Due by 5:00 pm(MST) Tuesday February 16, 2016 on Canvas

Answer the following four questions taken from our textbook. Please repeat the full question within your writeup and provide the answer (so that your document is fully encapsulated without the textbook).

1. Page 84 # 2 (20 pts)
2. Page 85 # 3 (20 pts)
3. Page 86 # 7 (20 pts)
4. Page 86 # 8 (20 pts)

For the problem below, solve the problem specified from the text in the assignment report format described in the syllabus. Please keep you answer to 10 single-column pages.(20 pts)

5. Page 88 #13 modified in the following way. Solve $u_t = \sigma u_{xx}$ with periodic boundary conditions on $[0, 2]$ with initial condition $u(x, t = 0) = \sin(2\pi x)$. Use the finite difference formulas in space as provided and the sigma parameter provided. You will need to use different spacing $h$ as specified. Plot your solution for the final times $T = 0, 0.5, 1.0$ and $1.5$.

6. Bonus (Nektar-5 points)
   (a) Compile and install Nektar.
   (b) Compile and run Time Integration Demo located in
       (nekter/library/Demos/LibUtilities/TimeIntegrationDemo.cpp)
   (c) Plot number of time steps taken to complete the simulation vs error generated for all time schemes available in demo. (Keep the number of points in 1D as 11)

This demo solves a one-dimensional advection-diffusion problem, defined as

$$\frac{du}{dt} + V \frac{du}{dx} = D \frac{d^2 u}{dx^2}$$

subject to:
- periodic boundary conditions
- the initial condition $u(x, 0) = \sin(2 \pi k x)$
and with $x = [0, 1]$
$t = [0, 1]$
$U = 1$
$D = 0.05$

The exact solution of the above equation is given by

$$u(x, t) = \exp(-D*(2 * pi * k)^2 * t) * \sin(2 * pi * k * (x - U * t))$$