**CFD Application to Ship Hydrodynamics**

**Mid-term Test**

Time: 1:00PM – 3:00PM Tuesday, Oct. 14, 2008

Location: 34-119 SNU

*Note: Answer in English*

1. (20 pts) For $y=sin\frac{πx}{2}$, obtain $\frac{dy}{dx}$ at $x=0.5$ with $∆x=0.1$ using:
2. $\frac{dy}{dx}≈\frac{y\_{j+1}-y\_{j-1}}{2∆x}$,
3. $\frac{dy}{dx}≈\frac{y\_{j+1}-y\_{j}}{∆x}$
4. $\frac{dy}{dx}≈\frac{y\_{j-2}-8y\_{j-1}+8y\_{j+1}-y\_{j+2}}{12∆x}$

and compare the accuracy of the results.

1. (10 pts) Repeat Problem 1 with $∆x=0.05, 0.025, 0.0125$ and determine whether the convergence with $∆x$ is consistent with the leading term of the truncation error.
2. (25 pts) For $y=sin\frac{πx}{2}$, obtain $\frac{d^{2}y}{dx^{2}}$ at $x=0.5$ with $∆x=0.1, 0.05, 0.025, 0.0125$ using:
3. $\frac{d^{2}y}{dx^{2}}≈\frac{y\_{j-1}-2y\_{j}+y\_{j+1}}{∆x^{2}}$,
4. $\frac{d^{2}y}{dx^{2}}≈\frac{-y\_{j-2}+16y\_{j-1}-30y\_{j}+16y\_{j+1}-y\_{j+2}}{12∆x^{2}}$

and compare the accuracy of the results and the convergence with the leading term in the truncation error.

1. (30 pts) Develop a finite volume discretization for mesh point *A(i,j)*, with the control volume BCDGHKEF in the figure below.



Compare the results from the evaluation of the side fluxes by the following three options, written for, e.g., side *K(E)F*:

1. 
2. 
3. 
4. (15 pts) Discuss the pros and cons of the following pairs.
	1. FDM vs. FVM
	2. Structured grid vs. Unstructured grid
	3. Upwind approximation vs. Central approximation