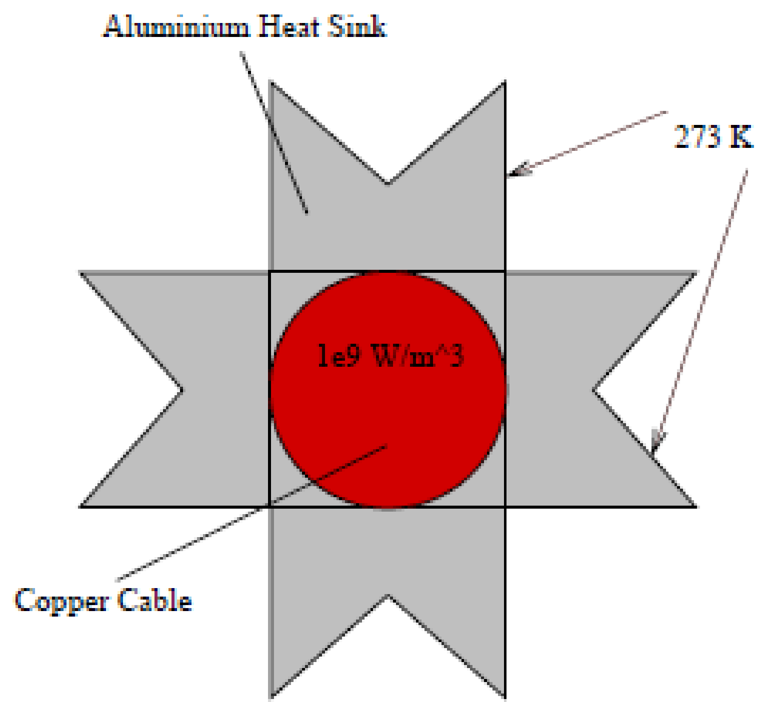
Results of Worksheet 5
Scientific Computing Lab

Submitted by – Group 1
Ravikishore Kommajosyula
Markus Auer
Tushar Upadhyay

A few Remarks

- Refinements have been terminated (in Exercise 1) before achieving the specified 3 Significant digit accuracy due to System Crashing for memory issues.
- Animations could not be saved on the machines and hence they have been replaced by Screenshots at all places.

Exercise 1 – Copper Cable in a Simple Heat Sink (2D)



Exercise 1 © - Solving with Free Mesh Parameters

Table 1 © - Normal Heat Flux over Outer Boundary

# Elements	Value of Integral (in W/m)
466	645911.9
1864	665167.7
7456	679833.5
29824	689654.2
119296	695976.9
477184	699992.7

