Homework 8

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Problem 1: Fig 6.10:

```
ClearAll["Global`*"];
speed = 300.0; x0 = 0.45; kk = 1000;  dx = 1/100; iMax = 1/dx;
nMax = 1000; dt = dx/(4*speed); rr = (speed dt)/dx;
(*for epsilon =0.00001*)
ϵ = (0.00001);  M = 1/dx;
y[i_] := Exp[-kk (i dx - x0)^2]
ymat = ConstantArray[0, {nMax, iMax + 1}];
ymat[[1]] = Table[y[i], {i, 1, Length[ymat[[1]]]}];
ymat[[2]] = ymat[[1]];

Do[Do[ymat[[All, 1]] = 0;
  ymat[[n, i]] = (2 (1 - rr^2) - 6 * ϵ * (rr^2) * (M^2)) * ymat[[n - 1, i]] -
    ymat[[n - 2, i]] + rr^2 * (1 + 4 * ϵ * M^2) * (ymat[[n - 1, i + 1]] + ymat[[n - 1, i - 1]]) -
    ϵ * (rr^2) * (M^2) * (ymat[[n - 1, i + 2]] + ymat[[n - 1, i - 2]]);
  ymat[[All, iMax + 1]] = 0;, {i, 3, iMax - 1}], {n, 3, nMax}]

ft = Abs[Fourier[ymat[[All, iMax - 5]]]]^2;
datf = Table[{(k - 1)/(nMax dt), ft[[k]]}, {k, 1, nMax/2 - 1}];
