Initialize extension field and polynomial ring over it. Syntax is initF(p,m) for GF(p^m).

```
> initF(2,3);
```

$$\alpha^3 + \alpha + 1$$

Initialize Reed-Solomon code: `initRS(n,r)`, `n=` code length, `r=` code redundancy.

The roots of the code are α^i for $i = 1,2,\ldots,r$. Returns code generator polynomial $g(x) = (x - \alpha)(x - \alpha^2) \ldots (x - \alpha^{(n-k-1)})$

```
> g := initRS(7,4); # n = 7, r = 4, k = 3
```

$$g := \alpha + 1 + \alpha x + x^2 + (\alpha + 1) x^3 + x^4$$

Generate random message

```
> u := rmsg();
```

$$u := \alpha^2 + (\alpha^2 + \alpha + 1) x + (\alpha^2 + \alpha + 1) x^2$$

Encode message using a *systematic encoder*

```
> c := encodeRS(u);
```

$$c := \alpha + x + \alpha^2 x^2 + \alpha x^3 + \alpha^2 x^4 + (\alpha^2 + \alpha + 1) x^5 + (\alpha^2 + \alpha + 1) x^6$$

Verify syndrome is zero

```
> syndrome(c);
```

$$0$$

Generate random error vector

```
> e:=rerr(2);
```

$$e := \alpha^2 + 1 + (\alpha^2 + \alpha + 1)\, x^6$$

Compute received word

```
> y:=P[`+`](c,e);
```

$$y := \alpha^2 + \alpha + 1 + x + \alpha^2\, x^2 + \alpha\, x^3 + \alpha^2\, x^4 + (\alpha^2 + \alpha + 1)\, x^5$$

Decode received word

```
> decodeRS(y);
```

```
syndrome S(x): :
```

$$\alpha + 1 + (\alpha^2 + \alpha)\, x + x^2 + (\alpha^2 + \alpha + 1)\, x^3$$

```
Running Euclidean algorithm:
iteration: -1
 q : 0
 r :
```

$$x^4$$

```
 s :
```

$$1$$

```
 t :
```

$$0$$

```
iteration: 0
 q : 0
 r :
```

$$\alpha+1+(\alpha^2+\alpha)\,x+x^2+(\alpha^2+\alpha+1)\,x^3$$

```
 s :
```

$$0$$

```
 t :
```

$$1$$

```
iteration: 1
 q :
```

$$\alpha^2+\alpha+\alpha^2\,x$$

```
 r :
```

$$1+(\alpha^2+1)\,x+(\alpha+1)\,x^2$$

```
 s :
```

$$1$$

```
 t :
```

$$\alpha^2+\alpha+\alpha^2\,x$$

```
iteration: 2
 q :
```

$$1+\alpha^2 x$$

```
 r :
```

$$\alpha+(\alpha^2+\alpha+1)\,x$$

```
 s :
```

$$1+\alpha^2 x$$

```
 t :
```

$$\alpha^2+\alpha+1+x+(\alpha^2+\alpha)\,x^2$$

```
Lambda:
```

$$\alpha^2+\alpha+1+x+(\alpha^2+\alpha)\,x^2$$

```
Gamma:
```

$$\alpha+(\alpha^2+\alpha+1)\,x$$

```
error word:
```

$$\alpha^2+1+(\alpha^2+\alpha+1)\,x^6$$

```
codeword  :
```

$$\alpha+x+\alpha^2 x^2+\alpha x^3+\alpha^2 x^4+(\alpha^2+\alpha+1)\,x^5+(\alpha^2+\alpha+1)\,x^6$$

```
syndrome  :
```

$$0$$

```
>
```