List of Figures

1.1 Variation of distribution function $f(v)$ as a function of $v$ for three values of $\gamma$. .......................................................... 30

1.2 Heuristic picture of envelope solitons solutions of the nonlinear Schrödinger equation (1.37) (arbitrary parameter values) (a) bright, (b) black, (c) grey type envelope solitons. .......................... 39

2.1 Variation of peak amplitude $\phi_m$ in KdV equation with $\delta(=\frac{n_{00}}{n_{e0}})$ for different values of $\beta$ and with $u_0 = 1$ and $\beta_1 = 0.001$. ............................................ 101

2.2 Variation of the quasi potential $V(\phi)$ in the DLs with $\phi$ for different values of $\beta$ and with $u_0 = 1$ and $\beta_1 = 0.001$. ............................................ 105

2.3 Variation of peak amplitude $\phi_{1m}$ in the mKdV with $\delta(=\frac{n_{00}}{n_{e0}})$ for different values of $\beta$ and with $u_0 = 1$ and $\beta_1 = 0.001$. ............................................ 106

2.4 Variation of peak amplitude $\phi_{2m}$ in the DLs with $\delta(=\frac{n_{00}}{n_{e0}})$ for different values of $\beta$ and with $u_0 = 1$ and $\beta_1 = 0.0001$. ............................................ 106

2.5 Variation of the thickness $d$ of the DLs of small amplitude solitons with $\delta(=\frac{n_{00}}{n_{e0}})$ for different values of $\beta$ and with $u_0 = 1$ and $\beta_1 = 0.001.107$

3.1 Variation of $\frac{P_1}{P_2}$ against $k$ for different values of $\beta$ with $\alpha = 2.0$ and $\theta = 100$. ................................................................. 120

3.2 Variation of $Q_1$ against $k$ for different values of $\beta$ with $\alpha = 2.0$ and $\theta = 100$. ................................................................. 121

3.3 Variation of $Z$ against $k$ for different values of $\beta$ with $\alpha = 2.0$ and $\theta = 100$. ................................................................. 122
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4</td>
<td>Variation of $Z$ against $k$ for different values of $\alpha(=\frac{na}{n_0})$ with $\beta = 0.3$ and $\theta = 100$.</td>
</tr>
<tr>
<td>3.5</td>
<td>Variation of $Z$ against $k$ for different values of $\theta(=\frac{T_h}{T_c})$ with $\beta = 0.4$ and $\alpha = 3$.</td>
</tr>
<tr>
<td>3.6</td>
<td>(a) Variation of $\phi_1$ as function of $\xi$ and $\eta$ for $\beta = 0.3$, $\alpha = 2$, $\theta = 100$ and $k = 3$ (stable region). (b) Variation of $Y$ as function of $\xi$ and $\eta$ for $\beta = 0.3$, $\alpha = 2$, $\theta = 100$ and $k = 3$ (stable region).</td>
</tr>
<tr>
<td>3.7</td>
<td>Variation of $Y$ as function of $\xi$ and $\eta$ for $\beta = 0$ and $\alpha = 2$, $\theta = 100$ and $k = 3$ (unstable region).</td>
</tr>
<tr>
<td>3.8</td>
<td>(a) Variation of $\phi_1$ as function of $\xi$ and $\eta$ for $\beta = 0.15$, $\alpha = 2$, $\theta = 100$ and $k = 0.3$ (unstable region). (b) Contour plot of $\phi_1$ as function of $\xi$ and $\eta$ for $\beta = 0.15$, $\alpha = 2$, $\theta = 100$ and $k = 0.3$ (unstable region).</td>
</tr>
<tr>
<td>3.9</td>
<td>(a) Variation of $\phi_1$ as function of $\xi$ and $\eta$ for $\beta = 0.3$, $\alpha = 2$, $\theta = 100$ and $k = 0.3$ (unstable region). (b) Contour plot of $\phi_1$ as function of $\xi$ and $\eta$ for $\beta = 0.3$, $\alpha = 2$, $\theta = 100$ and $k = 0.3$ (unstable region).</td>
</tr>
<tr>
<td>4.1</td>
<td>Showing $\tilde{A}' = 0 (\beta'_1$ versus $\mu'_i)$ curves for different values of $\mu'_e$ with $\sigma = 0.5$, $\beta = 0.3$ and $\tilde{\alpha} = 0.01$.</td>
</tr>
<tr>
<td>4.2</td>
<td>(a) Variation of peak amplitude $\phi''_m$ of positive solitary potential against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 1.5$. (b) Variation of amplitude $\phi''_m$ of negative solitary potential against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 0.1$.</td>
</tr>
<tr>
<td>4.3</td>
<td>(a) Variation of width $w$ of positive solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 1.5$. (b) Variation of width $w$ of negative solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 0.1$.</td>
</tr>
<tr>
<td>4.4</td>
<td>(a) Variation of Mach number $v_0$ of positive solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 1.5$. (b) Variation of Mach number $v_0$ of negative solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$ and $\tilde{\alpha} \beta'_1 = 0.1$.</td>
</tr>
</tbody>
</table>
4.5 (a) Variation of peak amplitude $\phi''_m$ of positive solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$, $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 1.5$. (b) Variation of peak amplitude $\phi''_m$ of negative solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$, $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 0.1$.