pl1 = ListPlot[datf, PlotRange → {{0, 3000}, {0, 2}}, Joined → True,
  AxesLabel → {"f (Hz)", "Power (a.u.)"}, PlotStyle → {Dotted}];
pl11 = ListPlot[datf, PlotRange → {{1500, 3000}, {0, 2}}, Joined → True,
   AxesLabel → {"f (Hz)", "Power (a.u.)"}, PlotStyle → {Dotted}];

(*for epsilon =2*0.00001*)

ϵ2 = (2 * 0.00001);
y2[i_] := Exp[-kk (i dx - x0)^2]
ymat2 = ConstantArray[0, {nMax, iMax + 1}];
ymat2[[1]] = Table[y[i], {i, 1, Length[ymat[[1]]]}];
ymat2[[2]] = ymat2[[1]];

Do[Do[ymat2[[All, 1]] = 0;
  ymat2[[n, i]] = (2 (1 - rr^2) - 6 * ϵ2 * (rr^2) * (M^2)) * ymat2[[n - 1, i]] - ymat2[[n - 2, i]] +
    rr^2 * (1 + 4 * ϵ2 * M^2) * (ymat2[[n - 1, i + 1]] + ymat2[[n - 1, i - 1]]) -
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        ϵ2 * (rr^2) * (M^2) * (ymat2[[n - 1, i + 2]] + ymat2[[n - 1, i - 2]]);
    ymat2[[All, iMax + 1]] = 0, {i, 3, iMax - 1}], {n, 3, nMax}]

ft2 = Abs[Fourier[ymat2[[All, iMax - 5]]]]^2;
