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> restart;with(linalg):with(LinearAlgebra):alias(sigma=sigma(t)):
> S3dash:=(t*diff(sigma,t,t))^2+(4*diff(sigma,t)^2-1)*(t*diff
(sigma,t)-sigma)+theta[0]*theta[2]*diff(sigma,t)-1/4*(theta[0]^2+
theta[2]^2);

$$S3dash := t^2 \left( \frac{\partial^2}{\partial t^2} \sigma \right)^2 + \left( 4 \left( \frac{\partial}{\partial t} \sigma \right)^2 - 1 \right) \left( t \left( \frac{\partial}{\partial t} \sigma \right) - \sigma \right) + \theta_0 \theta_2 \left( \frac{\partial}{\partial t} \sigma \right) - \frac{1}{4} \theta_0^2 - \frac{1}{4} \theta_2^2 \quad (1)$$

> n:=2;epsilon[1]:=1;epsilon[2]:=1;
n:=2
ε1:=1
ε2:=1
(2)
> K:=(n)->(ToeplitzMatrix(p,n)):
> U1:=seq(p[d+1]=psi[nu-n+d+1],d=0..2*n+1):
> Y:=seq(psi[nu-n+d]=psi(nu-n+d),d=0..2*n):
> psi:=(nu)->(t)^(epsilon[1]*nu/2)*(BesselJ(nu,2*sqrt(epsilon[1]*
epsilon[2]*t))):
> subs(U1,K(n));

$$\begin{bmatrix} \Psi_v & \Psi_{v-1} \\ \Psi_{v+1} & \Psi_v \end{bmatrix} \quad (3)$$

> tau:=t^(n*(n-1)/2)*det(subs(U1,Y,K(n))):
> sigma:=simplify(t*diff(ln(tau),t)+1/2*(epsilon[1]*epsilon[2]*t+
nu^2/2+n*(1-epsilon[1]*nu)-n^2/2)):

$$\sigma := \frac{1}{4} \left( 2 t^{3/2} \text{BesselJ}(v, 2 \sqrt{t})^2 + 2 t^{3/2} \text{BesselJ}(v+1, 2 \sqrt{t})^2 + \sqrt{t} \text{BesselJ}(v, 2 \sqrt{t})^2 v^2 \right. \\ \left. + \sqrt{t} \text{BesselJ}(v+1, 2 \sqrt{t})^2 v^2 - \text{BesselJ}(v, 2 \sqrt{t}) \text{BesselJ}(v+1, 2 \sqrt{t}) v^3 \right. \\ \left. - 2 t \text{BesselJ}(v, 2 \sqrt{t}) \text{BesselJ}(v+1, 2 \sqrt{t}) v + 4 \sqrt{t} \text{BesselJ}(v, 2 \sqrt{t})^2 \right) / \\ \left( \sqrt{t} \text{BesselJ}(v, 2 \sqrt{t})^2 + \sqrt{t} \text{BesselJ}(v+1, 2 \sqrt{t})^2 - \text{BesselJ}(v, 2 \sqrt{t}) \text{BesselJ}(v+1, 2 \sqrt{t}) v \right) \quad (4)$$

> theta[0]:=nu+n;theta[2]:=epsilon[1]*epsilon[2]*(nu-n);
θ0:=v+2
θ2:=v-2
(5)
> simplify(S3dash);
0
(6)

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