4.6 (a) Variation of width $w$ of positive solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 1.5$. (b) Variation of width $w$ of negative solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$, $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 0.1$.

4.7 (a) Variation of Mach number $V_0$ of positive solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$, $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 1.5$. (b) Variation of Mach number $V_0$ of negative solitary potential profile against $\mu'_i$ for different values of $\beta$ with $\sigma = 0.5$, $\sigma_1 = 1$, $\sigma_2 = 1.5$, $\omega_{c1} = 0.02$, $\omega_{c2} = 0.025$ and $\tilde{\alpha}\beta'_1 = 0.1$.

5.1 Variation of $\frac{P'_1}{Q'}$ against $k$ for different values of $\rho(= \frac{n_{e0}}{\rho_{\theta0}})$ with $\sigma' = 0.5$ and $\kappa = 25$.

5.2 Variation of $\frac{P'_1}{Q'}$ against $k$ for different values of $\kappa$ with $\sigma' = 0.5$ and $\rho = 0.2$.

5.3 Variation of the critical value $k_c$ against $\kappa$ for different values of $\rho(= \frac{n_{e0}}{\rho_{\theta0}})$ with $\sigma' = 0.5$.

5.4 Variation of the growth rate $\Gamma$ against $K$ for different values of $\rho(= \frac{n_{e0}}{\rho_{\theta0}})$ with $\sigma' = 0.5$ and $\kappa = 3$.

5.5 Variation of the growth rate $\Gamma$ against $K$ for different values of $\kappa$ with $\sigma' = 0.5$ and $\rho = 0.2$.

