```
AT = 3;
Ao = 0.05;
Cd = 0.7;
g  = 9.81;
Tc = 10;
Th = 90;
h_bar  = 1;
T_bar  = 75;
u1_bar = 0.029;
u2_bar = 0.126;
x_bar = [h_bar; T_bar];

tspan = [0 100];

x0 = [1.10; 81.5];
dx0 = x0 - x_bar;

u1 = @(t) (t<=25).*0.022 + (t>25).*0.043;
u2 = @(t) (t<=60).*0.14  + (t>60).*0.105;

du1 = @(t) u1(t) - u1_bar;
du2 = @(t) u2(t) - u2_bar;

nonlinear = @(t,x) [
    (1/AT)*( u1(t) + u2(t) - Cd*Ao*sqrt(2*g*x(1)) );
    (1/(x(1)*AT))*( u1(t)*(Tc-x(2)) + u2(t)*(Th-x(2)) )
];

A = [-0.0258   0;
      0      -0.0517];

B = [ 0.333   0.333;
     -21.67   5.00 ];

linear = @(t,dx) A*dx + B*[du1(t); du2(t)];
[t1, x_nl] = ode45(nonlinear, tspan, x0);
[t2, dx_l] = ode45(linear, tspan, dx0);

x_l = dx_l + x_bar';
figure;

subplot(2,1,1)
plot(t1, x_nl(:,1), 'b', 'LineWidth',2); hold on
plot(t2, x_l(:,1), 'r--', 'LineWidth',2)
xlabel('Time'); ylabel('Meters')
title('Water Height: Actual (solid) and Linearization (dashed)')
legend('Actual','Linearized')
grid on

subplot(2,1,2)
```

```
plot(t1, x_nl(:,2), 'b', 'LineWidth',2); hold on
plot(t2, x_l(:,2), 'r--', 'LineWidth',2)
xlabel('Time'); ylabel('Degrees')
title('Water Temp: Actual (solid) and Linearization (dashed)')
legend('Actual','Linearized')
grid on
```