Marine Model

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```
PolynomialRing(RationalField(), 'x').gen()
A=matrix([[ 1 , 1 , 0 , 1 , 1 , 0 , 0 , 0 ],[ 0 , 1 , 1 , 1 , 0 , 0 \
   , 1 , 0 ],[ 0 , 0 , 1 , 1 , 0 , 0 , 0 , 1 ],[ 0 , 1 , 0 , 1 , 1 ,\
    1 , 0 , 0 ],[ 0 , 1 , 0 , 1 , 1 , 0 , 0 , 1 ],[ 0 , 0 , 0 , 0 , \
   1 , 1 , 0 , 0 ],[ 0 , 0 , 0 , 0 , 0 , 0 , 1 , 0 ],[ 0 , 0 , 0 , 1\
    , 0 , 0 , 0 , 1 ]])
B = matrix.identity(8)-x*A
Q = B.determinant()
x
```

```
A
```

```
[1 1 0 1 1 0 0 0]
[0 1 1 1 0 0 1 0]
[0 0 1 1 0 0 0 1]
[0 1 0 1 1 1 0 0]
[0 1 0 1 1 0 0 1]
[0 0 0 0 1 1 0 0]
[0 0 0 0 0 0 1 0]
[0 0 0 1 0 0 0 1]
```

```
B
```

```
[-x + 1     -x      0     -x     -x      0      0      0]
[     0 -x + 1     -x     -x      0      0     -x      0]
[     0      0 -x + 1     -x      0      0      0     -x]
[     0     -x      0 -x + 1     -x     -x      0      0]
[     0     -x      0     -x -x + 1      0      0     -x]
[     0      0      0      0     -x -x + 1      0      0]
[     0      0      0      0      0      0 -x + 1      0]
[     0      0      0     -x      0      0      0 -x + 1]
```

```
Q
```

```
-4*x^7 + 19*x^6 - 42*x^5 + 56*x^4 - 48*x^3 + 26*x^2 - 8*x + 1
```

```
Q.factor()
```

```
-(4*x^3 - 7*x^2 + 5*x - 1)*(x^2 - x + 1)*(x - 1)^2
```

```
f = Q/(x-1)^2
```

```
f.simplify()
```
```
-(4*x^7 - 19*x^6 + 42*x^5 - 56*x^4 + 48*x^3 - 26*x^2 + 8*x - 1)/(x - 1)^2
```

```
expand(-(4*x^3 - 7*x^2 + 5*x - 1)*(x^2 - x + 1))
```
```
-4*x^5 + 11*x^4 - 16*x^3 + 13*x^2 - 6*x + 1
```