6.1 Variation of $\frac{R_1}{R_2}$ against $k$ for different values of $\kappa_i$ with $\sigma = 0.1$, $f = 0.9$ and $\kappa_e = 25$.
6.2 Variation of $S_1$ against $k$ for different values of $\kappa_i$ with $\sigma = 0.1$, $f = 0.9$ and $\kappa_e = 25$. ........................................... 181
6.3 Variation of $W$ against $k$ for different values of $\kappa_i$ with $\sigma = 0.1$, $f = 0.9$ and $\kappa_e = 25$. ........................................... 183
6.4 Variation of $W$ against $k$ for different values of $\sigma(= \frac{T_i}{T_e})$ with $f = 0.9$, $\kappa_e = 4$ and $\kappa_i = 4$. ........................................... 183
6.5 Variation of $W$ against $k$ for different values of $f(= \frac{n_e}{n_i})$ with $\sigma = 0.1$, $\kappa_e = 4$ and $\kappa_i = 4$. ........................................... 184
6.6 (a) Variation of $\phi^1_1$ as function of $\xi$ and $\eta$ for $f = 0.9$, $\sigma = 0.1$, $\kappa_e = 2$, $\kappa_i = 2$ and $k = 3$ (stable region) and (b) Variation of $\phi^1_1$ as function of $\xi$ and $\eta$ for $f = 0.9$, $\sigma = 0.1$, $\kappa_e = 2$, $\kappa_i = 2$ and $k = 10$ (unstable region). ........................................... 186
6.7 (a) Variation of $A'$ as function of $\xi$ and $\eta$ for $f = 0.9$, $\sigma = 0.1$, $\kappa_e = 4$, $\kappa_i = 4$ and $k = 3$ (stable region) and (b) Variation of $A'$ as function of $\xi$ and $\eta$ for $f = 0.9$, $\sigma = 0.1$, $\kappa_e = 4$, $\kappa_i = 4$ and $k = 10$ (unstable region). ........................................... 187
6.8 Variation of $R_1$ against $k$ for different values of $\kappa_i$ with $\sigma = 1$, $f = 2$ and $\kappa_e = 25$. ........................................... 188
6.9 Variation of $S_1$ against $k$ for different values of $\kappa_i$ with $\sigma = 1$, $f = 2$ and $\kappa_e = 25$. ........................................... 188
6.10 Analytic solution for a dromion. ........................................... 189
6.11 Variation of $W$ against $k$ for different values of $\kappa_i$ with $\sigma = 1$, $f = 2$ and $\kappa_e = 25$. ........................................... 189
6.12 Variation of $W$ against $k$ for different values of $f(= \frac{n_e}{n_i})$ with $\sigma = 1$, $\kappa_e = 4$ and $\kappa_i = 4$. ........................................... 190
6.13 Variation of $\phi^1_1$ as function of $\xi$ and $\eta$ for $f = 3$, $\sigma = 1$, $\kappa_e = 2$, $\kappa_i = 2$ and $k = 4$ (stable region). ........................................... 191
7.1 The phase velocity $\lambda$ is plotted vs $\alpha'$ for different values of $\sigma(= \frac{T_i}{T_e})$ with parameters $\nu = 2.5 \times 10^{-2}$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. ........................................... 203
7.2 The peak amplitude $\psi_0$ of Schamel type mKdV equation is plotted vs $\tilde{\beta}_1$ for different $\alpha'_1(=\frac{Z_2m_1}{Z_1m_2})$ with parameters $\nu = 2.5 \times 10^{-2}$, $\sigma = 0.5$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. .................................................. 205

7.3 The peak amplitude $\psi_0$ of generalized KdV equation is plotted vs $\alpha'_1$ for different $\tilde{\beta}_1(=T_{cf}T_{et})$ with parameters $\nu = 2.5 \times 10^{-2}$, $\sigma = 0.5$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. .................................................. 208

7.4 For slow mode, the mKdV soliton (solid curve), second order correction (dotted curve), and dressed soliton (dashed curve) are plotted with $\tilde{\beta}_1 = 0.9$ versus $\eta$. Other parameters are $\nu = 2.5 \times 10^{-2}$, $\alpha'_1 = 2$, $\sigma = 0.5$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. ................. 214

7.5 For slow mode, the amplitude of mKdV soliton (solid curve), second order correction (dotted curve), and dressed soliton (dashed curve) are plotted vs $\tilde{\beta}_1(=\frac{T_{cf}}{T_{et}})$. Other parameters are $\nu = 2.5 \times 10^{-2}$, $\alpha'_1 = 2$, $\sigma = 0.5$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. ................. 214

7.6 For fast mode, The mKdV soliton (solid curve), second order correction (dotted curve), and dressed soliton (dashed curve) are plotted with $\tilde{\beta}_1 = 0.9$ vs $\eta$. Other parameters are $\nu = 2.5 \times 10^{-2}$, $\alpha'_1 = 2$, $\sigma = 0.5$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. ................. 215

