s e_1 - \frac{1}{R_2} p_2 + s + 8 \quad R_C - \frac{1}{C_7} \\
\frac{\dot{p}_2}{\dot{t}} &= s e_1 - \frac{1}{R_2} p_2 + s + 8 \\
\frac{\dot{p}_1}{\dot{t}} &= f_7 \\
\frac{d q_1}{\dot{t}} &= f_1 = f_5 = f_3 - f_4 \\
\frac{d q_2}{\dot{t}} &= f_2 - f_8 = \frac{1}{I_2} p_2 - s + 8 \\
\end{align*}
\]

\[
\begin{align*}
\frac{\dot{p}_2}{\dot{t}} &= \frac{1}{I_2} p_2 - s + 8 \\
\end{align*}
\]

\[
\text{State Space form}
\]

\[
\begin{bmatrix}
\frac{\dot{p}_2}{\dot{t}} \\
\frac{\dot{p}_1}{\dot{t}} \\
\frac{d q_1}{\dot{t}} \\
\frac{d q_2}{\dot{t}}
\end{bmatrix} =
\begin{bmatrix}
\frac{R_6}{I_2} & -\frac{1}{C_7} \\
\frac{1}{I_2} & 0 \\
\frac{1}{I_2} & 0 \\
\frac{1}{R_2} & -\frac{1}{R_2}
\end{bmatrix}
\begin{bmatrix}
p_2 \\
p_1 \\
q_1 \\
q_2
\end{bmatrix} +
\begin{bmatrix}
1 \\
0 \\
0 \\
0
\end{bmatrix}
\]

\[
\begin{bmatrix}
p_2 \\
p_1 \\
q_1 \\
q_2
\end{bmatrix} =
\begin{bmatrix}
I_2 \\
R_2 \\
R_5 \\
R_4
\end{bmatrix}
\]
\[
\begin{align*}
R & \\
C & \\
e_1 &= \delta e_1 \\
f_1 &= f_x \\
e_2 &= e_1 - e_3 \\
f_2 &= \frac{1}{x_2} \\
\frac{df_2}{dt} &= \frac{1}{x_2} \\
e_3 &= e_2 \\
e_4 &= e_4 \\
e_5 &= e_4 - e_7 \\
e_6 &= f_6 x_6
\end{align*}
\]

\[
\begin{align*}
\mathbf{x}_1 &= \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \end{bmatrix} \\
\mathbf{x}_2 &= \begin{bmatrix} x_2 \\ x_3 \end{bmatrix}
\end{align*}
\]

State space form:

\[
\begin{align*}
\frac{d}{dt} \mathbf{x}_1 &= \begin{bmatrix} \frac{1}{x_2} & -\frac{1}{c_7} \\ 0 & 0 \end{bmatrix} \mathbf{x}_2 + \begin{bmatrix} 1 \\ 0 \end{bmatrix} \gamma \\
\frac{d}{dt} \mathbf{x}_2 &= \begin{bmatrix} \frac{1}{x_2} & 0 \end{bmatrix} \mathbf{x}_2 + \begin{bmatrix} 0 \\ -1 \end{bmatrix} \delta \\
x_1(0) &= \begin{bmatrix} e_0 \\ x_{01} \end{bmatrix} \\
x_2(0) &= \begin{bmatrix} x_{02} \\ x_{03} \end{bmatrix}
\end{align*}
\]

\[
2 \mathbf{x}_1 + \mathbf{C} A_1 \mathbf{x}_2 + \mathbf{C} B_1 = \mathbf{C} f_1
\]
1. Choose one of the systems below.

a) Develop the Computer Model suitable for entering in the computer for simulation using the Bond Graph method. You do not need to conduct the numerical simulation.

1. Recognize the system elements
2. Use a junction to represent distinct velocities
3. Attach the elements that experience those velocities
% dQ7=P2/I2-SF8

% ... Number of States  2
A(1,:) = [sb,sb];
A(1,:) = [0,1/I2];
B(1,:) = [sb,sb];
B(1,:) = [0,-1];

% dP2=SE1-P2/I2*R6+SF8*R6-Q7/C7
A(2,:) = [-1/C7,-1/I2*R6];
B(2,:) = [1,+1*R6];

% Generate C and D matrices corresponding to o...
% ... Generation of A, B matrices continues
%
% dQ7 = P2/I2 - SF8
% ... Number of States 2
A(1,:) = [sb, sb];
A(1,:) = [0, 1/I2];
B(1,:) = [sb, sb];
D(1,:) = [sb, sb];
B(1,:) = [0, -1];

% dP2 = SE1 - P2/I2*R6 + SF8*R6 - Q7/C7

\[ \frac{\text{d}p_2}{\text{d}t} = \text{SE}_1 - \left( \frac{1}{2} \right) \frac{p_2}{r_6} + \frac{s_f 8}{r_6} \frac{p_2}{c_7} \]

\[ \frac{\text{d}a_7}{\text{d}t} = (f_1 - f_5) = f_3 - f_4 \]

\[ \frac{\text{d}a_8}{\text{d}t} = f_7 - f_8 = \frac{1}{2} \frac{p_2}{r_6} - s_f 8 \]
A MATRIX

\[
\begin{pmatrix}
  1 & 0, & -- & 12 & -- & 7
  \\
  0 & -- & 1 & R6 & -- & --
  \\
  C7 & I2 & & & &
\end{pmatrix}
\]

B MATRIX

\[
\begin{pmatrix}
  0 & -1 &
  \\
  1 & R6 &
\end{pmatrix}
\]

\[
\frac{dp_2}{dt} = \frac{1}{16} \quad 18 = 5 + 8
\]
State space form:

\[
\begin{align*}
\dot{p}_2 &= \begin{bmatrix} \frac{1}{C_2} & -\frac{1}{C_2} \\ -\frac{1}{C_2} & \frac{1}{C_2} \end{bmatrix} p_2(t) + \begin{bmatrix} 0 \\ \frac{1}{R_1 C_2} \end{bmatrix} \eta(t) \\
\eta(t) &= \begin{bmatrix} \frac{1}{C_2} \\ 0 \end{bmatrix} p_2(t) + \begin{bmatrix} 0 \\ -1 \end{bmatrix} \eta(t) \\
x(t) &= \begin{bmatrix} C_1 & 0 \end{bmatrix} p_2(t) + \begin{bmatrix} C_2 \end{bmatrix} \eta(t)
\end{align*}
\]