Appendix

Chapter-III

$$m_1 = \frac{Sc + \sqrt{Sc^2 + 4Sc\gamma}}{2}, m_2 = \frac{-Sc + \sqrt{Sc^2 + 4Sc\gamma}}{2},$$

$$A_1 = \left(\frac{Pr + \sqrt{Pr^2 + 4Pr(F+\psi)}}{2}\right), \qquad A_2 = \frac{-Pr + \sqrt{Pr^2 + 4Pr(F+\psi)}}{2},$$

$$A_3 = \frac{-1 + \sqrt{1+4N}}{2}, \qquad A_4 = \frac{1 + \sqrt{1+4N}}{2}, A_5 = \frac{Gr}{A_1^2 - A_1 - N},$$

$$A_6 = \frac{Gm}{m_1^2 - m_1 - N}, \; A_7 = A_5 A_1, \; A_8 = A_6 m_1, \; A_9 = A_4(A_5 + A_6)$$

$$A_{10} = A_1 + A_4, \qquad A_{11} = 2A_8 A_9, \qquad A_{12} = 2A_7 A_8, \qquad A_{13} = 2A_7 A_9,$$

$$A_{14} = 2A_6(A_5 + A_6), \; A_{15} = 2A_5 A_6, \; A_{16} = 2A_5(A_5 + A_6)$$

$$A_{17} = B_{10} - B_{11} - B_{12} + B_{13} - B_{14} + B_{15} - B_{16},$$

$$B_1 = m_1 + A_4, \quad B_2 = A_1 + m_1, \qquad B_3 = Pr\left[\frac{A_7^2 + M^2 A_5^2}{4A_1^2 - 2A_1 Pr - \Pr(F+\psi)}\right],$$

$$B_4 = Pr\left[\frac{A_9^2 + M^2(A_5 + A_6)^2}{4A_4^2 - 2A_4 Pr - \Pr(F+\psi)}\right], B_5 = Pr\left[\frac{A_{13+} M^2 A_{16}}{A_{10}^2 - A_{10} Pr - \Pr(F+\psi)}\right],$$

$$B_6 = Pr\left[\frac{A_8^2+M^2A_6^2}{4m_1^2-2m_1Pr-\quad(F+\psi)}\right],\ B_7 = Pr\left[\frac{A_{11+}M^2A_{14}}{B_1^2-B_1Pr-\mathrm{Pr}\,(F+\psi)}\right],$$

$$B_8 = Pr\left[\frac{A_{12+}M^2A_{15}}{B_2^2 - B_2Pr - \mathrm{Pr}\,(F+\psi)}\right], B_9 = B_3 + B_4 - B_5 + B_6 - B_7 + B_8$$

$$B_{10} = \frac{GrB_9}{A_1^2 - A_1 - N}, \qquad B_{11} = \frac{GrB_3}{4A_1^2 - 2A_1 - N},$$

$$B_{12} = \frac{GrB_4}{4A_4^2 - 2A_4 - N},$$

$$B_{13} = \frac{GrB_5}{A_{10}^2 - A_{10} - N}, B_{14} = \frac{GrB_6}{4m_1^2 - 2m_1 - N}, \qquad B_{15} = \frac{GrB_7}{B_1^2 - B_1 - N},$$

$$B_{16} = \frac{GrB_8}{B_2^2 - B_2 - N}$$

Chapter-IV

$$\mathrm{A_1} = -\frac{\mathrm{Gr}}{(\mathrm{Pr}+\psi_2)(\mathrm{Pr}+\psi_3)},\ \mathrm{A_2} = -\frac{\mathrm{Gm}}{(\mathrm{Sc}+\psi_2)(\mathrm{Sc}+\psi_3)},\ \mathrm{A_3} = -(\mathrm{A_1}+\mathrm{A_2}),$$

$$\psi_1 = \frac{(-\mathrm{Pr}-\sqrt{\mathrm{Pr}^2+4\mathrm{i}\omega\,\mathrm{Pr}})}{2},\ \psi_2 = \frac{\left(-1+\sqrt{1+4\left(2\mathrm{i}\Omega+\mathrm{M}^2+\frac{1}{\mathrm{K}}\right)}\right)}{2},$$

$$\psi_3 = \frac{\left(-1-\sqrt{1+4\left(2i\Omega+M^2+\frac{1}{K}\right)}\right)}{2},\ \psi_4 = \frac{\left(-1+\sqrt{1+4\left(2i\Omega+M^2+\frac{1}{K}+i\omega\right)}\right)}{2},$$

$$\psi_5 = \frac{\left(-1-\sqrt{1+4\left(2i\Omega+M^2+\frac{1}{K}+i\omega\right)}\right)}{2},$$

$$N_r = \text{Real part}\left(e^{i\omega t}\frac{Gr}{\psi_5-\psi_1}\left(e^{\psi_5 z}-e^{\psi_1 z}\right)\right),$$

$$N_i = \text{Imaginary part}\left(e^{i\omega t}\frac{Gr}{\psi_5-\psi_1}\left(e^{\psi_5 z}-e^{\psi_1 z}\right)\right).$$

