Computational Physics Lab Continuous Assessment Exam

Time : 1 hour

February 04, 2016 (Session 3)

*Answer all. Any deviation from instructions will lead to **zero grade***

1. The Fourier series representation of the sawtooth wave $f(x) = x$ for $x \in [-\pi, \pi]$ with $f(x \pm 2\pi) = f(x)$, is given by

$$f(x) = 2\left[\sin x - \frac{\sin 2x}{2} + \frac{\sin 3x}{3} - \ldots + (-1)^{n+1}\frac{\sin nx}{n} + ...\right], x \in [-\pi, \pi] \quad (1)$$

(a) Write a C++ program that evaluates the n-th partial sum (i.e. sum of the first n terms), where $n = 2, 3, 4, \ldots, 8$, of the series, for $x \in [-\pi, \pi]$ and writes the values in a file. Take the increment of x to be $\pi/20$. Your program should write the values of x in the first column, the partial sum for $n = 2$ in the second column of the file, that for $n = 3$ in the third column, etc.

(b) Plot the partial sums (for $n = 2, 3, 4, \ldots, 8$) in a single plot, using gnuplot, for $x \in [-\pi, \pi]$. Save your plot as a postscript file with your roll number included in the name of the file. [6 + 4]

2. Compute the following integrals

$$I_1 = \int_{\pi/4}^{\pi/2} \frac{\cos x \ln \sin x}{1 + \sin x} dx$$

$$I_2 = \int_0^{3\pi/8} \tan x dx$$

using Simpson's-3/8-rule. **Write a Maple procedure named s3b8 that will take the integrand function, limits of the integration and the total number of sub-intervals as arguments and evaluates the integrals**.