ME627 Assignment 6

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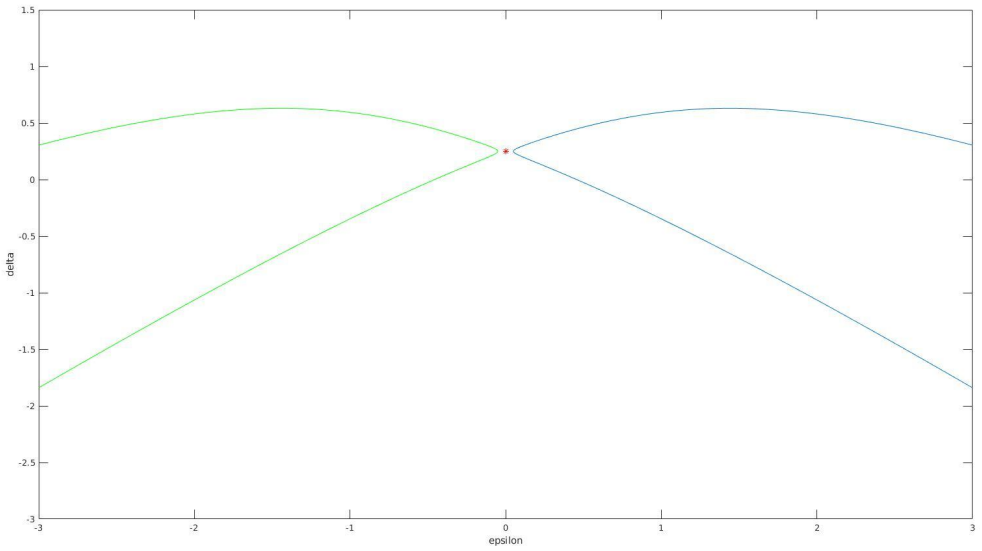
Q.1

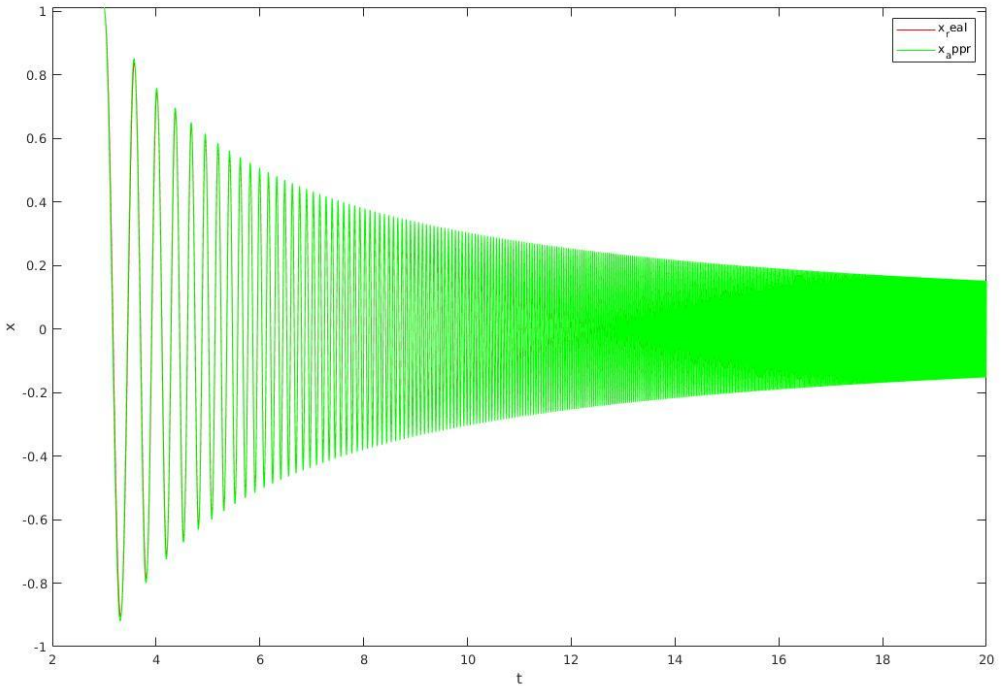


Matlab Code:

```
%function for Mathieu Eqn

function xdot=mathieu1(t,x)
global alpha delta1
delta=delta1; epsilon=alpha;
c=0.05;

xdot = [x(2); -(delta+epsilon*cos(t))*x(1)-c*x(2)];

% Plot Boundaries
clc;
clear all;
close all;
format long;
E = eye(2);
op =odeset('reltol',1e-12,'abstol',1e-12);
for k=1:2
    [t,x]=ode45('mathieu',[0,2*pi],E(:,k),op);
    E(:,k) = x(end,:)';
end
E
abs(eig(E))
[v,d]=eig(E)
```

```
prod(diag(d))

[t,x]=ode45('mathieu',[0,100*pi],v(:,1),op);

figure(1)
plot(t,x)
legend('x1','x2')
xlabel('t')
ylabel('x')

figure(2)
semilogy(t,abs(x))
xlabel('t')
ylabel('log(x)')

x0 = x(end,:)';
x0=x0/norm(x0);
```

