

Project brief

Develop a numerical algorithm which can design a ramjet engine. The inputs for your code should be

- (a) Free-stream pressure and temperature;
- (b) Flight Mach number
- (c) Normal shock strength
- (d) Burner entry Mach number
- (e) Burner temperature
- (f) Required thrust

The outputs of your code should be

- (a) Inlet area
- (b) Inlet throat area
- (c) Burner entry area
- (d) Burner exit area
- (e) Nozzle throat area
- (f) Exhaust area
- (g) Thermodynamic efficiency
- (h) Propulsive efficiency

Using the code you have developed, produce plots showing the variation of thermodynamic and propulsive efficiency with each of the input parameters above. When producing your plots, you will be required to hold some input parameters constant: for this, you are free to use any reasonable values.

You may make any reasonable, justifiable assumptions you wish, though these should be explicitly detailed and justified in the report.

Format

Each team should submit a single report consisting of the following sections:

- (a) Report cover page: Should indicate the title, the names of the team members, the submission date and the course code. Only those team members whose names appear on the cover sheet will receive credit for the coursework.
- (b) Definitions: It may be a good idea to include a brief statement at the beginning of your report defining the variables and terms you will be using. The purpose of this is only to ensure that the assessor is able to understand your solution. Similarly, it may clarify your solution if you include a labelled diagram.
- (c) Source code: Your report should include a printout of the complete source code (including all subroutines or functions) used to produce your results. You may write your code using any programming language you wish, *providing that it is sufficiently intuitive that a non-specialist will be able to interpret it* (MATLAB, Python, C++, Basic, FORTRAN and MS Excel are all acceptable). You may use any rudimentary in-built functions, but you may not use any available prefabricated normal shock or isentropic flow functions.
- (d) Comment lines: Your code should include comment lines, explaining what the code is doing at each step. Your comment lines should also indicate any assumptions you have made. *If I cannot figure out what your code is doing, I cannot give you credit for it.*
- (e) Results: Generate the plots listed in the project requirements. Use proper scientific conventions for plotting (note that the MS Excel default settings are *not* appropriate for the presentation of scientific data). If, for given conditions, no solution exists (or many solutions exist), comment on why this occurs.
- (f) Conclusion: You should include a very brief statement indicating whether or not you believe your code is working, and why. *this is a critical part of the project, as it demonstrates that not only could you produce the code, but you could interpret and explain the results.*

Electronic file submissions must be in PDF format only, and less than 5 MB in size. For figures or plots, use line drawings only. Hand-drawn figures are acceptable, so long as they are clear and of technical-drawing standard.

Remember, this is an exercise in analysis, not in report-writing. You do not need to repeat material covered in class, and there is no need for a detailed description. You only need to include an explanatory text in your report if you cannot clearly explain what you are doing in comment lines. Reports should be concise.