datf2 = Table[{(k - 1) / (nMax dt), ft2[[k]]}, {k, 1, nMax / 2 - 1}];
pl2 = ListPlot[datf2, PlotRange → {{0, 3000}, {0, 2}}, Joined → True,
   AxesLabel → {"f (Hz)", "Power (a.u.)"}, PlotStyle → {DotDashed}];
pl22 = ListPlot[datf2, PlotRange → {{1500, 3000}, {0, 2}}, Joined → True,
    AxesLabel → {"f (Hz)", "Power (a.u.)"}, PlotStyle → {DotDashed}];

(*case for zero stiffness*)
ymat3 = ConstantArray[0, {nMax, iMax + 1}];
ymat3[[1]] = Table[y[i], {i, 1, Length[ymat3[[1]]]}];
ymat3[[2]] = ymat[[1]];

Do[Do[ymat3[[n, i]] = 2 (1 - rr²) ymat3[[n - 1, i]] - ymat3[[n - 2, i]] +
      rr² (ymat3[[n - 1, i + 1]] + ymat3[[n - 1, i - 1]]), {i, 2, iMax}], {n, 3, nMax}]
ft3 = Abs[Fourier[ymat3[[All, iMax - 5]]]]^2;
datf3 = Table[{(k - 1) / (nMax dt), ft3[[k]]}, {k, 1, nMax / 2 - 1}];
pl3 = ListPlot[datf3, PlotRange → {{0, 3000}, {0, 2}},
    Joined → True, AxesLabel → {"f (Hz)", "Power (a.u.)"}];
