## BOUNDARY LAYER FLOW (TASK 1) – ANSYS TUTORIAL

### Step 1: Open Ansys Workbench

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Step 2: Drag the Fluent Box into the Workbench Schematic Area



#### Step 3: RMB the Geometry and Edit Using Design Modeler



### Step 4: Select the XY Plane and Select "Sketching"



Step 5: Draw a Rectangle using the "Rectangle" Tool under the Draw Tab and Dimension this with the "General" Dimension Tool under the Dimensions Tab. Dimensions are shown in the Figure.



Step 6: Use the Line Tool to draw a horizontal line in the middle of the rectangle and a diagonal line to a form the figure shown below. Use the "Trim" Tool under the Modify tab to remove the excess lines and dimension as before using the dimensions shown in the figure.



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Step 7: Under the "Concept" Tab, select "Surfaces from Sketches". Select all edges of the drawing.

Step 8: Click "Generate" to generate the surface and close the Design Modeler.



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Step 9: Edit the Mesh by selecting RMB -> Edit

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Step 10: Select the flat plate and RMB -> Create Named Selection; call this "Flat Plate". Repeat this process for the other edges, such as the Inlet, Outlet, and Opposite (Left, Right, and Top, respectively)

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Step 11: RMB Mesh -> Insert -> Sizing, to define a mesh size.

Step 12: Create a Mesh based on a Named Selection and select the "Flat Plate" as shown before. Input the Number of Divisions (Select 1000 for a fine mesh, or 200 if you have the Academic version). Set the Bias Type and Bias Factor as shown.

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| E Advanced   |   |                |             |                 |  |                  |  |              |                    |                 |             |                |                     |        |
| Behavior:  | Soft  |                |             |                 |  |                  |  |              |                    |                 |             |                | × .                 |        |
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Step 13: Generate the Mesh, it should look similar to what is shown below, then close the Mesh Editor.

| D 60 *   | Contest   |   |              |               | A. Plast New     | (Faird) - Meda                              | ng physics autodom              | Profett                |  |       |                |              |          |        |           | - 8                 | ×         |
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| Outsile of "Edge Tiping"   | Sinna   | + # E X                                 |              | ATA           | State .          | (注)   | 公田林白田                           | TRANK AND A            | Thank the  | 林林    | 長公井            | 大田公          | 计公开      | 公开     | 12.63     |                     |           |
| II Scope   | - 1995-W.   |   |              | 江口油           | <b>Williamen</b> | Com carried in                              | al statement of the             | The source cost of the | 明確語語の  | 19-50 | designed and   | souther as   | 10000    | 田田田    | 1417 역    | 4                   |           |
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| fige   | Number of Divisions   |   | -            | -             |                  |   |                                 |                        |  |       |                |              |          |        |           |                     |           |
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| files Option   | Hist Factor   |   |              |               |                  |   |                                 | 0.288                  | 0.78.5   |       |                |              |          |        |           |                     |           |
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Step 14: Open Ansys Fluent by RMB -> Setup, select Double Precision and then OK.



Step 15: Perform a Mesh Check, then set the Model to "Viscous – K-Epsilon (2 eqn.)" as shown.



Step 16: Set the Material to a Fluid and Air, with the density and viscosity values shown in the figure.

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| fin Named Expressions<br>5 Solution<br>5 Mathods<br>5 Costrols<br>10 Report Definitions<br>10 Rendmark<br>10 Cell Registers   | Gravity                        | Chang  | e/Greate) Delet   | a dess hee        |                            |   |                       |                                 |       |
| Transition  |                                |  | Lanna   | A                 |                            |   |                       |                                 | .08   |



Step 17: Set Cell Zone Conditions to "Fluid" for the surface\_body.

Step 18: Set the Boundary Conditions. The "flat\_plate" and "Wall-surface\_body" should be set to wall, all others should be set to their respective types.