7.7 Profiles of the mKdV soliton and higher order soliton are plotted vs $\eta$ for two different values of $\tilde{\beta}_1(=\frac{T_{cf}}{T_{et}})$ with parameters $\nu = 2.5 \times 10^{-2}$, $\mu_i = 0.8$, $\mu_e = 0.2$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. Solid (dashed) curve corresponds to $\tilde{\beta}_1 = 0.7$ and dotted (dotdashed) curve to $\tilde{\beta}_1 = 0.8$ for first (second) order soliton solution. .................. 217
7.8 Profiles of the mKdV soliton and higher order soliton are plotted vs $\eta$ for two different values of $\alpha'_1 = \frac{Z_{m1}^2}{Z_{m2}^2}$ with parameters $\nu = 2.5 \times 10^{-2}$, $\mu_i = 0.8$, $\mu_e = 0.2$, $\tilde{\beta}_1 = 0.8$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. Solid (dashed) curve corresponds to $\alpha'_1 = 1.2$ and dotted (dotdashed) curve to $\alpha'_1 = 2.2$ for first (second) order soliton solution.

7.9 Profiles of the mKdV soliton and higher order soliton are plotted vs $\eta$ for two different values of $\sigma = \frac{T_e}{T_i}$ with parameters $\nu = 2.5 \times 10^{-2}$, $\mu_i = 0.8$, $\mu_e = 0.2$, $\tilde{\beta}_1 = 0.8$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. Solid (dashed) curve corresponds to $\sigma = 0.5$ and dotted (dotdashed) curve to $\sigma = 0.8$ for first (second) order soliton solution.

7.10 Profiles of the mKdV soliton and higher order soliton are plotted vs $\eta$ for two different values of $\sigma_d = \frac{T_d}{Z_{m2}^2}$ with parameters $\nu = 2.5 \times 10^{-2}$, $\mu_i = 0.8$, $\mu_e = 0.2$, $\tilde{\beta}_1 = 0.8$ and $\sigma_d = 0.001$. (a) DA slow mode (b) DA fast mode. Solid (dashed) curve corresponds to $\sigma_d = 0.001$ and dotted (dotdashed) curve to $\sigma_d = 0.005$ for first (second) order soliton solution.

8.1 Showing $\hat{A} = 0$ ($\frac{1}{3}$ versus $\kappa$ curve).

8.2 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\frac{1}{3} = \frac{n_e}{n_i}$ for positive dust, with parameters $\kappa = 3.5$, $\beta_1 = 0.4$, $V = 0.5$ and $\eta_0 = 0.5$.

8.3 3D plot of $\phi$ as function of $\xi$ and $\tau$ for positive dust, with parameters $\kappa = 3.5$, $\beta_1 = 0.4$, $V = 0.5$ and $\eta_0 = 0.5$. (a) $1/\delta = 2$ (b) $1/\delta = 4$.

8.4 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\frac{1}{3} = \frac{n_e}{n_i}$ for negative dust, with parameters $\kappa = 3.5$, $\beta_1 = 0.4$, $V = 0.5$ and $\eta_0 = 0.5$.

