```
> restart;with(PDEtools):with(plots):with(LinearAlgebra):with
  (linalg):with(PolynomialTools):with(ListTools):
> n:=4;a:=-2;c:=-10;
```

$$n := 4$$

$$a := -2$$

$$c := -10 \tag{1}$$

```
> m:=(m,n)->expand(diff((1)/x^(n-1)*pochhammer(b,n-1)/m!,b$m)):
> A:=map(factor,Matrix([<seq(factor(expand(1/x^(i-1)*pochhammer(b,
  i-1))),i=1..n)>,seq(<seq(m(k,i),i=1..n)>,k=1..n-1)],n,shape=
  triangular[lower]));
```

$$A := \begin{bmatrix} 1 & 0 & 0 & 0 \\ \frac{b}{x} & \frac{1}{x} & 0 & 0 \\ \frac{b\,(b+1)}{x^2} & \frac{2\,b+1}{x^2} & \frac{1}{x^2} & 0 \\ \frac{b\,(b+1)\,(b+2)}{x^3} & \frac{3\,b^2+6\,b+2}{x^3} & \frac{3\,(b+1)}{x^3} & \frac{1}{x^3} \end{bmatrix} \tag{2}$$

```
> b:=-24:
> mu:=(b,k)->(simplify(x^b*simplify(sort(Beta(1-b-n+c, a+2-c-n+k)*
  hypergeom([a,-2+b+2*n-k],[c+n-1-k],x)*pochhammer(c+n-1-k,-a)
  /pochhammer(-2+b+2*n-k,-a)))));
> mu2 := (k) -> simplify(sort(x^b*simplify((-1)^a*Beta(-c-n+2+a+k,
  -b-n+1+c)*x^(-a)*hypergeom([a, -c-n+2+a+k], [3+a+k-b-2*n], 1/x)))
  ):
> phi:=expand(simplify(sort(hypergeom([a,b], [c], x))))*x^(b);mu(b-
  n+1,n-1)*x^(n-1);
```

$$\phi := \frac{1 - \frac{24}{5}\,x + \frac{92}{15}\,x^2}{x^{24}}$$

$$\frac{1}{411863760}\,\frac{92\,x^2 - 72\,x + 15}{x^{24}} \tag{3}$$

```
> H:=map(factor,HankelMatrix(<seq(mu2(i),i=0..2*n-2)>,n));phi:for K
  from 1 to n do;l[K]:=diff(%,x)*x*(x-1);od:wronskian([phi,seq(l
  [k],k=1..n-1)],x):for K from 1 to n do;h[K]:=Row(%,1);row(%%,2);
  wronskian(%*x*(x-1),x):od:T:=simplify(<seq(simplify(h[k]),k=1..n)
  >);
```

$$H := \left[\left[\frac{1}{2450448}\,\frac{51\,x^2 - 36\,x + 7}{x^{24}}, \frac{1}{23279256}\,\frac{171\,x^2 - 133\,x + 28}{x^{24}}, \right.\right.$$

$$\left.\left.\frac{1}{33256080}\,\frac{95\,x^2 - 80\,x + 18}{x^{24}}, \frac{1}{58198140}\,\frac{70\,x^2 - 63\,x + 15}{x^{24}}\right],\right.$$

$$\left.\left[\frac{1}{23279256}\,\frac{171\,x^2 - 133\,x + 28}{x^{24}}, \frac{1}{33256080}\,\frac{95\,x^2 - 80\,x + 18}{x^{24}},\right.\right.$$

$$\frac{1}{58198140}\ \frac{70x^2-63x+15}{x^{24}},\ \frac{1}{38798760}\ \frac{21x^2-20x+5}{x^{24}}\Bigg],$$
$$\Bigg[\frac{1}{33256080}\ \frac{95x^2-80x+18}{x^{24}},\ \frac{1}{58198140}\ \frac{70x^2-63x+15}{x^{24}},$$
$$\frac{1}{38798760}\ \frac{21x^2-20x+5}{x^{24}},\ \frac{1}{89237148}\ \frac{23x^2-23x+6}{x^{24}}\Bigg],$$
$$\Bigg[\frac{1}{58198140}\ \frac{70x^2-63x+15}{x^{24}},\ \frac{1}{38798760}\ \frac{21x^2-20x+5}{x^{24}},$$
$$\frac{1}{89237148}\ \frac{23x^2-23x+6}{x^{24}},\ \frac{1}{356948592}\ \frac{46x^2-48x+13}{x^{24}}\Bigg]\Bigg]$$

