

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING
FINAL EXAMINATION – APRIL 2001
AER510S – AEROSPACE PROPULSION
EXAM TYPE: X

Duration: 2-1/2 Hours
Examiner: Prof. J.P. Sislian
Teaching Assistant: V. Turca

1. A ramjet has *ideal* performance in every component except that combustion occurs at finite Mach number at constant pressure. Show that in this case the specific thrust is given by

$$\frac{T_h}{\dot{m}_o} = a_o M_o \left\{ \left[\tau_b - \left(\frac{M_b}{M_o} \right)^2 (\tau_b - 1) \right]^{1/2} - 1 \right\}$$

Mark: 30/100

2. For an *ideal* turbojet engine with fixed τ_λ and π_c , does the nozzle-exit static temperature increase or decrease with increasing M_o ? What does this imply about the thermal efficiency of the engine?

Mark: 20/100

3. A turbojet compressor of pressure ratio $\pi_c = 30$ and a compressor efficiency $\eta_c = 0.89$ is driven by a turbine with polytropic efficiency $e_t = 0.90$. Determine π_t and the turbine efficiency η_t . Assume:

$$T_2^\circ = 255.6 \text{ K}, \quad T_4^\circ = 1444.4 \text{ K},$$

$$f = 0.02, \quad C_{pc} = 1000 \text{ J/kg-K}, \quad \gamma_c = 1.4, \quad C_{pt} = 1240 \text{ J/kg-K},$$

$$\gamma_t = 1.3 \quad \text{and} \quad \eta_m = 1.0$$

Mark: 20/100

4. For an *ideal* turbofan show that when s is minimized with respect to τ_c , for given τ_c and α , it is required to have $u_9 = u_9^*$.

Mark: 30/100