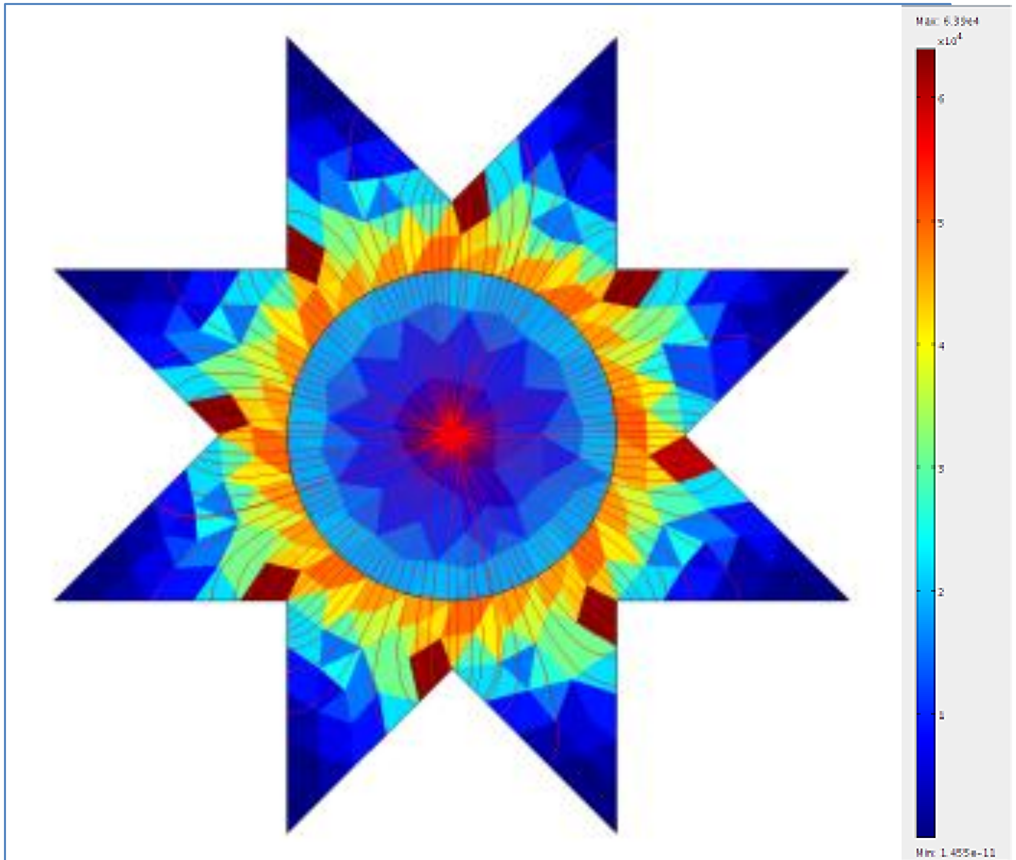


Figure 1 © - Temperature Gradient Plot

Observation regarding Quality of Solution:

Solution is Qualitatively correct. We notice that we get different temperature Gradients around the inner corners while we expect the solution to be symmetric. This indicates that the mesh needs to be refined further to get better results

Exercise 1 (d) - Solving with Hand-made Mesh Refinement

Table 1 (d) - Normal Heat Flux over Outer Boundary

# Elements	Value of Integral (in W/m)
1596	687497.2
6384	693023.7
25536	697662.7
102144	700936.3
408576	703094.8

Exercise 1 (e) - Solving with Adaptive Mesh Refinement

Table 1 (e) - Normal Heat Flux over Outer Boundary

# Elements	Value of Integral (in W/m)
3322	694148.1
7868	701299.8
17942	703800
39388	705595.9
84247	706161.4
177127	706464.3
371395	706699.7

