ASE 376K Homework # 5

1. Start with expressions for specific thrust and thrust for a turbofan engine. Assume $f << 1$ and pe=pa. Assuming $U_{e,p} = 4u$ and $U_{e,f} = 2u$, and flight speed of u, derive expressions for

   (a) Thrust Ratio (thrust of bypass flow to primary flow)
   (b) Specific Thrust (use the total mass flow of air for this)
   (c) Thrust Specific Fuel Consumption

2. An engine has been designed for a V/STOL aircraft. The maximum take off (MTO) weight in Vertical Take Off (VTO) condition is 9415 kg. Assuming the engine is designed for maximum thrust in VTO condition, compute the exhaust velocity when the vehicle is flying at its top speed of 1083 km/hr. The engine is a low-bypass turbofan with a bypass ratio of 1.2, maximum incoming airflow of 196 kg/s and fuel air ratio of 0.03 at maximum thrust. Assume exhaust velocity for both streams is the same.

3. For Problem 3, if the nozzles are turned down by 25^{o} from the horizontal, calculate the vertical component of thrust developed.

4. Compare the stagnation pressure loss and static compression ratio of a normal shock inlet (internal compression) with an incoming Mach No. of 3.0 against the following supersonic intake scenario: An oblique shock inlet (external compression) with an incoming Mach No. of 3.0, and a multi-angle ramp of 5 degrees and 8 degrees, followed by a normal shock. Use normal and oblique shock tables or graphs. Based on the results discuss the advantage and disadvantage of the two types of systems.