pl33 = ListPlot[datf3, PlotRange → {{1500, 3000}, {0, 2}},
    Joined → True, AxesLabel → {"f (Hz)", "Power (a.u.)"}];

Show[pl1, pl2, pl3]
Show[pl11, pl22, pl33]
```
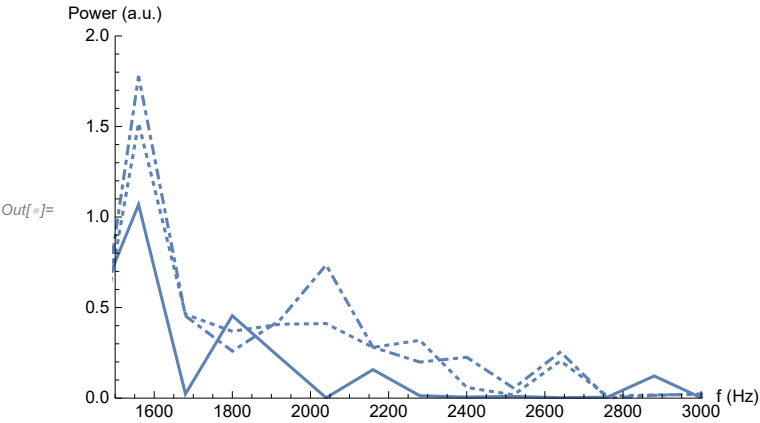
Out[ ]=
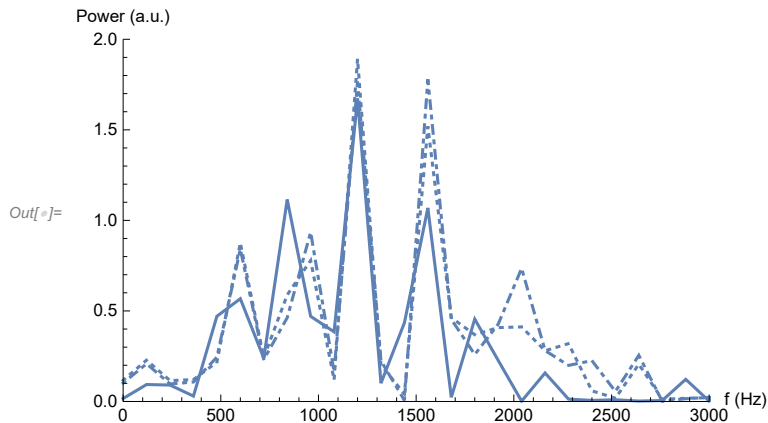
Problem 2

```
In[ ]:= ClearAll["Global`*"]
       speed = 330.0; x0 = 0.31; kk = 1000; dx = 1/150; iMax = IntegerPart[0.62/dx];
       nMax = 1000; dt = dx/(4*speed); rr = (speed dt)/dx;
       ε = 3.8*(10^(-5));  M = 0.62/dx;
       b = 0.5;
       y[i_] := Exp[-kk (i dx - x0)^2]
       ymat = ConstantArray[0, {nMax, iMax + 1}];
       ymat[[1]] = Table[y[i], {i, 1, Length[ymat[[1]]]}];
       ymat[[2]] = ymat[[1]];
       ymat[[1, 1]] = 0;
       ymat[[2, 1]] = 0;
       ymat[[1, iMax + 1]] = 0;
       ymat[[2, iMax + 1]] = 0;
       Do[
        Do[ymat[[n, i]] = ((2 (1 - rr^2) - (6*ε*(rr^2)*(M^2)))/(1 + b*dt))*ymat[[n - 1, i]] +
          ((-1 + b*dt)/(1 + b*dt))*ymat[[n - 2, i]] +
