**gfun[poltodiffeq]** - determine the differential equation satisfied by a polynomial in holonomic functions

**Calling Sequence**

poltodiffeq(P, listdiffeq, list_unknowns, y(z))

**Parameters**

- **P** - polynomial in \(z\) and the (possibly differentiated) variables in \(\text{list\_unknowns}\)
- **listdiffeq** - list containing, for each of the variables in \(\text{list\_unknowns}\), either a linear differential equation or a set containing the equation together with initial conditions
- **list\_unknowns** - list of the unknowns \([y_1(z), y_2(z), ...]\), in the same order as in \(\text{listdiffeq}\)
- **y, z** - the name of the holonomic function and the generic variable

**Description**

- If \(y_1(z), y_2(z), ...\) are holonomic functions solutions of \(\text{listdiffeq}[1], \text{listdiffeq}[2], ..., \text{poltodiffeq}\) outputs a linear differential equation verified by \(P(z,y_1(z),...).\)

**Examples**

```
> with(gfun):
Sin:={diff(y1(z),z,z)=-y1(z),y1(0)=0,D(y1)(0)=1}:
Cos:={diff(y2(z),z,z)=-y2(z),y2(0)=1,D(y2)(0)=0}:
poltodiffeq(y1(z)^2+y2(z)^2,[Sin,Cos],[y1(z),y2(z)],y(z));

\[
\begin{align*}
D(y)(0) &= 0, y(0) = 1, D^2(y)(0) = 0, \frac{d^3}{dz^3} y(z) + 4 \left( \frac{d}{dz} y(z) \right) \\
\end{align*}
\]

(2.1)

> poltodiffeq(y1(z)^2+diff(y1(z),z)^2,[Sin],[y1(z)],y(z));

\[
\begin{align*}
\frac{d}{dz} y(z), y(0) = 1
\end{align*}
\]

(2.2)

**See Also**

- gfun, gfun[parameters], gfun[diffeq+diffeq], gfun[diffeq*diffeq], gfun[poltorec]