

```

> restart;
with(LinearAlgebra):
with(Student[MultivariateCalculus]):
with( DynamicSystems ):
with(plots):
> M88:=Matrix(8, 8, {(1, 1) = 1, (1, 2) = 0, (1, 3) = 0, (1, 4) =
0, (1, 5) = 0, (1, 6) = 0, (1, 7) = 0, (1, 8) = 0, (2, 1) = 0,
(2, 2) = 1, (2, 3) = 0, (2, 4) = 0, (2, 5) = 0, (2, 6) = 0, (2,
7) = 0, (2, 8) = 0, (3, 1) = 0, (3, 2) = 0, (3, 3) = 1, (3, 4) =
0, (3, 5) = 0, (3, 6) = 0, (3, 7) = 0, (3, 8) = 0, (4, 1) = 0,
(4, 2) = 0, (4, 3) = 0, (4, 4) = 1, (4, 5) = 0, (4, 6) = 0, (4,
7) = 0, (4, 8) = 0, (5, 1) = 0, (5, 2) = 0, (5, 3) = 0, (5, 4) =
0, (5, 5) = 1, (5, 6) = 0, (5, 7) = 0, (5, 8) = 0, (6, 1) = 0,
(6, 2) = 0, (6, 3) = 0, (6, 4) = 0, (6, 5) = 0, (6, 6) = 1, (6,
7) = 0, (6, 8) = 0, (7, 1) = 0, (7, 2) = 0, (7, 3) = 0, (7, 4) =
0, (7, 5) = 0, (7, 6) = 0, (7, 7) = 1, (7, 8) = 0, (8, 1) = 0,
(8, 2) = 0, (8, 3) = 0, (8, 4) = 0, (8, 5) = 0, (8, 6) = 0, (8,
7) = 0, (8, 8) = 1});

```

$$M88 := \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

(1)

```

> K88:=Matrix(8, 8, {(1, 1) = 2000000, (1, 2) = 0, (1, 3) = 0., (1,
4) = -1000000, (1, 5) = 0, (1, 6) = -99256.35650, (1, 7) = 0, (1,
8) = 0, (2, 1) = 0, (2, 2) = 2000000, (2, 3) = 0., (2, 4) = 0,
(2, 5) = -1000000, (2, 6) = 490049.1564, (2, 7) = 0, (2, 8) = 0,
(3, 1) = 0., (3, 2) = 0., (3, 3) = 19927.59766, (3, 4) =
-100000.0000, (3, 5) = 0.2051033808e-4, (3, 6) = -9925.635660,
(3, 7) = 0, (3, 8) = 0, (4, 1) = -1000000, (4, 2) = 0, (4, 3) =
-100000.0000, (4, 4) = 2000000, (4, 5) = 0, (4, 6) = 0., (4, 7) =
-1000000, (4, 8) = 0, (5, 1) = 0, (5, 2) = -1000000, (5, 3) =
0.2051033808e-4, (5, 4) = 0, (5, 5) = 2000000, (5, 6) = 0., (5,
7) = 0, (5, 8) = -1000000, (6, 1) = -99256.35650, (6, 2) =
490049.1564, (6, 3) = -9925.635660, (6, 4) = 0., (6, 5) = 0., (6,
6) = 500073.8114, (6, 7) = 99256.35650, (6, 8) = -490049.1564,
(7, 1) = 0, (7, 2) = 0, (7, 3) = 0, (7, 4) = -1000000, (7, 5) =
0, (7, 6) = 99256.35650, (7, 7) = 1000000, (7, 8) = 0, (8, 1) =
0, (8, 2) = 0, (8, 3) = 0, (8, 4) = 0, (8, 5) = -1000000, (8, 6)
= -490049.1564, (8, 7) = 0, (8, 8) = 2000000});

```

```

K88 := [[2000000, 0, 0., -1000000, 0, -99256.35650, 0, 0],

```

```

[0, 2000000, 0., 0, -1000000, 4.900491564 105, 0, 0],

```

```

[0., 0., 19927.59766, -1.0000000000 105, 0.00002051033808, -9925.635660, 0, 0],

```

```

[-1000000, 0, -1.0000000000 105, 2000000, 0, 0., -1000000, 0],

```

(2)

```

[0, -1000000, 0.00002051033808, 0, 2000000, 0., 0, -1000000],
[-99256.35650, 4.900491564 105, -9925.635660, 0., 0., 5.000738114 105, 99256.35650,
-4.900491564 105],
[0, 0, 0, -1000000, 0, 99256.35650, 1000000, 0],
[0, 0, 0, 0, -1000000, -4.900491564 105, 0, 2000000]]

