
Cauchy-Euler and Cauchy-Legendre method

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clc
clear all
syms x r c1 c2 t
k1=input('Enter the coefficient of (ax+b)^2 * d2y/dx^2 : ');
k2=input('Enter the coefficient of (ax+b) * dy/dx : ');
k3=input('Enter the coefficient of y : ');
a=input('Enter the value of a : ');
b=input('Enter the value of b : ');
f1=input('Enter f in terms of x : ');
f=simplify(subs(f1,x,(exp(t)-b)/a));
eq=k1*a^2*r^2+(a*k2-a^2*k1)*r+k3;
r=solve(eq,r);
p=real(r(1));
q=imag(r(1));
if q~=0
    y1=exp(p*t)*cos(q*t);
    y2=exp(p*t)*sin(q*t);
elseif r(1)==r(2)
    y1=exp(p*t);
    y2=t*exp(p*t);
else
    y1=exp(r(1)*t);
    y2=exp(r(2)*t);
end
yc=c1*y1+c2*y2;
w=y1*diff(y2,t)-y2*diff(y1,t);
yp=-y1*int(y2*f/(a^2*k1*w),t)+y2*int(y1*f/(a^2*k1*w),t);
yy=yc+yp;
y=subs(yy,t,log(a*x+b));
disp('General solution of the given ODE :- ')
disp(simplify(y))
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%The following code is for solving the equation with given values.
a1=input('Enter the initial value : ');
c=input('Enter the value of y(a1) : ');
d=input('Enter the value of Dy(a1) : ');
eq1=subs(y,x,a1)-c;
eq2=subs(diff(y),x,a1)-d;
[c1 c2]=solve(eq1,eq2);
y=subs(y);
disp('Solution of the initial value problem : ')
disp(y)
ezplot(y)
```

Problem -1 :-

Enter the coefficient of $(ax+b)^2 * d^2y/dx^2$: 1

Enter the coefficient of $(ax+b) * dy/dx$: -1

Enter the coefficient of y : 1

Enter the value of a : 1

Enter the value of b : 0

Enter f in terms of x : $\log(x)$

General solution of the given ODE :-

$\log(x) + c_1*x + c_2*x*\log(x) + 2$

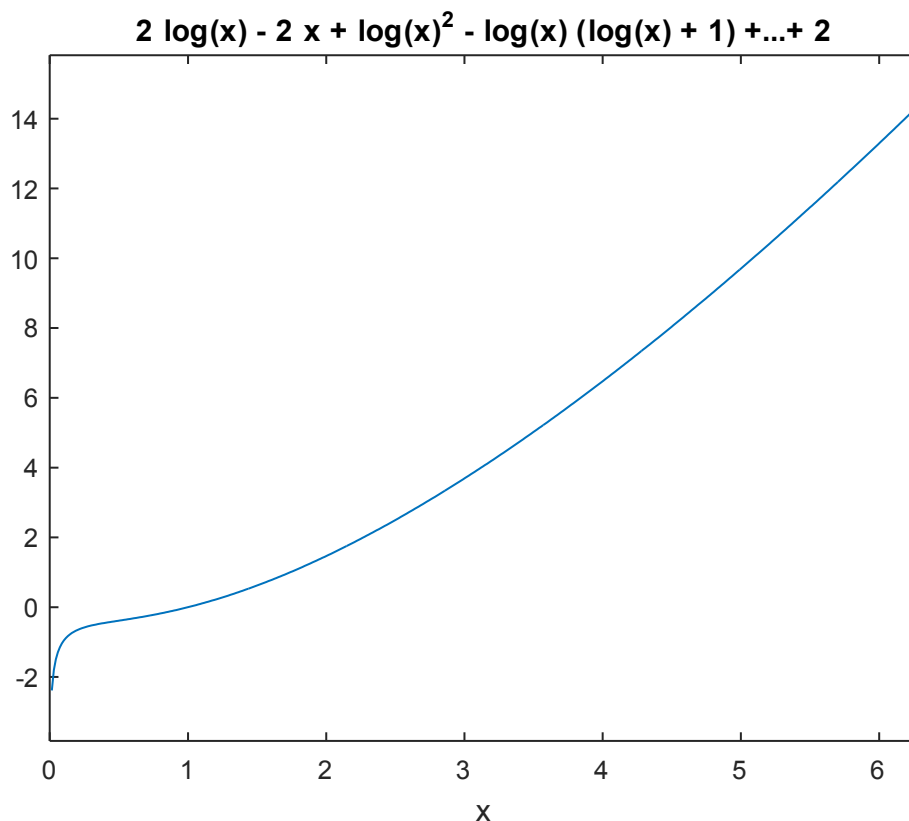
Enter the initial value : 1

Enter the value of $y(a_1)$: 0

Enter the value of $Dy(a_1)$: 1

Solution of the initial value problem :

$2*\log(x) - 2*x + \log(x)^2 - \log(x)*(\log(x) + 1) + 2*x*\log(x) + 2$



Problem -2 :-

Enter the coefficient of $(ax+b)^2 * d^2y/dx^2$: 1
Enter the coefficient of $(ax+b) * dy/dx$: -1
Enter the coefficient of y : -12
Enter the value of a : 1
Enter the value of b : 0
Enter f in terms of x : $6*x$
General solution of the given ODE :-
 $(x^{(1 - 13^{(1/2)})}) * (13*c1 - 6*x^{(13^{(1/2)})}) + 13*c2*x^{(2*13^{(1/2)})})/13$

Problem -3 :-

Enter the coefficient of $(ax+b)^2 * d^2y/dx^2$: 1
Enter the coefficient of $(ax+b) * dy/dx$: 3
Enter the coefficient of y : -36
Enter the value of a : 1
Enter the value of b : 0
Enter f in terms of x : $3*x^2-4*x+1$
General solution of the given ODE :-
 $(2772*c1 - 77*x*x^{(37^{(1/2)})}) + 2772*c2*x^{(2*37^{(1/2)})} + 336*x^{(37^{(1/2)})}*x^2 - 297*x^{(37^{(1/2)})}*x^3)/(2772*x^{(37^{(1/2)})} + 1)$