ج بخش-۳ شماره تمرین

```
Sum[r^(2 n) e^(i 2 n k L), {n, 0, ∞}]
```

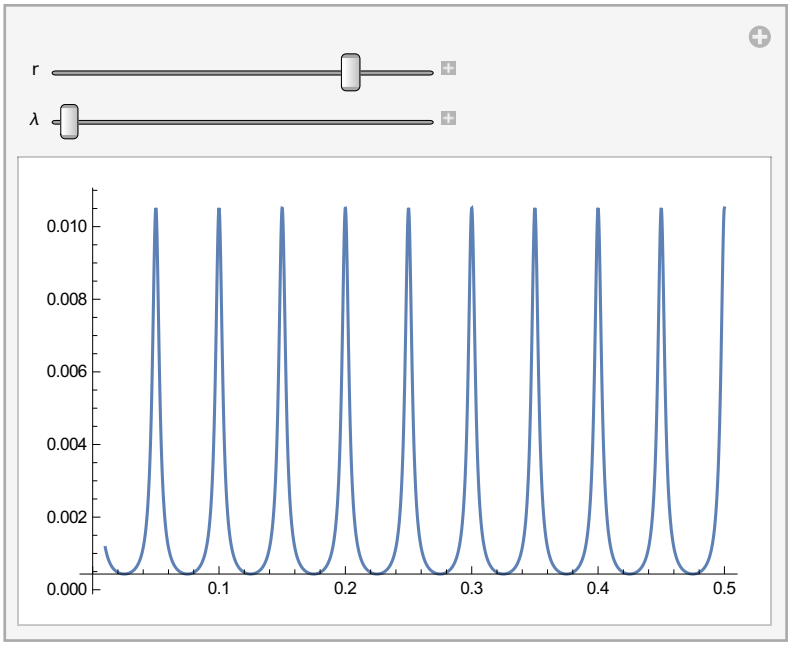
$$-\frac{1}{-1+e^{2 i k L} r^2}$$

```
Sum[α^n, {n, 0, ∞}]
```

$$\frac{1}{1-\alpha}$$

ورودی موج طول و انعکاس ضریب مقدار توانید می زیر نموداردر

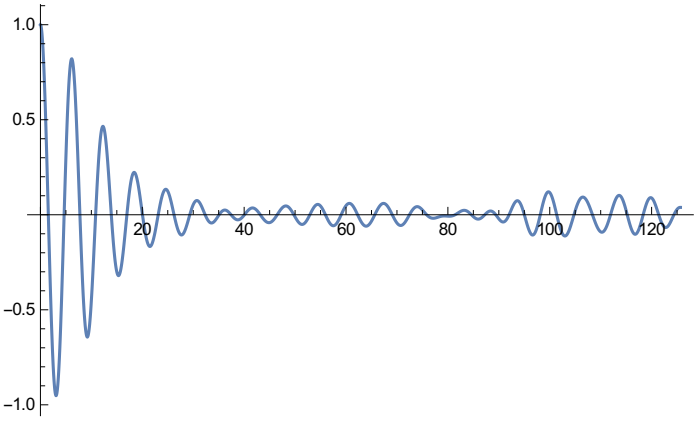
```
Manipulate[With[{k = 2 π / λ},
  Plot[Abs[(1 - r)^2 / (-1 + e^(2 i k L) r^2)]^2, {L, .1 λ, 5 λ}, PlotRange → {All, All}]], {r, 0, 1}, {λ, .1, 1}]
```