```

```
> DDD:=(M88*s^2+K88) ;
```

```
TTT:=MatrixInverse(DDD) :
```

```
DDD:= [[s2 + 2000000, 0, 0., -1000000, 0, -99256.35650, 0, 0],
```

```
[0, s2 + 2000000, 0., 0, -1000000, 4.900491564 105, 0, 0],
```

```
[0., 0., s2 + 19927.59766, -1.000000000 105, 0.00002051033808, -9925.635660, 0, 0],
```

```
[-1000000, 0, -1.000000000 105, s2 + 2000000, 0, 0., -1000000, 0],
```

```
[0, -1000000, 0.00002051033808, 0, s2 + 2000000, 0., 0, -1000000],
```

```
[-99256.35650, 4.900491564 105, -9925.635660, 0., 0., s2 + 5.000738114 105,
99256.35650, -4.900491564 105],
```

```
[0, 0, 0, -1000000, 0, 99256.35650, s2 + 1000000, 0],
```

```
[0, 0, 0, 0, -1000000, -4.900491564 105, 0, s2 + 2000000]]
```

(3)

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>
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```
> TTT:=TransferFunction(<TTT[1,7],TTT[2,7],TTT[3,7],TTT[4,7],TTT[5,
7],TTT[6,7],TTT[7,7],TTT[8,7]>);
```

$TTT :=$	<b>Transfer Function</b>
	continuous
	8 output(s); 1 input(s)
	inputvariable = $[uI(s)]$
	outputvariable = $[yI(s), y2(s), y3(s), y4(s), y5(s), y6(s), y7(s), y8(s)]$

(4)

```
> PrintSystem(TTT) ;
```

## Transfer Function

continuous

8 output(s); 1 input(s)

inputvariable =  $[uI(s)]$

outputvariable =  $[yI(s), y2(s), y3(s), y4(s), y5(s), y6(s), y7(s), y8(s)]$

$$tf_{1,1} = \frac{9.901481757 \cdot 10^{11} s^{120} + 7.414610682 \cdot 10^{19} s^{118} + 2.685112134 \cdot 10^{27} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{2,1} = \frac{4.864049377 \cdot 10^{10} s^{120} + 3.716070470 \cdot 10^{18} s^{118} + 1.373119463 \cdot 10^{26} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{3,1} = \frac{9.901481757 \cdot 10^{10} s^{120} + 7.610667190 \cdot 10^{18} s^{118} + 2.831887724 \cdot 10^{26} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{4,1} = \frac{1.000000 \cdot 10^6 s^{122} + 7.689877339 \cdot 10^{13} s^{120} + 2.862721346 \cdot 10^{21} s^{118} + 6.873431951 \cdot 10^{29} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{5,1} = \frac{-4.687503487 \cdot 10^{21} s^{114} + 9.7168815 \cdot 10^{29} s^{112} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{6,1} = \frac{-99256.35650 s^{122} - 7.781569274 \cdot 10^{12} s^{120} - 2.953664655 \cdot 10^{20} s^{118} - 7.231671755 \cdot 10^{28} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{7,1} = \frac{s^{124} + 7.889877338 \cdot 10^7 s^{122} + 3.015518842 \cdot 10^{15} s^{120} + 7.438485502 \cdot 10^{22} s^{118} + 1.331210 \cdot 10^{30} s^{116} + \dots}{s^{126} + 7.989877338 \cdot 10^7 s^{124} + 3.093407765 \cdot 10^{15} s^{122} + 7.732270271 \cdot 10^{22} s^{120} + 1.402703365 \cdot 10^{30} s^{118} + \dots}$$

$$tf_{8,1} = \frac{-4.864049377 \cdot 10^{10} s^{76} - 2.371668284 \cdot 10^{18} s^{74} - 5.483091046 \cdot 10^{25} s^{72} - 7.9 \cdot 10^{32} s^{70} + \dots}{s^{82} + 5.225920639 \cdot 10^7 s^{80} + 1.300939474 \cdot 10^{15} s^{78} + 2.053242760 \cdot 10^{22} s^{76} + 2.306918128 \cdot 10^{29} s^{74} + 1.402703365 \cdot 10^{36} s^{72} + \dots}$$

```
> MagnitudePlot(TTT,linearfreq=true,linearmag = true, decibels =  
false,hertz = true, range = .01 .. 100,view=[.01 .. 100,0 ..  
0.0001]);
```

