National Central University
Department of Atmospheric Sciences

Radar Meteorology

Homework I

2021/09/27 - 2021/10/08

(1) (5 pts each)

Extend the following functions at x = 0 using Taylor expansion to at least three non-zero terms. Plot the results from the Taylor expansion and the original function, and compute their differences.

(a) sin(x)

(b) cos(x)

(c) 1/cos(x)

(d) $(1+x)^{1/2}$

(2) 40 pts

Please prove that equation (2.20) in the text book

$$\mathrm{s(h)} = \int_0^h \frac{aCdh'}{R[R^2n^2(h')-C^2]^{1/2}}\text{，}\mathrm{C} = \mathrm{an}(0)\cos\theta_e$$

is the solution of equation (2.21)

$$\frac{d^2h}{ds^2} - \left(\frac{2}{R} + \frac{1}{n}\frac{dn}{dh}\right)\left(\frac{dh}{ds}\right)^2 - \left(\frac{R}{a}\right)^2\left(\frac{1}{R} + \frac{1}{n}\frac{dn}{dh}\right) = 0$$

See the text book for the definitions of all variables。

(Note: You will need to use the Leibnitz rule to perform the differential:

$$\mathrm{I}(x) = \int_{a(x)}^{b(x)} F(x,x')dx'$$

$$\frac{dI}{dx} = \int_{a(x)}^{b(x)} \frac{\partial F}{\partial x} dx' + F(x,b(x))\frac{db}{dx} - F(x,a(x))\frac{da}{dx}$$

(You can compute ds/dh first，then dh/ds and d^2h/ds^2).