الف بخش-۴ سوال

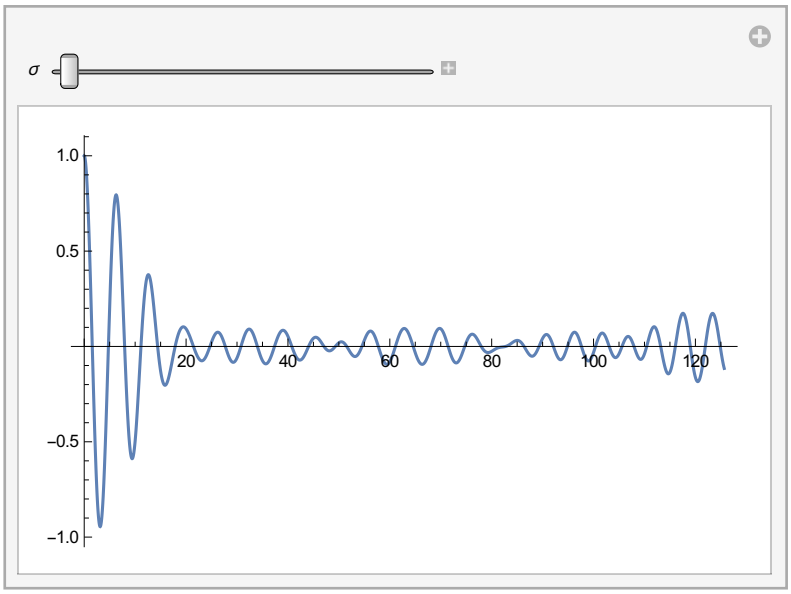
```
nLight = 100; ω0 = 1; dωratio = .1;

ωlist = Table[RandomVariate[NormalDistribution[ω0, dωratio * ω0]] , nLight];

ϕlist = Table[RandomVariate[NormalDistribution[ϕ0, dϕratio * ϕ0]], nLight];
```

```
Plot[1 / nLight * Total[Table[Cos[ωlist[[i]] t(*+ϕlist[[i]]*)], {i, 1, nLight}]],
 {t, 0, 40 π}, PlotRange → All]
```



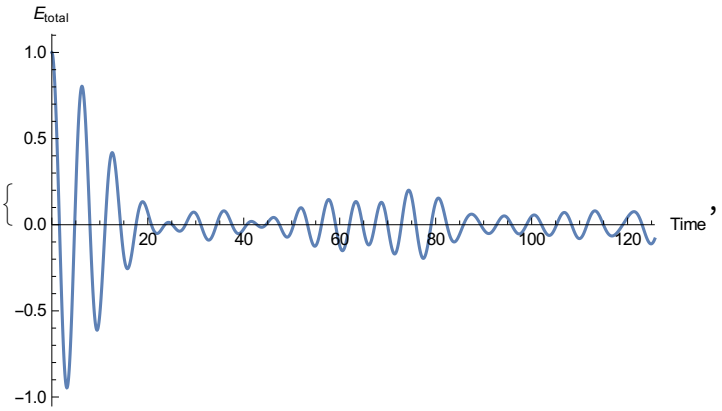
Here you can change σ dynamically and see how that affects the coherence time.

```
Manipulate[
 With[{ωlist = Table[RandomVariate[NormalDistribution[ω0, dωratio * ω0]] , nLight] },
  Plot[1 / nLight * Total[Table[Cos[ωlist[[i]] t], {i, 1, nLight}]],
   {t, 0, 40 π}, PlotRange → All]], {{dωratio, .1, "σ"}, .1, 1}]
```