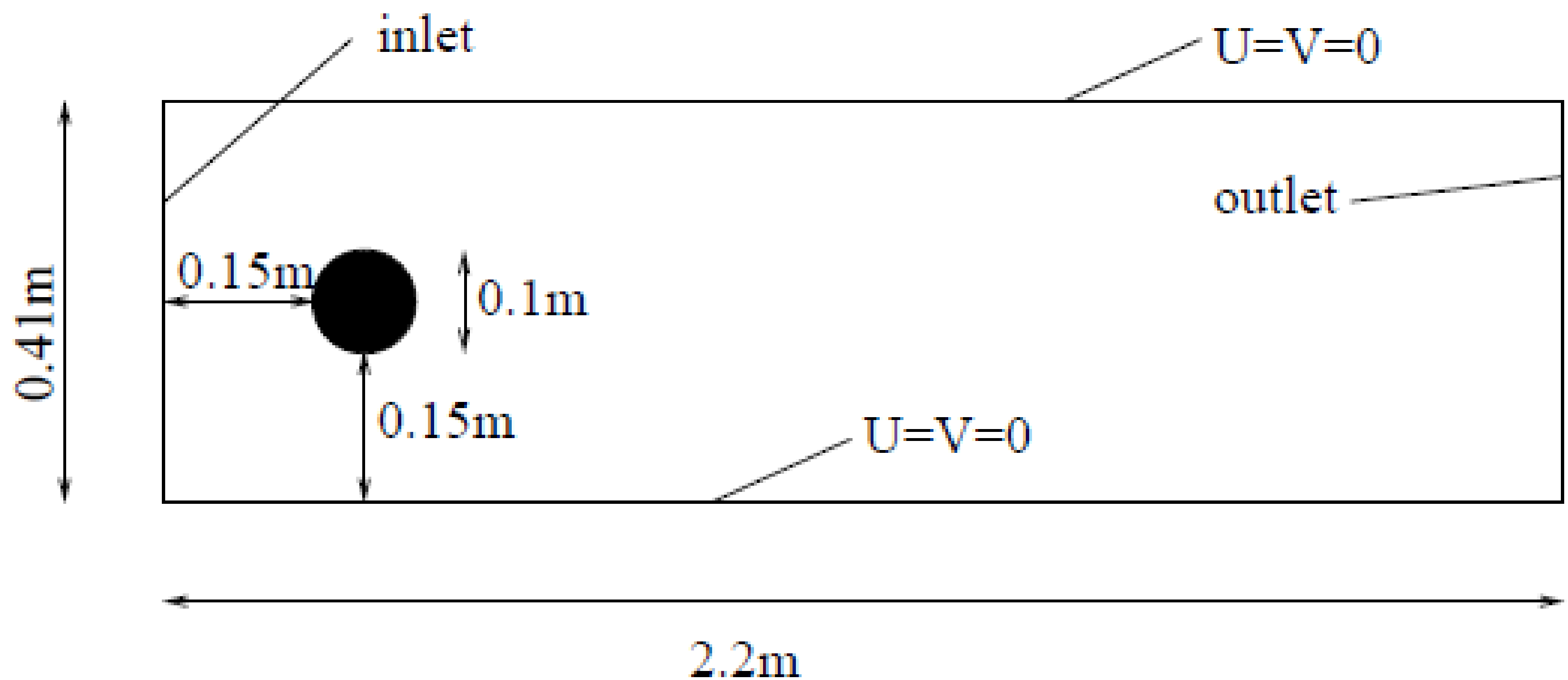
Observation regarding Mesh Refinement:
We observe that the Mesh is coarse in areas where we have a low Temperature Gradient and the Mesh is refined (fine) only in the areas where we have a high Temperature gradient (and hence we need a finer resolution to capture all the behaviors of the system).

Exercise 1 (f) - Solving with Adaptive Mesh Refinement and Round Corners

Table 1 (f) - Normal Heat Flux over Outer Boundary

# Elements	Value of Integral (in W/m)
22122	707759.7
48658	707246.1
103687	707067

Exercise 2 – Flow around a cylinder (2D)



