Corrections and additional problem 6.2

P1.6 Eq.1.8 delete (dx/dt) on left-hand-side of equation

P1.7 Eq.1.10 replace r with x on right-hand-side

P1.7 Eq.1.15 insert = after *V*

P1.9 Eq.1.19 insert = before *T*

P2.2 Eq.2.3 insert boldface ***r*** on right-hand-side in same style as Eq.2.4

P3.3 Eq.3.10 replace 2 with 4 (so that it reads $\frac{\gamma^2}{4}$)

P3.3 replace 2 with 4 in equation 13 lines after Eq.3.10

P3.9 insert *t* after \omega in Eq.3.34 and Eq.3.35

P4.6 line before Eq. 4.15 replace "considering" with "considered"

P4.6 after last line reading "… corresponding phasor diagram." insert "In the long-time limit, the chaotic trajectory visits every point in phase-space shown as black in the figure."

P4.7 in Fig.4.6 caption replace "… showing frequency doubling." with "showing chaotic behavior."

P4.8 in Fig4.7 caption "…number of collisions per unit time is proportional to …"

P4.11 second line place link to footnote 3 AFTER period at end of sentence to avoid looking like m^3

P5.1 3rd line after beginning of section 5.1 replace "neural" with "neutral"

P5.3 Eq.5.10 replace 2 with 4 (so that it reads $\frac{\gamma^2}{4}$)

P5.4 before Eq.5.14 replace "defined through the relations" with "written"

P5.4 Eq.5.16 lower limit second integral is $-\infty$

P5.4 Eq.5.16 right-hand-side insert ε_0 before χ

P5.5 2nd line after Eq.5.18 replace "because" with "since", replace "forces" with "ensures", and insert "goes" after "integrand"

P5.5 3rd line after Eq.5.18 replace "Since" with "Because", replace "can" with "may", and "write" with "give"

P5.5 Eq.5.19 right-hand-side denominator insert missing i so it reads $\mathrm{i}2\pi$

P5.5 1st line after Eq. 5.19 replace "where" with "In this expression"

P5.6 Eq.5.29 denominator should read $\left(\omega^2-\omega_0^2\right)^2$ as in Eq.5.30

P5.7 4th line after section 5.5 replace "permittivity" with "permeability"

P5.10 Eq.5.48 replace $\frac{\omega^2}{c^2}$ before bracket with $\frac{c^2}{\omega^2}$

P5.10 Eq.5.56 insert i to read $\mathrm{i}\varepsilon_{\mathrm{r,Im}}(\omega)$

P5.14 Eq5.78 replace bracket ( ) to right of R with | |

P5.16 First line replace $\varepsilon_{\mathrm{r,LO}}(q,\omega)$ with $\varepsilon_{\mathrm{r,LO}}(\mathbf{q},\omega)$

P5.16 Last line replace $\mathrm{E}(t)=\mathbf{E}_0 e^{-\mathrm{i}\omega t}$ with $\mathbf{E}(t)=\mathbf{E}_0 e^{-\mathrm{i}\omega t}$

P5.18 Eq5.90 insert $\varepsilon_{\mathrm{r}\infty}$ before right-hand-side term in bracket both top and bottom line

P5.19 Write Eq.5.98 to read:

$$S(\omega)=\frac{1}{\varepsilon_{\mathrm{r}\infty}}\frac{\omega\gamma(\omega_{\mathrm{LO}}^2-\omega_{\mathrm{TO}}^2)}{(\omega^2-\omega_{\mathrm{LO}}^2)^2+\omega^2\gamma^2}$$

P5.20 write Eq.5.99 to read:

$$S(\omega_{\mathrm{LO}}) = \frac{(\omega_{\mathrm{LO}}^2 - \omega_{\mathrm{TO}}^2)}{\varepsilon_{\mathrm{r}\infty}\gamma\omega_{\mathrm{LO}}}$$

P5.20 delete line before Eq.5.100

P5.20 delete Eq.5.100

P5.20 in line 6 of problem 5.1 replace $\frac{\gamma^2}{2}$ with $\frac{\gamma^2}{4}$

P6.1 10th line replace "… setting the oscillator frequency to …" to read "… setting the natural oscillator frequency appearing in the Lorentz model to …"

P6.2 4th line after Eq.6.5 replace $\mathbf{p}_{\mathrm{e}}$ with $\mathbf{p}_{\mathrm{ex}}$

P6.3 2nd line after Eq.6.7 replace "… any wave …" with "… any electric field wave …"

P6.4 replace $\mathbf{p}_{\mathrm{e}}$ with $\mathbf{p}_{\mathrm{ex}}$ at bottom of page

P6.6 Eq.6.20 replace "2" with "Im" so that it reads $\sigma_{\mathrm{Im}}(\omega)$

P6.8 Eq.6.34 remove period at end of equation

P6.11 Eq.6.50 left-hand-side denominator replace t with t^2

P6.17 10th line after section 6.8 replace "… velocity is …" with "… velocity of electrons is …"

P6.17 11th line after section 6.8 replace "… the electron …" with "… the calculated electron …"

P6.18 Eq.6.78 replace bracket ( ) to right of R with | |

P6.19 insert new problem:

Problem 6.2 Contributions to relative permittivity in n-type GaAs include polarization of valence electrons, longitudinal polar-optic phonons, and conduction band electrons. If these contributions are assumed to be uncorrelated (corresponding to a random phase approximation or RPA) then, in the long wavelength limit,

$$\varepsilon_{\mathrm{r}}(\omega) = \varepsilon_{\mathrm{r}\infty}\left(1 + \frac{\omega_{\mathrm{TO}}^2 - \omega_{\mathrm{LO}}^2}{\omega(\omega + \mathrm{i}\gamma) - \omega_{\mathrm{TO}}^2} - \frac{\omega_{\mathrm{p}}^2}{\omega(\omega + \mathrm{i}\gamma)}\right)$$

where the longitudinal polar-optic phonon energy is $\hbar\omega_{\mathrm{LO}} = 36.3\ \mathrm{meV}$, the transverse polar-optic phonon energy is $\hbar\omega_{\mathrm{TO}} = 33.3\ \mathrm{meV}$, and high-frequency relative permittivity from the valence electrons is $\varepsilon_{\mathrm{r}\infty} = 11.1$. The plasma frequency is

$$\omega_{\mathrm{p}} = \sqrt{\frac{n_0 e^2}{m_{\mathrm{eff}}\varepsilon_0\varepsilon_{\mathrm{r}\infty}}}$$

where n_0 is the density of conduction band electrons and $m_{\mathrm{eff}} = 0.7 \times m_0$ is the effective electron mass.

(a) Plot the real and imaginary parts of $\varepsilon_{\mathrm{r}}(\omega)$ and the loss function

$$S(\omega) = \mathrm{Im}\left(\frac{-1}{\varepsilon_{\mathrm{r}}(\omega)}\right)$$

in the energy range $8\ \mathrm{meV} < \hbar\omega \leq 80\ \mathrm{meV}$ for conduction band electron carrier densities $0.1\times10^{18}\mathrm{cm}^{-3}$, $0.5\times10^{18}\mathrm{cm}^{-3}$, $1\times10^{18}\mathrm{cm}^{-3}$, and $2\times10^{18}\mathrm{cm}^{-3}$, and assume $\gamma = 1.8\ \mathrm{meV}$.

(b) Explain the origin of the change in relative peak values of $S(\omega)$ in (a) as a function of n_0.