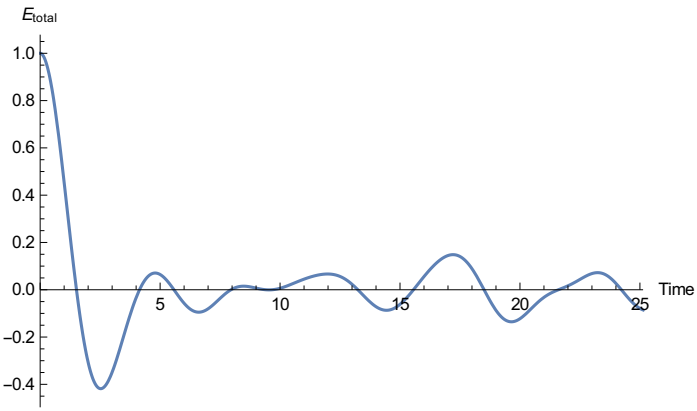


Net electric field as a function of time for different values of σ

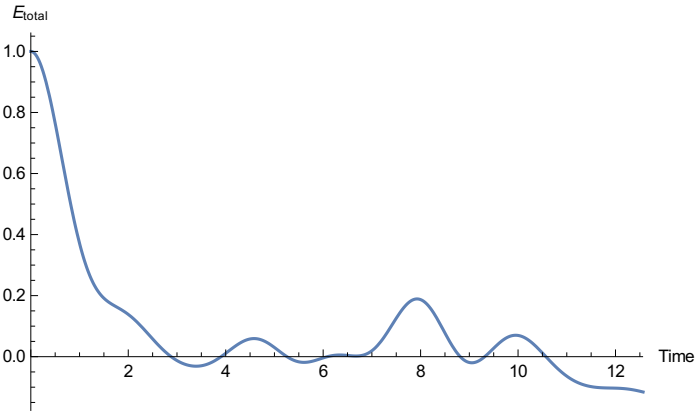
```
Table[
 With[{ωlist = Table[RandomVariate[NormalDistribution[ω0, dωratio * ω0]] , nLight] },
  Plot[1 / nLight * Total[Table[Cos[ωlist[[i]] t], {i, 1, nLight}]],
   {t, 0, 40 π / 10 / dωratio}, PlotRange → {{0, 40 π / 10 / dωratio}, All},
   ImageSize → Medium, AxesLabel → {"Time", "E_total"}]], {dωratio, {.1, .5, 1, 2, 5}}]
```


E_{total}
1.0
0.5
0.0
−0.5
−1.0
20
40
60
80
100
120
Time

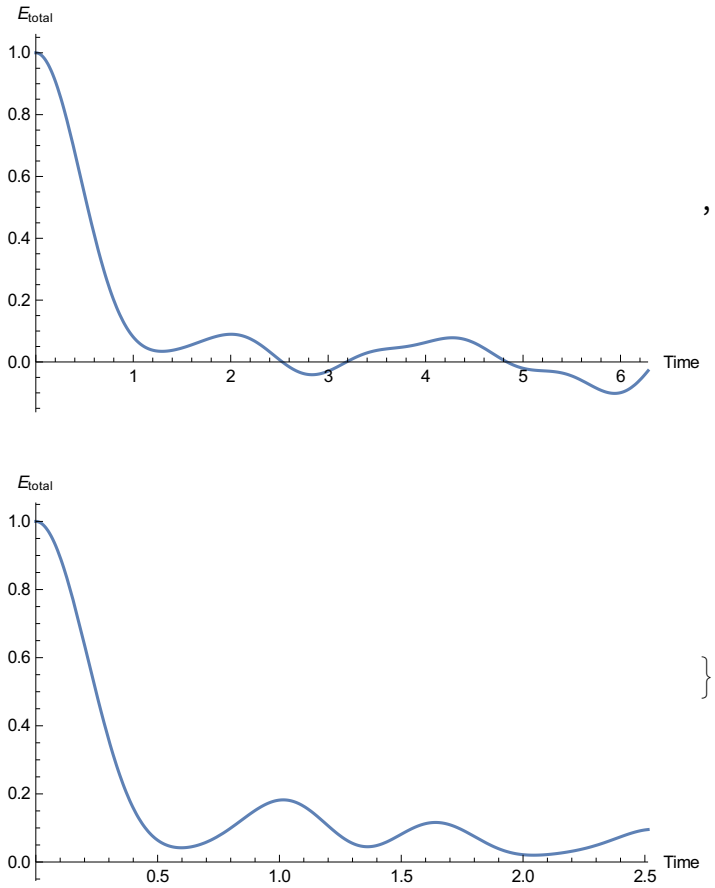
,


E_{total}
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
5
10
15
20
25
Time