Exercise 2 (b) – Stationary Flow Scenario

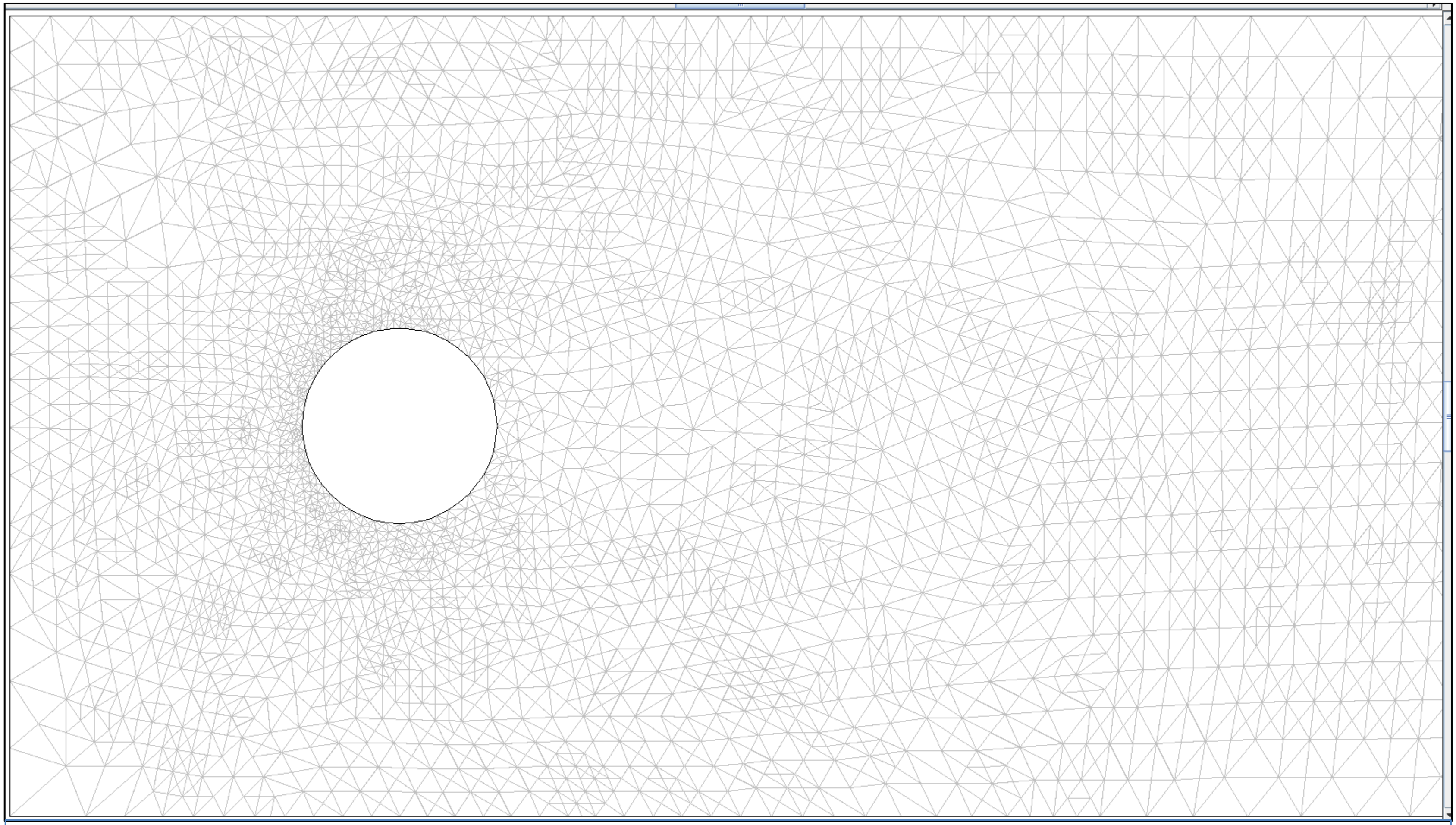


Figure 2(b)(i) – Mesh in Stationary Flow Scenario

