$k_u = 2\pi/\lambda_u$

3.1 $$\frac{d\gamma}{dz} = \frac{e^{i\theta}}{4i}\sum_n J_n\left(\frac{K^2}{4+2K^2}\right)\left[e^{-2ink_u z} + e^{-2i(n+1)k_u z}\right] + c.c.$$

$$= \frac{e^{i\theta}}{4i}\left[J_0\left(\frac{K^2}{4+2K^2}\right)\left[\cancelto{1}{e^{-2i(0)k_u z}} + e^{-2i(1)k_u z}\right] + J_{-1}\left(\frac{K^2}{4+2K^2}\right)\left[e^{-2i(-1)k_u z} + \cancelto{1}{e^{-2i(0)k_u z}}\right]\right]$$

$$= \frac{e^{i\theta}}{4i}\int_0^{\lambda_u} J_0\left(\frac{K^2}{4+2K^2}\right)\left[1 + e^{-4\pi i z/\lambda_u}\right] - J_{-1}\left(\frac{K^2}{4+2K^2}\right)\left[1 + e^{4\pi i z/\lambda_u}\right] dz$$

$$= \frac{e^{i\theta}}{4i}\left[J_0\left(\frac{K^2}{4+2K^2}\right)\left[\int_0^{\lambda_u} 1\,dz + \cancelto{0}{\int_0^{\lambda_u} e^{-4\pi i z/\lambda_u}\,dz}\right] - J_{-1}\left(\frac{K^2}{4+2K^2}\right)\left[\int_0^{\lambda_u} 1\,dz + \cancelto{0}{\int_0^{\lambda_u} e^{4\pi i z/\lambda_u}\,dz}\right]\right]$$

$$= \frac{e^{i\theta}}{4i}\left[J_0\left(\frac{K^2}{4+2K^2}\right)\left[\lambda_u + [0]\right] - J_{-1}\left(\frac{K^2}{4+2K^2}\right)\left[\lambda_u + [0]\right]\right]$$

$$= \frac{e^{i\theta}}{4i}\left[\lambda_u J_0\left(\frac{K^2}{4+2K}\right) - \lambda_u J_{-1}\left(\frac{K^2}{4+2K^2}\right)\right]$$

$$= \lambda_u \frac{e^{i\theta}}{4i}\left[J_0\left(\frac{K^2}{4+2K}\right) - J_{-1}\left(\frac{K^2}{4+2K^2}\right)\right]$$