          ((rr^2*(1 + 4*ε*M^2))/(1 + b*dt))*(ymat[[n - 1, i + 1]] + ymat[[n - 1, i - 1]]) +
          ((-ε*(rr^2)*(M^2))/(1 + b*dt))*(ymat[[n - 1, i + 2]] + ymat[[n - 1, i - 2]]),
         {i, 3, iMax - 1}], {n, 3, nMax}]
       ymat // MatrixForm
       signal = Table[{n dt, ymat[[n, 6]]}, {n, 1, nMax}];
       ListPlot[signal, Joined → True, PlotRange → All];
       Manipulate[
        ListPlot[Table[ymat[[n]], {n, 1, nMax}, Joined → True, PlotRange → All]], {n, 1, nMax}]
       (* Don't know why manipulate don't work. but I have
        plotted manualy differnt instances of time*)

       ListPlot[ymat[[50]], Joined → True, PlotRange → All]
       ListPlot[ymat[[100]], Joined → True, PlotRange → All]
       ListPlot[ymat[[200]], Joined → True, PlotRange → All]
       ListPlot[ymat[[300]], Joined → True, PlotRange → All]
       ListPlot[ymat[[400]], Joined → True, PlotRange → All]
       ListPlot[ymat[[500]], Joined → True, PlotRange → All]
       ListPlot[ymat[[600]], Joined → True, PlotRange → All]
       ListPlot[ymat[[700]], Joined → True, PlotRange → All]
       ListPlot[ymat[[800]], Joined → True, PlotRange → All]
       ListPlot[ymat[[900]], Joined → True, PlotRange → All]
       ListPlot[ymat[[950]], Joined → True, PlotRange → All]
       ListPlot[ymat[[960]], Joined → True, PlotRange → All]
       ListPlot[ymat[[970]], Joined → True, PlotRange → All]
       ListPlot[ymat[[990]], Joined → True, PlotRange → All]
       ListPlot[ymat[[999]], Joined → True, PlotRange → All]
```
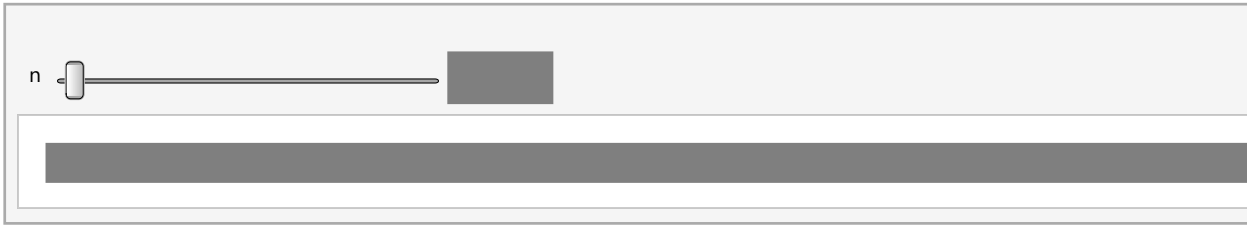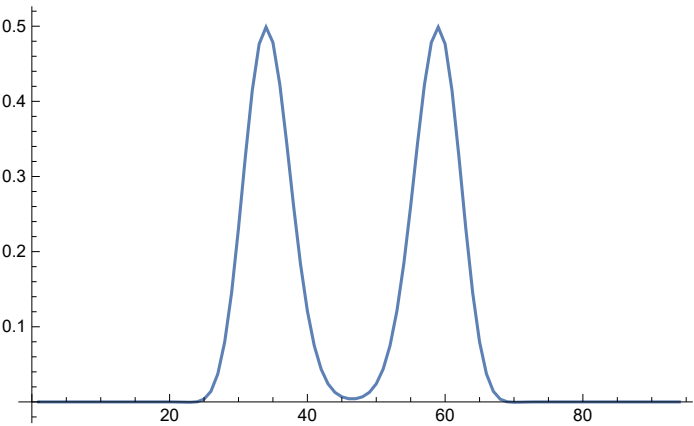
Out[●]//MatrixForm=

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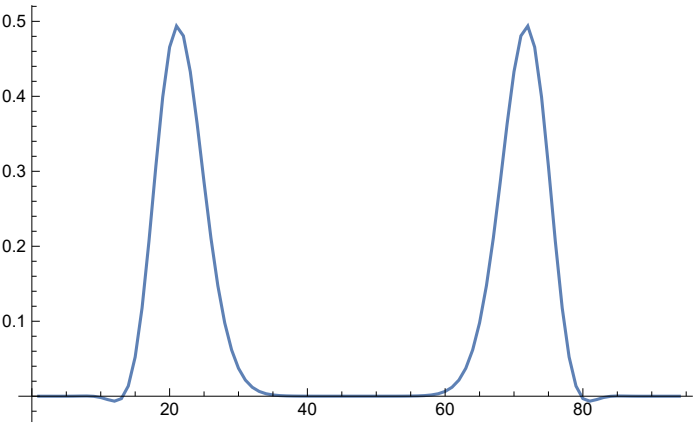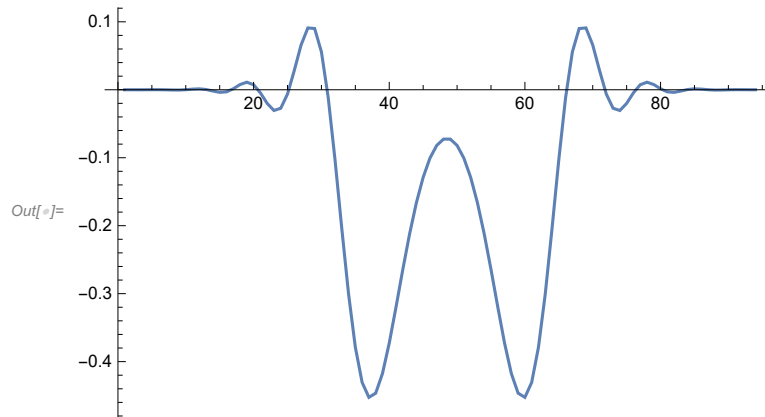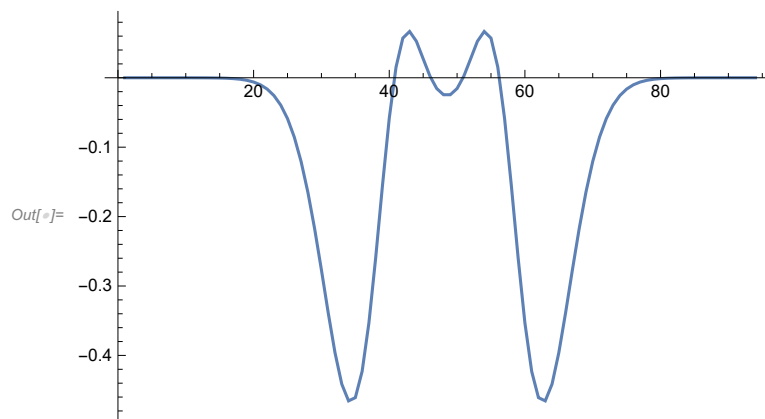