Exercise 2 (b) – Stationary Flow Scenario

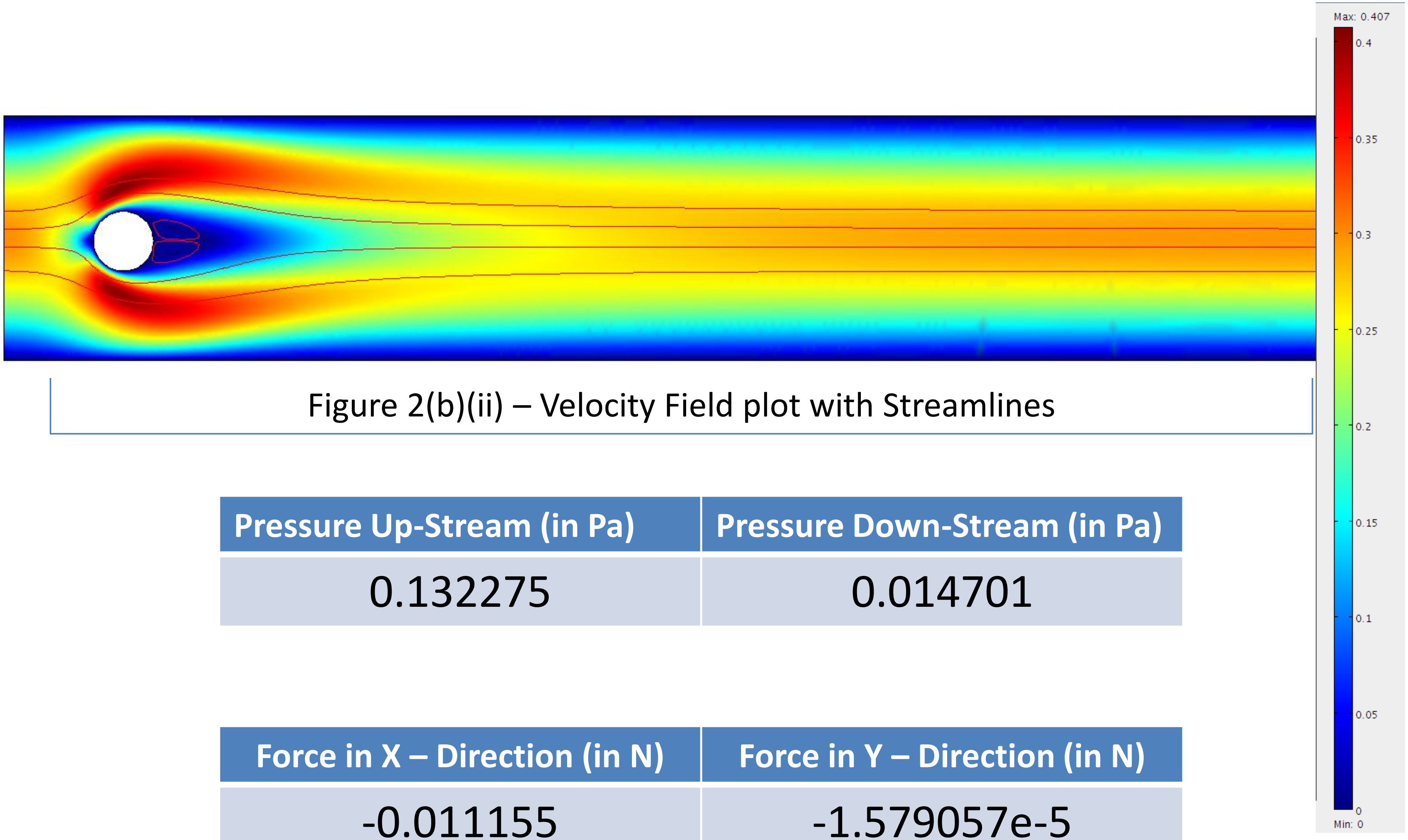
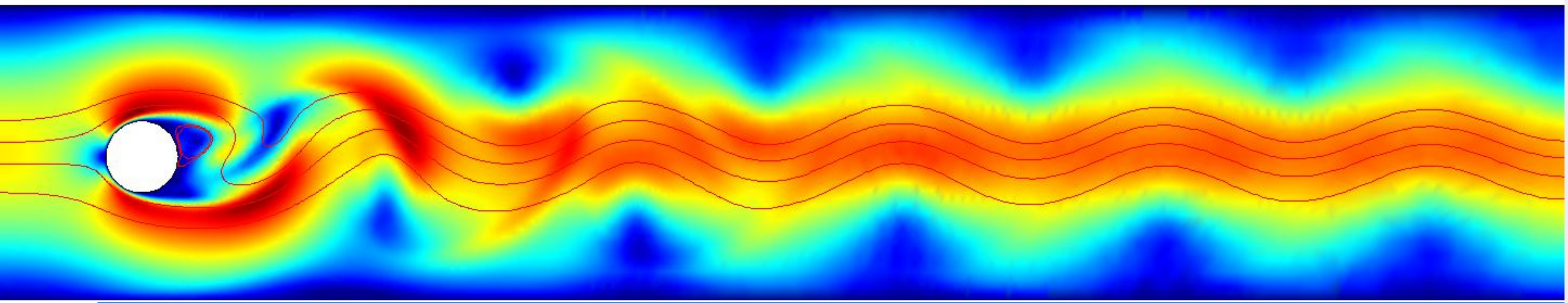


