HW #1

Problem 1

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```
> restart
```

Helpful functions

```
> with(inttrans):
> u := t -> Heaviside(t):
> PAR := (Za, Zb) -> simplify((Za*Zb)/(Za+Zb)):
> SCS := X -> sort(collect(simplify(expand(numer(X))/expand(denom(X))), s), s):
> IL := (X, s, t) -> simplify(convert(invlaplace(convert(X, parfrac, s), s, t), expsincos)):
> ILTS := (X, s, t) -> simplify(convert(invlaplace(X, s, t), expsincos)):
```

Part A

```
> eq1 := (L1*s + 1/(C*s))*I1 - 1/(C*s)*I2 = V
```

$$eq1 := \left(L1\,s + \frac{1}{C\,s}\right) I1 - \frac{I2}{C\,s} = V \tag{1}$$

```
> eq2 := (1/(C*s) + R)*I2 - 1/(C*s)*I1 = -Vl
```

$$eq2 := \left(\frac{1}{C\,s} + R\right) I2 - \frac{I1}{C\,s} = -Vl \tag{2}$$

```
> eq3 := Vl = I2*L2*s
```

$$eq3 := Vl = I2\,L2\,s \tag{3}$$

```
> solMesh := solve({eq1, eq2, eq3}, [I1, I2, Vl])
```

$$solMesh := \left[\left[I1 = \frac{V\left(L2\,s^2\,C + R\,C\,s + 1\right)}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + L1\,s + L2\,s + R}, I2 = \frac{V}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + L1\,s + L2\,s + R}, Vl = \frac{V\,L2\,s}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + L1\,s + L2\,s + R}\right]\right] \tag{4}$$

```
> TFMesh := simplify(expand(rhs(solMesh[][3])/V))
```

$$TFMesh := \frac{s\,L2}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + (L1 + L2)\,s + R} \tag{5}$$

```
> vals := R = 2, C = 1/6, L1 = 2, L2 = 3
```

$$vals := R = 2, C = \frac{1}{6}, L1 = 2, L2 = 3 \tag{6}$$

> simplify(subs(vals, TFMesh))

$$\frac{9\,s}{3\,s^3 + 2\,s^2 + 15\,s + 6} \tag{7}$$

Part B

> $eq1Node := \frac{Vs}{L1 \cdot s} = Vr \cdot \left(\frac{1}{L1 \cdot s} + C \cdot s + \frac{1}{R} \right) - \left(\frac{1}{R} \right) Vl$

$$eq1Node := \frac{Vs}{L1\,s} = Vr \left(\frac{1}{L1\,s} + C\,s + \frac{1}{R} \right) - \frac{Vl}{R} \tag{8}$$

> $eq2Node := \frac{(Vr - Vl)}{R} = \frac{Vl}{L2 \cdot s}$

$$eq2Node := \frac{Vr - Vl}{R} = \frac{Vl}{L2\,s} \tag{9}$$

> solNode := solve({eq1Node, eq2Node}, [Vr, Vl])

$$solNode := \left[\left[Vr = \frac{(L2\,s + R)\,Vs}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + L1\,s + L2\,s + R}, Vl = \frac{L2\,Vs\,s}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + L1\,s + L2\,s + R} \right] \right] \tag{10}$$

> $TFNode := simplify\left(expand\left(\frac{rhs(solNode[\,][2])}{Vs} \right) \right)$

$$TFNode := \frac{s\,L2}{C\,L1\,L2\,s^3 + C\,L1\,R\,s^2 + (L1 + L2)\,s + R} \tag{11}$$

> $vals := R = 2, C = \frac{1}{6}, L1 = 2, L2 = 3$

$$vals := R = 2, C = \frac{1}{6}, L1 = 2, L2 = 3 \tag{12}$$

> simplify(subs(vals, TFNode))

$$\frac{9\,s}{3\,s^3 + 2\,s^2 + 15\,s + 6} \tag{13}$$