

Computational Fluid Dynamics (AE/ME 339)

Take Home Final Exam (Due: 10:30 am, Tuesday, December 7, 2002)

1. You are to write a computer program and a report summarizing the results for flow in a converging/diverging nozzle using the equations in the conservation form. The nozzle shape is given by

$$A = 1 + 2.2(x - 1.5)^2 \quad 0 \leq x \leq 3 \quad (1)$$

Fluid medium: air

Reservoir conditions:

$$\text{Case 1: } p_0 = 40 \text{ atm (abs), Case 2: } p_0 = 1.5 \text{ atm (abs)} \\ T_0 = 15 \text{ C}$$

Nozzle exit conditions:

$$p_e = 1 \text{ atm (abs)}$$

Your report should include the following at a minimum: (You are welcome to run additional cases and discuss your results. Your report should not be more than 10 pages)

- i) A flow diagram of the procedure.
- ii) Problem set up: Governing equations, initial and boundary conditions.
- iii) Tabulated values of the Case 1 results for 30 intervals in the manner given in Table 7.3 (Text). Use non-dimensional form and the same order of variables as in Table 7.3.
- iv) Plot of the pressure ratio, temperature ratio and Mach number given in the table. Plot all the variables in the same graph.
- v) Redo the calculations for Case 2 and tabulate and plot the results as in the previous case.
- vi) Results and discussion
- vii) A copy of the source code on floppy disk with instructions to run it.
- viii) Conclusions

Important notes:

- i) You are expected to work independently. **Do not consult or collaborate** with anybody else.
- ii) Remember that this is not a home work project. **I will answer only questions to clarify the statement of the problem or to give missing information, if any.**
- iii) There will be a 10-minute oral review of your work on December 17, 10:30 am, 214 Civil Engineering Building, at the regular final exam time.
- iv) Your grade will be based on the report and the oral review.