Figure 2(b)(ii) – Velocity Field plot with Streamlines

Pressure Up-Stream (in Pa)	Pressure Down-Stream (in Pa)
0.132275	0.014701

Force in X – Direction (in N)	Force in Y – Direction (in N)
-0.011155	-1.579057e-5

Exercise 2 (c) – Time Dependent Flow Scenario



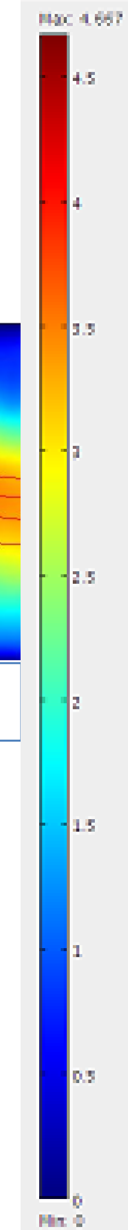


Figure 2(c)(i) – Velocity Field plot with Streamlines

Exercise 2 (c) – Time Dependent Flow Scenario

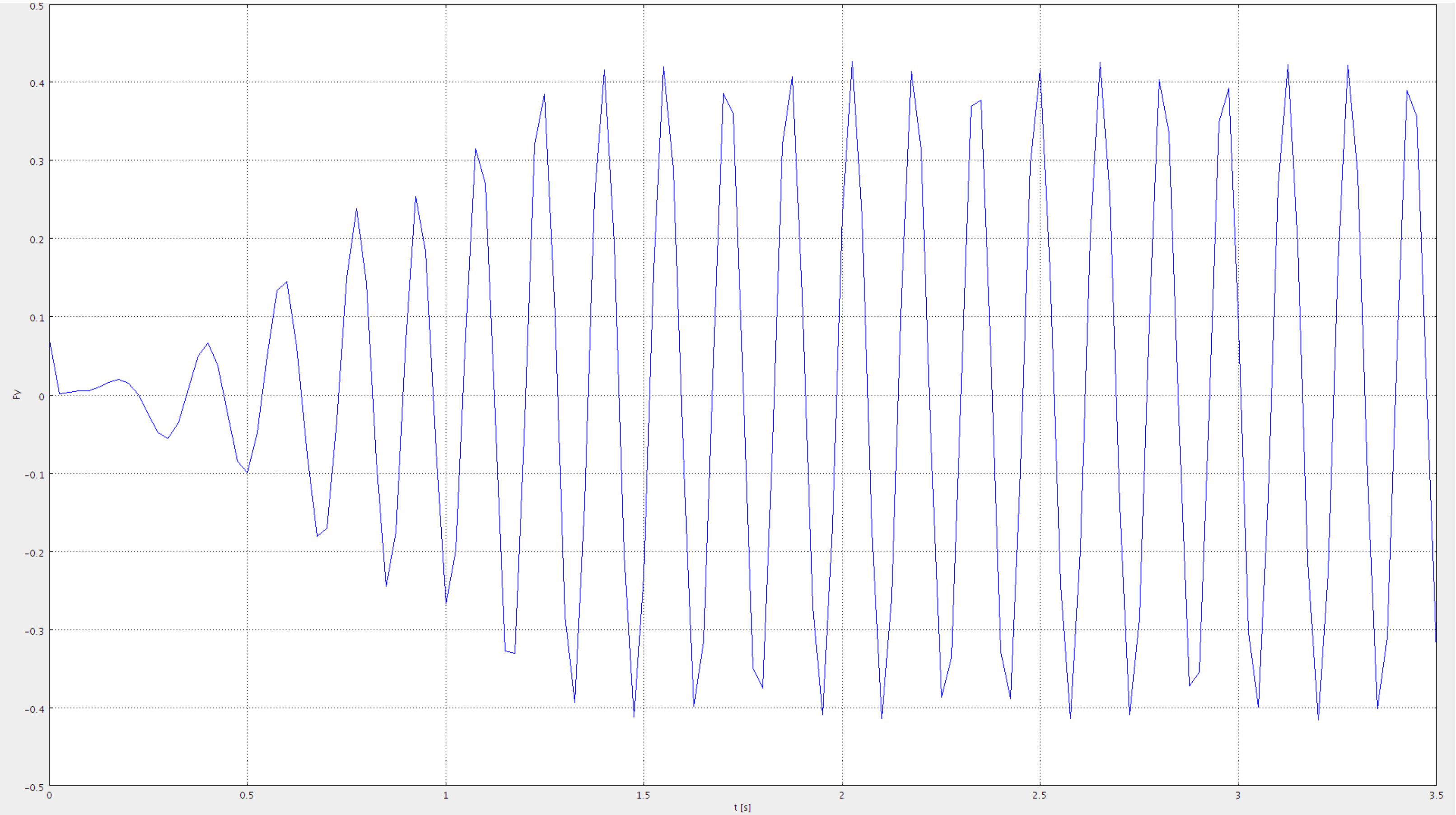