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| <ul> <li>Radiation (0ff)</li> <li>Heat Exchanger (0ff)</li> <li>G. Species (0ff)</li> <li>Solutionation &amp; Mebing L.</li> <li>G. Solutionation &amp; Mebing L.</li> <li>G. Solutionation (0ff)</li> <li>G. Structure (0ff)</li> <li>G. Structure (0ff)</li> <li>G. Structure (0ff)</li> <li>G. Solutionation (0ff)</li> <li>Solutionation (0ff)</li> <li>Solution (0ff)</li> <li>Solutionation</li></ul>   | ine pow<br>infer<br>enterior-surface_body<br>apposite<br>outfat<br>well-surface_body |   |   |                           |                      |       |
| Gat plate twall (d+7)  | Prote Type ID  |   |   |                           |                      |       |
| C inlet (velocity-inlet, id=3)   | webory-met - s   | - B @ #   |   |                           |                      |       |
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| order (pressure-suffer, L,     swift warfare, tooly (tyrem,     Dynamic Mesh     Reference Values     Keference Roamey   | Display Meet Denote Conditions   | Tacs area statistics:<br>minimum face area (s2<br>meminum face area (s2<br>Checking mesh<br>Dune. | 0 8.611318e-04<br>0 8.510812e-02                              |                           |                      |       |



Step 19: Set the reference values as shown in the figure below.

Step 20: Set the Methods to the values shown in the figure.

| A Fluid Flow (Fluent) Fluent@LAPTOP-APIC   | TRCL [2.6. dp. plovs, ske] (ANSYS CRO Exterprise)   |  |  |                    | -                   | в х   |
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| Ein Domain Phy   | rsica Neur-Defined Solution   | Humata View                            | Parallel Design                          | • <b>Q</b> ,Quit3- | 97 E                | ANSIS |
| Bitsch         Bitsch           ()         1x0         ()   | Scale     Q Continue  | es Diterfa                             | Nesh Models                              | Adapt              | Serface<br>+ Create |       |
| Outfine View   | Tatali Page   | 0                                      |  | Mesh               |                     | ×     |
| -Hisr Test   | Solution Methods  |  |  |                    |                     |       |
| Boundary Conditions     Interplate (well, kt=5)     Interplate (well, kt=7)     Interplate (well, kt=7)     Interplate (well-action) (kt=6)     Interplate (well-action) | Pressure-Velocity Coupling     Scheme     Coupled     Southal Descritutation     Crateria     Crateria     Crateria     Second Order     Momentum     Second Order Upwind     Turbuler: External     Second Order Upwind     Turbuler: Dissipation Rate |  |  |                    |                     |       |
| Cell Registers   | second Order Upwind   | Commis                                 |  |                    |                     |       |
| Calculation Activities     Ann Calculation   | Transert Formulation  | minimum face area<br>meximum face area | (#2): 2.130005e-03<br>(#2): 1.554253e-01 |                    |                     |       |
| G Results  | 🗆 Mai-Belative Time Advancement   | Checking mesh                          | ••••••                                   |                    |                     |       |
| the Granting   | There the Level it.   |  |  |                    |                     |       |

#### Step 21: Set the residuals to 1e-06 as shown.

| Linux File (Next) Residuant/HUN   | CHCL THE RELIENCE AND DAMAGE THE ENDING   | net  |  |   |             |            | -                               | 0 ×   |
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| Mesh<br>() Dro ()<br>() Uno ()<br>() Uno ()<br>() Drok. ()<br>() Quality +  | Datidae Manifers  | Zones<br>Equations<br>Radial Monto   | Check Conv   | erfaces Nesh  | Models<br>X | Adapt      | Surface<br>+ Create +<br>Manage |       |
| Outfleie View   | V Plot<br>Window<br>1 Conves. Autes.<br>Berations to Plot<br>1000 C<br>Recations to Store<br>1000 C | Residence view of the second s | heathers<br>1  | Le-06<br>Le-06<br>Le-06<br>Le-06<br>Convergence Criterior<br>abactute<br>Convergence Cond | Riena       | NDesh      |                                 | ×     |
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Step 22: Change the Initialization values to those shown below and then click, "Initialize".





Step 23: Go to "Run Calculation" set the Number of Iterations to 1000 and click "Calculate"

Step 24: After the calculations have been run, under "Results", double-click Contours and select "Velocity" of the surface\_body, then press Save/Display.