Q.2



Maple Code:

```
> restart:
> de := diff(x(t), t, t) + t^4 * x(t); tau1 := 1/3 * t^3;
```

$$de := \frac{d^2}{dt^2} x(t) + t^4 x(t)$$

$$\tau 1 := \frac{t^3}{3}$$

```
> xdot := diff(x(tau), tau) * diff(tau1, t);
```

$$xdot := \left(\frac{d}{d\tau} x(\tau)\right) t^2$$

```
> xddot := diff(xdot, t) + diff(xdot, tau) * diff(tau1, t);
```

$$xddot := 2\left(\frac{d}{d\tau} x(\tau)\right) t + \left(\frac{d^2}{d\tau^2} x(\tau)\right) t^4$$

```
> dea := xddot + t^4 * x(tau);
```

$$dea := 2\left(\frac{d}{d\tau} x(\tau)\right) t + \left(\frac{d^2}{d\tau^2} x(\tau)\right) t^4 + t^4 x(\tau)$$

```
> dea := subs(t = (3*tau)^(1/3), dea);
```

$$dea := 2\left(\frac{d}{d\tau} x(\tau)\right) 3^{1/3} \tau^{1/3} + 3\left(\frac{d^2}{d\tau^2} x(\tau)\right) 3^{1/3} \tau^{4/3} + 3\, 3^{1/3} \tau^{4/3} x(\tau)$$

```
> deb := diff(x(tau), tau, tau) - solve(dea, diff(x(tau), tau, tau));
```

$$deb := \frac{d^2}{d\tau^2} x(\tau) + \frac{3\tau x(\tau) + 2\frac{d}{d\tau} x(\tau)}{3\tau}$$

```
> simplify(%);
```

$$\frac{d^2}{d\tau^2} x(\tau) + \frac{\tau x(\tau) + \frac{2\frac{d}{d\tau} x(\tau)}{3}}{\tau}$$

```
> expand(%);
```

$$\frac{d^2}{d\tau^2} x(\tau) + x(\tau) + \frac{2\left(\frac{d}{d\tau} x(\tau)\right)}{3\tau}$$

```
> deb := %;
```

$$deb := \frac{d^2}{d\tau^2} x(\tau) + x(\tau) + \frac{2\left(\frac{d}{d\tau} x(\tau)\right)}{3\tau}$$

```
> xs := x(tau) = 1/(tau^(1/3)) * y(tau);
```

$$xs := x(\tau) = \frac{y(\tau)}{\tau^{1/3}}$$

```
> dec := expand(subs(xs, deb));
```

$$dec := \frac{2\,y(\tau)}{9\,\tau^{7/3}} + \frac{\frac{d^2}{d\tau^2} y(\tau)}{\tau^{1/3}} + \frac{y(\tau)}{\tau^{1/3}}$$

```
> dec := diff(y(tau), tau$2) - solve(dec, diff(y(tau), tau$2));
```

$$dec := \frac{d^2}{d\tau^2} y(\tau) + \frac{y(\tau)\left(9\,\tau^2 + 2\right)}{9\,\tau^2}$$

```
> expand(%);
```

$$\frac{d^2}{d\tau^2} y(\tau) + y(\tau) + \frac{2\,y(\tau)}{9\,\tau^2}$$

Matlab Code:

```
% function for WKB approx

function xdot = wkb2(t,x)

xdot = [x(2);-x(1)*t^4];

% Run COntinuation

clc;
close all;
clear all;
op = odeset('reltol',1e-12,'abstol',1e-12);
[t,x] = ode45('wkb2',[3,20],[1;0],op);
figure(1)
%plot(t,x(:,1),'r');

tau = (1/3)*t.^(3);
xa=2.11*(1./tau.^(1/3)).*sin(tau-1.1);

plot(t,x(:,1),'r',t,xa,'g');
xlabel('t')
ylabel('x')
legend('x_real','x_appr')
```