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% Function file for Nonlinear cstr plant
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```
function dedt = NLcstrplant(t,x,flag,paravec,u,d)
```

```
Vr = paravec(1);  
Tf = paravec(2);  
lambda = paravec(3);  
Cao = paravec(4);  
ko = paravec(5);  
E = paravec(6);  
R = paravec(7);  
rho = paravec(8);  
Cp = paravec(9);  
U = paravec(10);  
Aj = paravec(11);  
Vj = paravec(12);  
Tcin = paravec(13);  
rho_j = paravec(14);  
Cj = paravec(15);  
Ca_ss = paravec(16);  
Tr_ss = paravec(17);  
Tj_ss = paravec(18);  
F_ss = paravec(19);  
Fj_ss = paravec(20);
```

```
Ca_dev = x(1);  
Tr_dev = x(2);  
Tj_dev = x(3);
```

```
% steady state plus deviation for all variables
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```
Ca = Ca_ss + Ca_dev;  
Tr = Tr_dev + Tr_ss;  
Tj = Tj_dev + Tj_ss;  
Fj = u + Fj_ss;  
F = d + F_ss;
```

```
% Ca cannot be less than zeros
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```
if Ca <=0  
    Ca = 0;  
end
```

```
% Plant equations
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```
dCdt = (F/Vr)*(Cao -Ca) - Vr*Ca*ko*exp((-E)/(R*Tr));  
dTrdt = (F/Vr)*(Tf-Tr) - (lambda*Ca*ko*exp((-E)/(R*Tr)))/(rho*Cp) - (U*Aj*(Tr-Tj))/(Vr*rho*Cp);  
dTjdt = (Fj/Vj)*(Tcin-Tj) + (U*Aj*(Tr-Tj))/(Vj*rho_j*Cj);  
dedt = [dCdt;dTrdt;dTjdt];  
end
```