| A Public Films  | (Fort) Port   | ISCUTOR JH                         | CIRCL Dis. o  | C Sport and Distances in  | Eriessive)   |  |  |            |  |                           |                                 | ( <b>D</b> ) × |
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| () 345  | Oud.  | Mesh<br>Quality +                  | Scale.  | Contour<br>Contour Nerrer<br>velocity-contour<br>Optices  | Zon<br>Contours of   | 5  | Interf   | × 10       | Mesh Models<br>Dynamic Mesh<br>Moong Planes<br>Turtin Topology | Adapt<br>Rofine / Coansen | Surface<br>+ Create _<br>Marage |                |
| Outfine View  |   |                                    | Tank.   | w Filed   | Velocity   |  |  |            | Contours of V  | elocity Magnitude (m/s)   |                                 | ×              |
| Hint Test   | erence Frame<br>med Express<br>thois<br>thois<br>out Definition<br>nitors<br>Report Pitto<br>Report Pitto<br>Report Pitto<br>Report Pitto<br>Report Pitto<br>Report Pitto<br>Autorn<br>Convergence<br>Repitters<br>altation<br>a Uakton Addivit | s<br>ons<br>5<br>Conditions<br>185 | I Lan<br>Oysk<br>U C<br>Tan<br>Tan<br>Tan<br>Tan<br>Tan<br>Tan<br>Tan | Node Values     Carbor Lines     Carbor Lines     Clobal Sarge     Abb Range     Date Tuffus     Draw Mesh      Coloring     Danded     Siteath      Coloring      Co | Velocity Magnitud<br>Has<br>B<br>Sastfaces (Filter Te<br>fist: pitter<br>Henrice surface, bo<br>opporter<br>surface, body<br>well-safface, body<br>Mune Sarface, s   | He Max   | 5) E C F   |            |  |                           |                                 |                |
| <ul> <li>■ Surfice</li> <li>● Surfice</li> <li>● Grapping</li> <li>● Graping</li> <li>● Graping</li> <li>● Graping</li>     &lt;</ul> | faces<br>phics<br>Mesh<br>Contours<br>M selectly o<br>Vectors<br>Pathloes<br>Raticle Track  | antour                             | 1<br>Deta   | File Quartities   | Action of Control of C | Apartua Choos Hi<br>Tarca<br>Mi<br>Choos<br>Dune | Apa<br>area statistic<br>nimum face area<br>kinum face area<br>king mesh | 1923 1 8.1 | E118188-04<br>6118188-04<br>6108128-02                         |                           |                                 |                |

Step 25: Close Fluent, then in the Workbench, go to Results, then RMB -> Edit.



Step 26: Go to Insert, Location, Line as shown below.



Step 27: Set the Values to the location desired, the first one should be the values shown below. Repeat this process for the other 2 locations.



Step 28: Go to Insert, Chart.



Step 29: Input the information shown in the following 3 figures to generate your Chart. Repeat this process for the other 2 locations.

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|---|--|---|-----------|
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| Take absolu   | te value of data points  |   |           |
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| tals of Velocit   | y Profile  |   |           |
| General Dat<br>Data Selection   | a Series X Axis  | Y Axis Line Display Chart   | Display   |
| Variable  | x  |   | - 61      |
| Boondary Data   | C Hybrid   | e Conservative  |           |
| Avis Ranna  | or value or data points  |   |           |
| constraintly.   | anges automatically  |   |           |
| Determine n   | 0.753 (0.953) (0.953)  | Hay 1.0   | 80        |
| Determine #   |  |   |           |
| Petermine in  |  | The second se |           |
| Determine //<br>Hin (-1.0   | ic scale   | []] Invert axis   |           |
| Determine /<br>Hin (1.0<br>Logwitter<br>Avis Number Fo  | ic scale<br>xmatting   | []] Invertaxis  |           |
| Determine /<br>Hin (4.2<br>Logarithm<br>Axis Number Fo<br>Determine t   | ic scale<br>xisatting<br>he number format auto                     | Invertaxis  | _         |
| Determine //     Min (1.2     Logarithm     Axis Number Fo     Determine t     Riection                                   | ic scale<br>xmatting<br>he number format auto<br>3                 | Invertaxa<br>onetcely<br>: Scientific   |           |
| Determine //     Min (4.4)     Logarithm     Axis Number Fo     Determine t     Recision     Axis Labels                  | ic scale<br>xesating<br>he number format auto<br>3                 | Invertaxis<br>anatody<br>2   Scientific   |           |
| Determine //     Min (4.2)     Logarithm     Axis Number Fo     Determine to     Recision     Axis Labels     Que data fo | ic scale<br>xinatting<br>ne number format auto<br>3<br>axis labels | Invertaxa<br>anatody<br>2 Scientific  | 8         |

Step 30: The chart should look like the figure below. To generate Contours and Vectors, click the corresponding Contour and Vector buttons.