$$T:=\Bigg[\Bigg[\frac{1}{15}\ \frac{92x^2-72x+15}{x^{24}},\ -\frac{8}{15}\ \frac{(253x^2-207x+45)(x-1)}{x^{24}},\tag{4}$$
$$\frac{8}{15}\ \frac{(5313x^3-10120x^2+5796x-1080)(x-1)}{x^{24}},$$
$$-\frac{8}{15}\ \frac{(106260x^4-324093x^3+350152x^2-158148x+25920)(x-1)}{x^{24}}\Bigg],$$
$$\Bigg[-\frac{8}{15}\ \frac{(253x^2-207x+45)(x-1)}{x^{24}},$$
$$\frac{8}{15}\ \frac{(5313x^3-10120x^2+5796x-1080)(x-1)}{x^{24}},$$
$$-\frac{8}{15}\ \frac{(106260x^4-324093x^3+350152x^2-158148x+25920)(x-1)}{x^{24}},$$
$$\frac{8}{15}\ \frac{1}{x^{24}}\left((2018940x^5-8607060x^4+14159145x^3-11182600x^2+4233564x\right.$$
$$\left.-622080)(x-1)\right)\Bigg],$$
$$\Bigg[\frac{8}{15}\ \frac{(5313x^3-10120x^2+5796x-1080)(x-1)}{x^{24}},$$
$$-\frac{8}{15}\ \frac{(106260x^4-324093x^3+350152x^2-158148x+25920)(x-1)}{x^{24}},$$
$$\frac{8}{15}\ \frac{1}{x^{24}}\left((2018940x^5-8607060x^4+14159145x^3-11182600x^2+4233564x\right.$$
$$\left.-622080)(x-1)\right),\ -\frac{8}{15}\ \frac{1}{x^{24}}\left((x-1)\left(36340920x^6-201894000x^5\right.\right.$$
$$\left.\left.+455324100x^4-532176645x^3+339155608x^2-111679812x+14929920\right)\right)\Bigg],$$

$$\left[-\frac{8}{15}\ \frac{(106260\,x^4-324093\,x^3+350152\,x^2-158148\,x+25920)\,(x-1)}{x^{24}},\right.$$

$$\frac{8}{15}\ \frac{1}{x^{24}}\left((2018940\,x^5-8607060\,x^4+14159145\,x^3-11182600\,x^2+4233564\,x\right.$$

$$\left.-622080)\,(x-1)\right),\ -\frac{8}{15}\ \frac{1}{x^{24}}\left((x-1)\,(36340920\,x^6-201894000\,x^5\right.$$

$$\left.+455324100\,x^4-532176645\,x^3+339155608\,x^2-111679812\,x+14929920)\right),$$

$$\frac{8}{15}\ \frac{1}{x^{24}}\left((x-1)\,(617795640\,x^7-4288228560\,x^6+12487143900\,x^5-19750014900\,x^4\right.$$

$$\left.\left.+18297977313\,x^3-9918379240\,x^2+2912023836\,x-358318080)\right)\right]\Bigg]$$

```
> B:=map(factor,Matrix( n, n, (i,j)->expand(binomial(n-j,n-i)
  /pochhammer(c-b-i+1,i-j)/(x-1)^(i-1))));
```

$$B := \begin{bmatrix} 1 & 0 & 0 & 0 \\ \frac{3}{13\,(x-1)} & \frac{1}{x-1} & 0 & 0 \\ \frac{1}{52\,(x-1)^2} & \frac{1}{6\,(x-1)^2} & \frac{1}{(x-1)^2} & 0 \\ \frac{1}{1716\,(x-1)^3} & \frac{1}{132\,(x-1)^3} & \frac{1}{11\,(x-1)^3} & \frac{1}{(x-1)^3} \end{bmatrix} \tag{5}$$

```
> E:=Matrix( n, n, (i,j)->expand(Stirling1(j-1,i-1)));
```

$$E := \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & -1 & 2 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{6}$$

```
> map(factor,A.T.E.B);
```

$$\left[\left[-\frac{1}{13}\ \frac{46\,x^2-48\,x+13}{x^{24}}, -\frac{4\,(23\,x^2-23\,x+6)}{x^{24}}, -\frac{552}{5}\ \frac{21\,x^2-20\,x+5}{x^{24}},\right.\right. \tag{7}$$

$$\left.-\frac{4048}{5}\ \frac{70\,x^2-63\,x+15}{x^{24}}\right],$$

$$\left[\frac{32}{13}\ \frac{23\,x^2-23\,x+6}{x^{24}}, \frac{368}{5}\ \frac{21\,x^2-20\,x+5}{x^{24}}, \frac{2944}{5}\ \frac{70\,x^2-63\,x+15}{x^{24}},\right.$$

$$\left.\frac{56672}{5}\ \frac{95\,x^2-80\,x+18}{x^{24}}\right],$$

$$\left[-\frac{2576}{65}\ \frac{21\,x^2-20\,x+5}{x^{24}}, -\frac{5152}{15}\ \frac{70\,x^2-63\,x+15}{x^{24}}, -\frac{36064}{5}\ \frac{95\,x^2-80\,x+18}{x^{24}},\right.$$

$$\left[-\frac{113344\left(171x^2-133x+28\right)}{x^{24}} \right],$$

$$\left[\frac{10304}{65}\ \frac{70x^2-63x+15}{x^{24}}, \frac{18032}{5}\ \frac{95x^2-80x+18}{x^{24}}, \right.$$

$$\left. \frac{61824\left(171x^2-133x+28\right)}{x^{24}}, \frac{6460608\left(51x^2-36x+7\right)}{x^{24}} \right]\Bigg]$$