Intake design Steps

1. Select the engine and the aircraft (type – civil/military etc.)
2. Select the design point – usually cruise condition. If there are other concerns or critical design issues – consider.
3. Select the Intake positioning – wing mounted, fuselage side mounted, buried inside the fuselage etc.
4. Select the design Mass flow through the Intake
5. Obtain the flight Mach no. and the engine face delivery Mach no. – That sets up the diffusion requirement
6. Determine or obtain the engine face Diameter D_2 and area A_2 .
7. Choose an Intake cross section at the Intake entry face – Axi-symmetric, Assymetric, 2-D – Square / Rectangular
8. Choose a lip shape – Body of revolution of an Airfoil shape, Sharp (for Supersonic) with circular arcs, Elliptic
9. Choose a cowling shape – either i) extended upper lip, or ii) extended lower lip to create a blended intake face
10. Create an internal shape of the intake for subsonic diffusion to meet the delivery Mach no.
11. Choose the approach area ratio A_1 / A_∞ from the theory; Use A_2 / A_∞ to begin with along with flow ratio A_∞ / A_1
12. Use parameters like Duct Integral, I, Position ratio J and K to determine various geometrical parameters. Use the graphs and plots available for this purpose.
13. Determine momentum B.L. thickness (if fuselage mounted) using position ratio and other theories
14. Determine the internal length of the subsonic Intake, L
15. Assign the ramp angles, the shock structure for a supersonic Intake and compute the flow through the shock
16. Compute all the losses, --- Approach, Shock and internal flow from theories available
17. Determine on Bleeds and Diverters (if required)
18. Create one diagram to show all the geometrical features of the Intake.

Nozzle Design procedure

1. Step-1 Determine nozzle design point: (may be Take off)
   Nozzle throat Parameters
   Mass flow parameter
   Assume value of discharge coefficient C_d and calculate actual flow area required and on Area ratio calculate the exit area of nozzle (for a simple convergent nozzle).

2 Step-2 Determine velocity coefficient:
   Using gas table using Critical Area ratio calculate Mach no and Pressure ratio
   Calculate ideal exit velocity at design point
   Calculate actual exit velocity at design point
   Calculate velocity coefficient at design point

3 Step 3 – Nozzle performance assessment:
   Calculate Nozzle thrust coefficient at Design point
   Calculate gross thrust at Design point

4. Step 4 - Decide on variable area requirement at the exit face depending on operational requirement

5. Step – 5 – Compute Nozzle performance at two more critical operating points e.g. Cruise and Climb

6. Step- 6 – Determine the extent of thrust vectoring required and adapt variable geometry for this purpose
   Compute thrusts with thrust vectoring