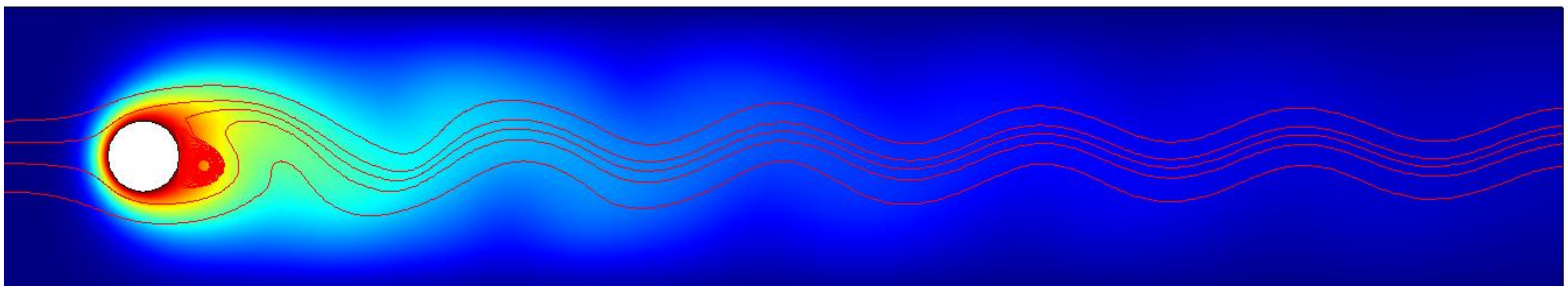
Figure 2(c)(ii) – Plot of Fy over simulation time

Frequency:
Frequency of Fy = 6 Hz

Exercise 2 (d) – Time Dependent Flow Scenario with Additional Heat Transfer

Figure 2(d)(i) – Temperature Distribution at final stage (Time t = 7 sec)

Exercise 2 (d) – Time Dependent Flow Scenario with Additional Heat Transfer



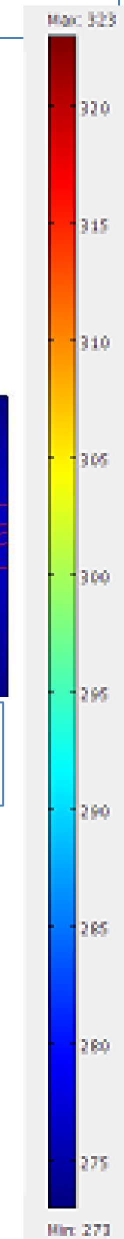


Figure 2(d)(i) – Temperature Distribution at final stage (Time t = 5 sec)