Chapter-VII

$$B_1 = \left(\frac{3+4R}{3Pr}\right), \beta_2 = -\left(\frac{1+\sqrt{1+4QB_1}}{2}\right),\ \beta_4 = -\left(\frac{1+\sqrt{1+4(n-Q)B_1}}{2}\right),$$

$$\beta_6 = -Sc\,, \qquad \beta_8 = -\left(\frac{Sc+\sqrt{Sc^2+4nSc}}{2}\right), \beta_{10} = -\left(\frac{1+\sqrt{1+4N}}{2}\right),$$

$$\beta_{12} = -\left(\frac{1+\sqrt{1+4(n-N)}}{2}\right), \qquad L_1 = -\frac{A\beta_2}{B_1\beta_2^2+\beta_2-(n-Q)},$$

$$L_2 = 1 - L_1\,, P_1 = -\frac{S_0 Sc}{\beta_2^2 + Sc\beta_2}\,, \qquad P_2 = 1 - P_1, P_3 = -\frac{AP_2 Sc\beta_6}{\beta_6^2 + Sc\beta_6 - nSc}\,,$$

$$P_4 = -\frac{AP_1 Sc\beta_2}{\beta_2^2 + Sc\beta_2 - nSc}\,, \qquad P_5 = 1 - P_3 - P_4\,, A_1 = -\frac{Gr}{\beta_2^2 + \beta_2 - N}\,,$$

$$A_2 = -\frac{GmP_2}{\beta_6^2+\beta_6-N}\,, A_3 = -\frac{GmP_1}{\beta_2^2+\beta_2-N}\,, A_4 = (U_p - 1 - A_1 - A_2 - A_3),$$

$$A_6 = -\frac{AA_4\beta_{10}}{\beta_{10}^2 + \beta_{10} - (n+N)}\,, A_7 = -\frac{AA_1\beta_2}{\beta_2^2 + \beta_2 - (n+N)}\,,$$

$$A_8 = -\frac{AA_2\beta_6}{\beta_6^2 + \beta_6 - (n+N)}\,, A_9 = -\frac{AA_3\beta_2}{\beta_2^2 + \beta_2 - (n+N)}\,,$$

$$A_{10} = -\frac{GrL_2}{\beta_4^2 + \beta_4 - (n+N)}\,, A_{11} = -\frac{GrL_1}{\beta_2^2 + \beta_2 - (n+N)}\,,$$

$$A_{12} = -\frac{GmP_5}{\beta_8^2 + \beta_8 - (n+N)}\,, A_{13} = -\frac{GmP_3}{\beta_6^2 + \beta_6 - (n+N)}\,,$$

$$A_{14} = -\frac{GmP_4}{\beta_2^2 + \beta_2 - (n+N)}\,, \qquad A_{15} = -(1 + A_6 + A_7 + \cdots \ldots \ldots \ldots \ldots + A_{14})$$

Chapter VIII

$$\xi_2 = -\left(\frac{Sc + \sqrt{Sc^2 + 4C_r Sc}}{2}\right), \quad \xi_4 = -\left(\frac{Sc + \sqrt{Sc^2 + 4Sc\,(C_r + n)}}{2}\right),$$

$$\xi_6 = -\left(\frac{Pr + \sqrt{Pr^2 + 4Pr\,(F + Q)}}{2}\right), \quad \xi_8$$

$$= -\left(\frac{Pr + \sqrt{Pr^2 + 4Pr\,(F + Q + n)}}{2}\right),$$

$$\xi_{10} = -\left(\frac{1+\sqrt{1+4N}}{2}\right), \quad C_1$$

$$= \frac{Gr\,(1+\phi_1\xi_6)}{(\xi_6^2-\xi_6-N)\,(1+\phi_1\xi_{10})} + \frac{Gm\,(1+\phi_1\xi_2)}{(\xi_2^2-\xi_2-N)\,(1+\phi_1\xi_{10})},$$

$$C_2 = \frac{-\,Gr}{\xi_6^2-\xi_6-N}, \quad C_3 = \frac{-\,Gm}{\xi_2^2-\xi_2-N},$$

$$C_4 = \frac{-\,A\,C_1\,(1+\phi_1\xi_{10})\,\xi_{10}}{(\xi_{10}^2-\xi_{10}-n-N)\,(1+\phi_1\xi_{12})}$$

$$+ \frac{A\,Gr\,\xi_6\,(1+\phi_1\xi_6)}{(\xi_6^2-\xi_6-N)\,(\xi_6^2-\xi_6-n-N)\,(1+\phi_1\xi_{12})}$$

$$+ \frac{A\,Gm\,\xi_2\,(1+\phi_1\xi_2)}{(\xi_2^2-\xi_2-N)\,(\xi_2^2-\xi_2-n-N)\,(1+\phi_1\xi_{12})}$$

$$- \frac{Gr\,B_1\,(1+\phi_1\xi_8)}{(\xi_8^2-\xi_8-n-N)\,(1+\phi_1\xi_{12})}$$

$$+ \frac{Gr\,B_1\,(1+\phi_1\xi_6)}{(\xi_6^2-\xi_6-n-N)\,(1+\phi_1\xi_{12})} - \frac{1}{1+\phi_1\xi_{12}},$$

$$C_5 = \frac{A\,C_1\,\xi_{10}}{(\xi_{10}^2-\xi_{10}-n-N)}, \quad C_6 = \frac{-\,A\,Gr\,\xi_6}{(\xi_6^2-\xi_6-N)\,(\xi_6^2-\xi_6-n-N)},$$

$$C_7 = \frac{-\,A\,Gm\,\xi_2}{(\xi_2^2-\xi_2-N)\,(\xi_2^2-\xi_2-n-N)}, \quad C_8 = \frac{Gr\,E_1}{(\xi_8^2-\xi_8-n-N)},$$

$$C_9 = \frac{-\,Gr\,E_1}{(\xi_6^2-\xi_6-n-N)}, \quad E_1 = \frac{A\,Sc\,\xi_2}{\xi_2^2-Sc\,\xi_2-(R+n)Sc},$$

$$E_2 = \frac{A\,Pr\,\xi_6}{\xi_6^2-Pr\,\xi_6-(F+Q+n)Pr}.$$