,

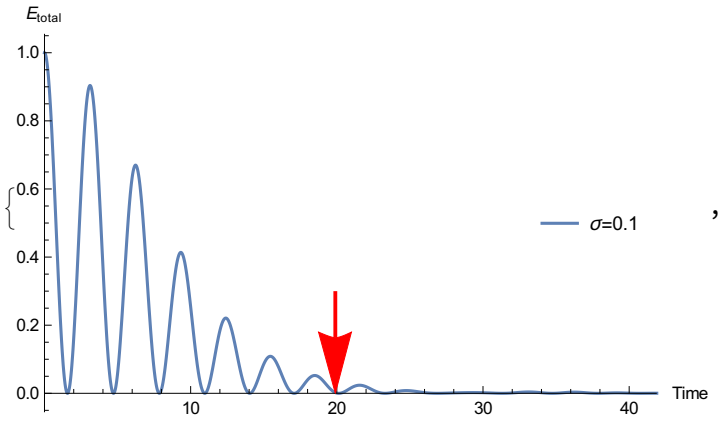

E_{total}
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
10
12
Time

,

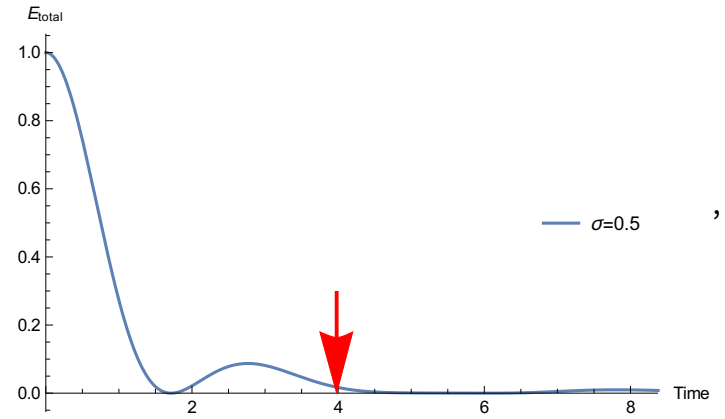


Light intenity as a function of time for different values of σ

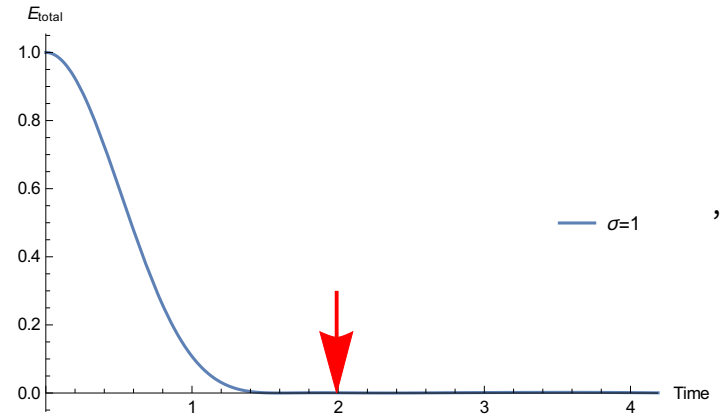
```
Table[
 With[{ωlist = Table[RandomVariate[NormalDistribution[ω0, dωratio * ω0]] , nLight] },
  Plot[Abs[1 / nLight * Total[Table[Cos[ωlist[[i]] t], {i, 1, nLight}]]]^2,
   {t, 0, 40 π / 30 / dωratio}, PlotRange → {{0, 40 π / 30 / dωratio}, All},
   ImageSize → Medium, PlotLegends → Placed[{"σ=" <> ToString[dωratio]},
     {Right, Center}], AxesLabel → {"Time", "E_total"},
   Epilog → {Arrowheads[.1], Thick, Red, Arrow[{{19 π / 30 / dωratio, .3},
       {19 π / 30 / dωratio, 0}}]}]], {dωratio, {.1, .5, 1, 2, 5}}]
```