8.5 3D plot of $\phi$ as function of $\xi$ and $\tau$ for negative dust, with parameters $\kappa = 3.5$, $\beta_1 = 0.4$, $V = 0.5$, $\eta_0 = 0.5$ and $1/\delta = 0.9$. 
8.6 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\beta_1(= T_i/T_e)$ for positive dust, with parameters $\kappa = 3.5$, $1/\delta = 1.4$, $V = 0.5$ and $\eta_0 = 0.5$. ........................................................................................................ 236
8.7 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\beta_1(= T_i/T_e)$ for negative dust, with parameters $\kappa = 3.5$, $1/\delta = 0.95$, $V = 0.5$ and $\eta_0 = 0.5$. ........................................................................................................ 236
8.8 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\kappa$ for positive dust, with parameters $\beta_1 = 0.2$, $1/\delta = 4$, $V = 0.5$ and $\eta_0 = 0.5$. ........................................................................................................ 237
8.9 Variation of $\phi$ with $\zeta = (\xi - V\tau)$ for different values of $\kappa$ for negative dust, with parameters $\beta_1 = 0.2$, $1/\delta = 0.95$, $V = 0.5$ and $\eta_0 = 0.5$. ........................................................................................................ 237
8.10 Variation of the amplitude $\phi_m$ of the positive shock potential profiles with $\kappa$ for different values of $\frac{1}{\delta}(= n_{e0}/n_{i0})$. ........................................................................................................ 240
8.11 Variation of the amplitude $|\phi_m|$ of the negative shock potential profiles with $\kappa$ for different values of $\frac{1}{\delta}(= n_{e0}/n_{i0})$. ........................................................................................................ 240
9.1 Variation of normalized dust charge number $Z_d$ with plasma potential disturbance $\phi$ for fixed $\beta = 0.1$, $\beta_1 = 0.001$, $\beta_2 = 0.1$, $\delta_1 = 0.1$ and $\delta = 0.3$. ........................................................................................................ 252
9.2 Variation of the critical Mach number $M_s$ with $\delta_1(= n_{i0}/n_{e0})$ for fixed $\beta = 0.1$, $\beta_1 = 0.001$, and $\delta = 0.3$. ........................................................................................................ 255
9.3 Variation of the critical Mach number $M_s$ with $\beta$ for fixed $\beta_1 = 0.001$, $\beta_2 = 0.1$, and $\delta = 0.3$. ........................................................................................................ 255
9.4 Variation of pseudopotential $V(\phi, M)$ with $\phi$ for different values of $\delta_1(= n_{i0}/n_{e0})$ and fixed $M = 2$, $\beta = 0.4$, $\delta = 0.3$, $\beta_2 = 0.1$ and $\beta_1 = 0.001$. ........................................................................................................ 257
9.5 Plot of pseudopotential $V(\phi, M)$ with $\phi$ for different values of $M$ and with $\beta = 0.4$, $\delta_1 = 0.1$, $\delta = 0.3$, $\beta_2 = 0.1$ and $\beta_1 = 0.001$. ........................................................................................................ 258
9.6 (a) Variation of maximum potential $\phi_m$ (a) for negative potential solitary waves and (b) for positive potential solitary waves with $\delta_1$ for different values of the Mach number $M$ for fixed $\beta = 0.4$, $\delta = 0.3$, $\beta_2 = 0.1$ and $\beta_1 = 0.001$. ........................................................................................................ 259
9.7 Variation of soliton potential ($\phi_{Im}$) in KdV with $\delta_1 (= \frac{n_p 0}{n_e 0})$ for different values of $M$ and with $\beta = 0.4$, $\beta_2 = 0.1$, $\delta = 0.3$ and $\beta_1 = 0.001$.

9.8 Variation of soliton potential ($\phi_{Im}$) in KdV with $\delta_1 (= \frac{n_p 0}{n_e 0})$ for different values of $\beta$ and with $M = 2$, $\beta_2 = 0.1$, $\delta = 0.3$ and $\beta_1 = 0.001$.

9.9 Variation of double layer amplitude ($\phi_{2m}$) in DL solution with $\delta_1 (= \frac{n_p 0}{n_e 0})$ for different values of $M$ and with $\beta = 0.4$, $\beta_2 = 0.1$, $\delta = 0.3$ and $\beta_1 = 0.001$.

9.10 Variation of double layer amplitude ($\phi_{2m}$) in DL solution with $\delta_1 (= \frac{n_p 0}{n_e 0})$ for different values of $\beta$ and with $M = 2$, $\beta_2 = 0.1$, $\delta = 0.3$ and $\beta_1 = 0.001$.

10.1 Unstable regions with $\omega_c = 1.45$, (a) $\beta = 0.2$, (b) $\beta = 0.25$, (c) $\beta = 0.3$ and (d) $\beta = 0.35$.

10.2 Variation of growth rate $\Gamma$ against $K$ for different values of $\beta$ with $\alpha = 1.5$ and $\theta = 500$.

10.3 Variation of growth rate $\Gamma$ against $K$ for different values of $\alpha (= \frac{n_h}{n_c})$ with $\beta = 0.2$ and $\theta = 500$.

10.4 Variation of growth rate $\Gamma$ against $K$ for different values of $\theta (= \frac{T_h}{T_c})$ with $\beta = 0.2$ and $\alpha = 1.5$. 