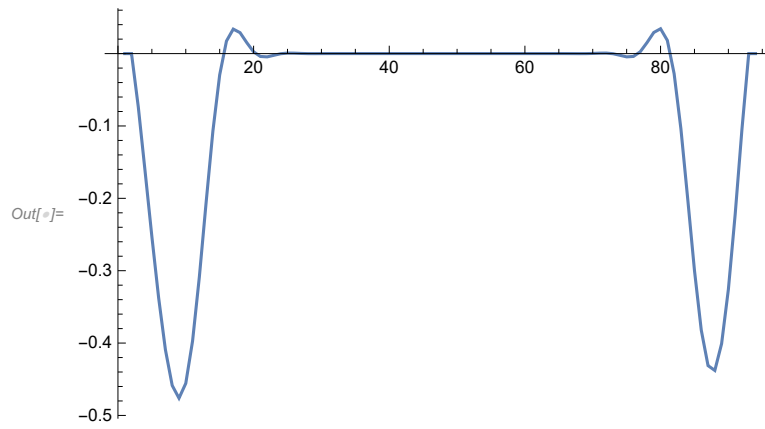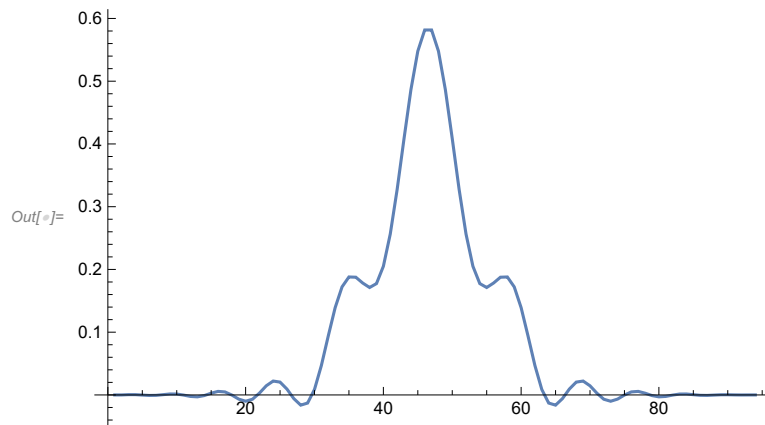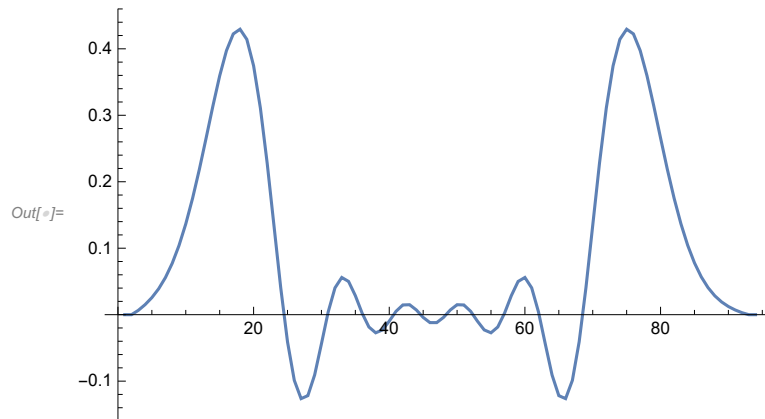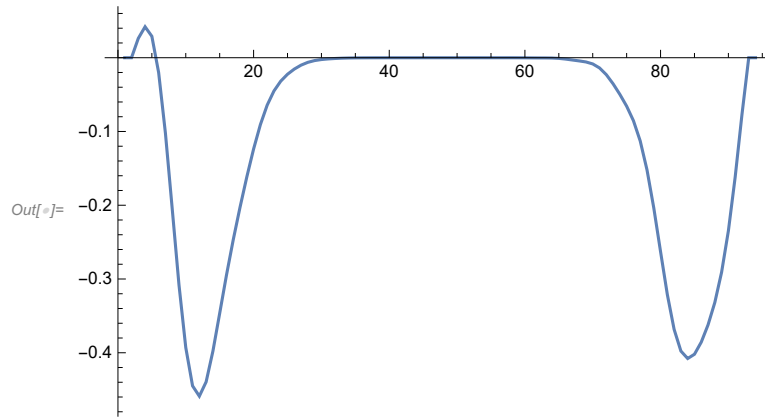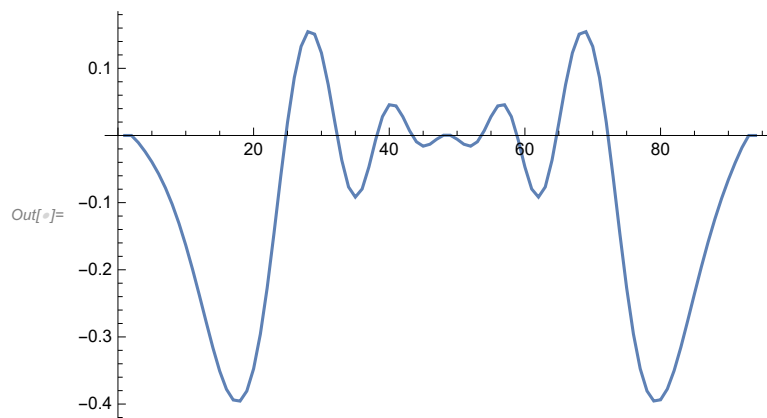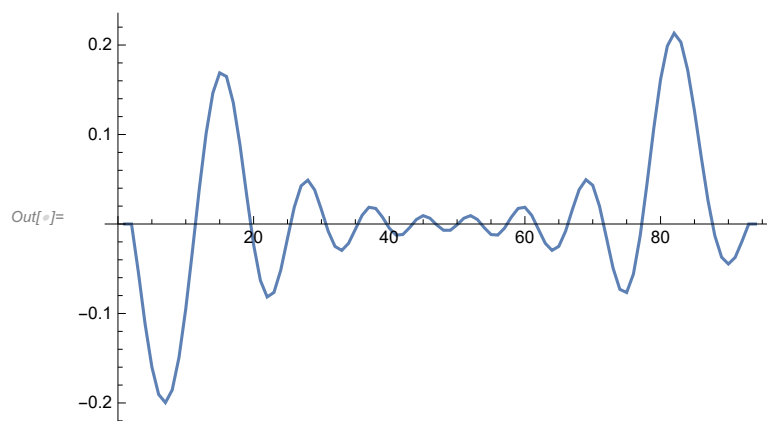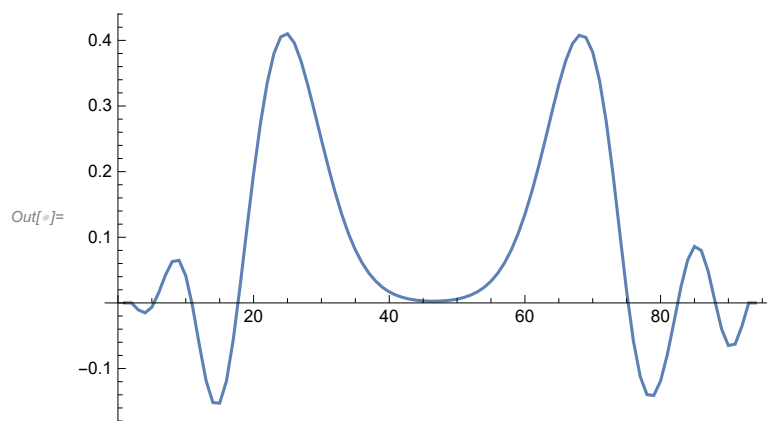
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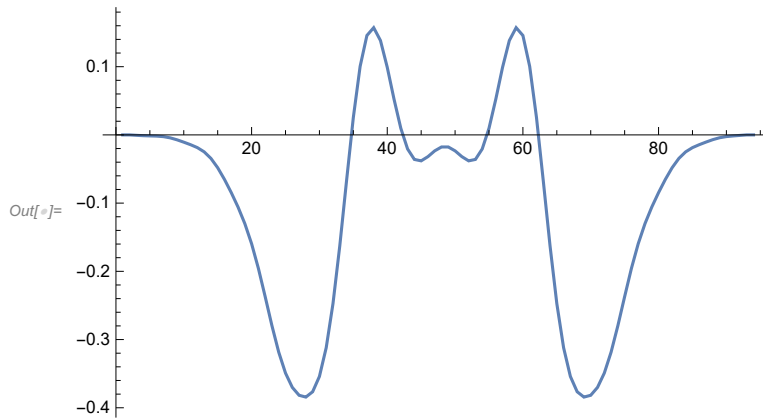Out[●]=
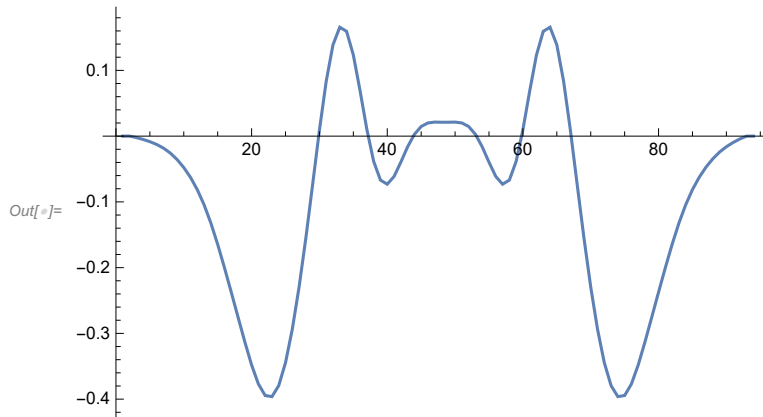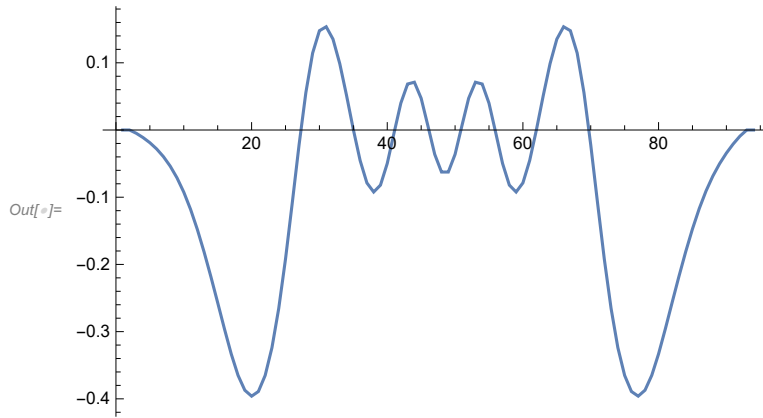
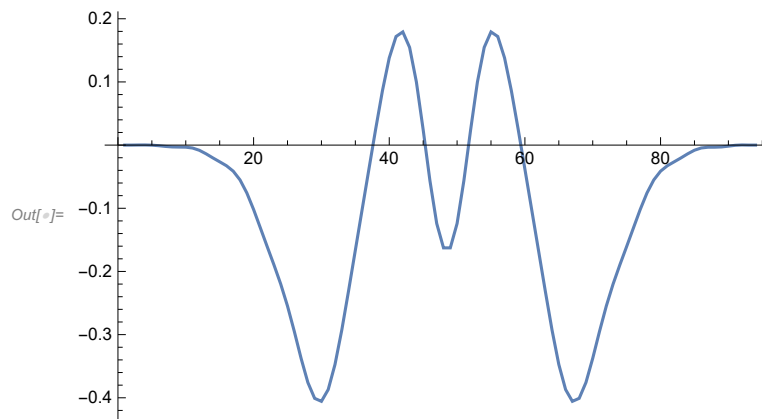

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Table: Non–list iterator Joined → True at position 3 does not evaluate to a real numeric value.

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General: Further output of Table::nliter will be suppressed during this calculation.

ListPlot: Table[ymat⟦FE`n$$68⟧, {FE`n$$68, 1., nMax}, Joined → True, PlotRange → All] is not a list of numbers or pairs of numbers.