E_{total}
1.0
0.8
0.6
0.4
0.2
0.0
10
20
30
40
Time
σ=0.1

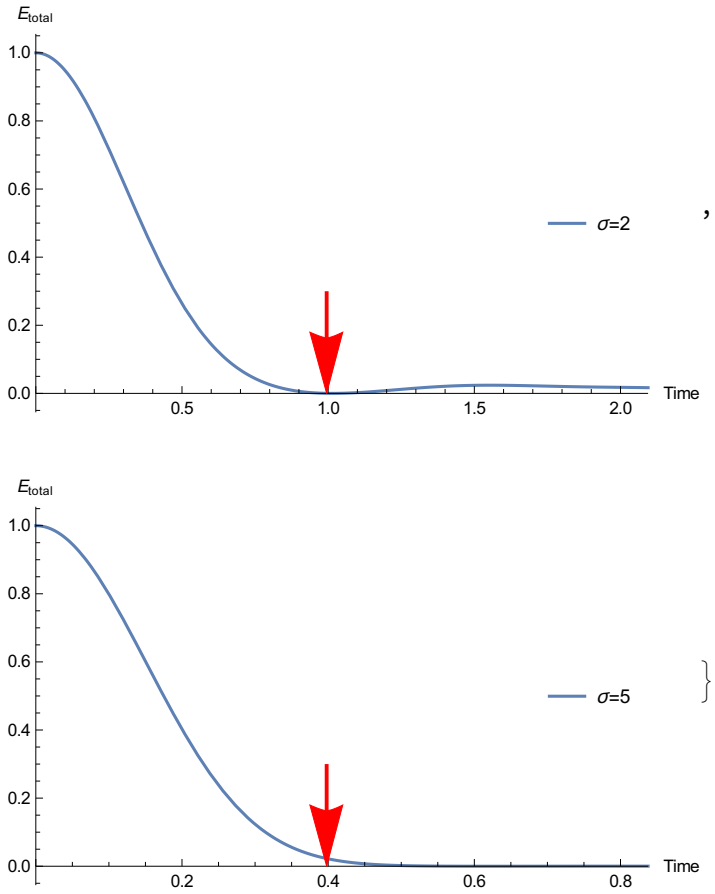
,


E_{total}
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
Time
σ=0.5

,

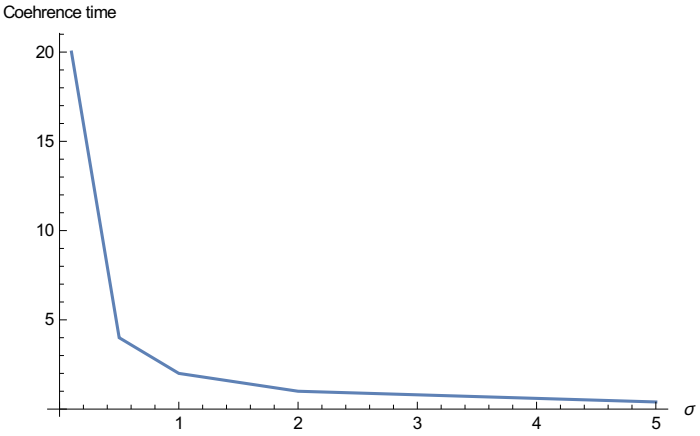

E_{total}
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
Time
σ=1

,



Here's the list of the points indicated in the plots above which represent the coherence time. The following plot shows how the coherence time decreases with widening the uncertainty range in frequency.

```
σlist = {{.1, 20}, {.5, 4}, {1, 2}, {2, 1}, {5, .4}};
ListPlot[σlist, Joined → True, AxesLabel → {"σ", "Coehrence time"}]
```



In a log log plot, it is clear that this is a power-law.

```
ListLogLogPlot[σlist, Joined → True,
 AxesLabel → {"σ", "Coehrence time"}, PlotMarkers → {Automatic, 10}]
```