UPES

End Semester Examination, May, 2018

Roll No: -------------

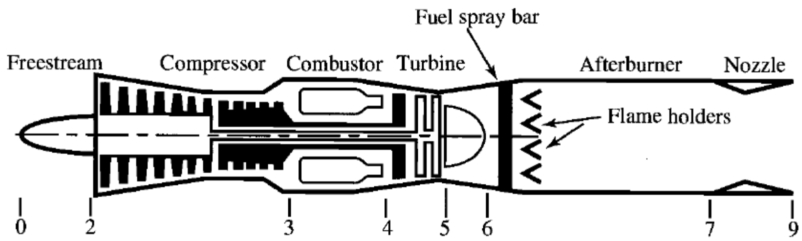
Program Name: B.Tech ASE, ASE+AVE **Semester –VI**
Course Name : Prolusion II **Max. Marks : 100**
Course Code : ASEG 322 **Duration : 3 Hrs**
No. of page/s:04
Isentropic tables and Handouts are allowed

Instructions: Make use of *sketches/plots* to elaborate your answer. Brief and to the point answers are expected. **The Question paper has three sections: Section A, B and C, Section B and C have internal choices.**

Section A (Attempt ALL questions) **5x4=20 Marks**			
		Marks	Course Outcomes
Q1.	What is the difference in propulsive action between a propeller engine and a jet propulsion engine?	**4**	**CO4**
Q2.	Describe Compressor Staging Problems, Degree of reaction, Cascade Airfoil and Diffusion Factor.	**4**	**CO5**
Q3.	Differentiate between air specific impulse and fuel specific impulse. In what way these two parameters are useful in comparing different propulsion systems.	**4**	**CO3**
Q4.	What are the Main Burner types, Burner components for air breathing Engines, airflow distribution and cooling air ?	**4**	**CO2**
Q5.	Describe the effect of heat addition and heat extraction on the flow velocity in a constant area duct Rayleigh flow when the flow is (i). Initially subsonic (ii). Initially Supersonic	**4**	**CO1**
Section B (Attempt ALL questions) **(5 X 8 =40 Marks)**			
6.	A supersonic stream at Mach number 3.0 has to be decelerated in a convergent nozzle to sonic conditions at the exit of the nozzle.	**8**	**CO2**

	Calculate the pressure and temperature at the entry and the mass flow rate. What will be the temperature indicated by a thermocouple held in the flow direction at the entry. The conditions at the nozzle exit are 0.8 at,. 293 k and the exit area is 40 cm^2		
7.	The data at inlet to a ramjet engine combustion chamber employing a hydrogen fuel are as follows: Velocity of air fuel mixture= 73 m/s, Static temperature=333 K, static pressure= 0.55 bar. The heat of reaction of the fuel air mixture is 1400 kJ/kg. Assuming that the working fluid has the same thermodynamic properties as air before and after combustion. Calculate (i). the loss in stagnation pressure due to heat addition (ii). the maximum heat of reaction for which flow with the specified initial conditions can be maintained	**8**	**CO3**
8.	An ideal turbofan with an exhausted fan flies at sea level at a Mach number of 0.75. The Primary flow is 74.83 kg/s, and the bypass ratio is 1.20. The compressor pressure ratio is 15, whereas that of the fan is 3. The fuel has a heating value of 41,400 kJ/kg, and the burner exit total temperature is 1380 K. Find the developed thrust and the TSFC if ϒ=1.40	**8**	**CO4**
9.	Derive the variation of throat area ratio A/A* and pressure ratio P2/P1 with respect to Mach number for the supersonic flow. (OR) A normal shock wave occurs at the inlet of a diffuser. The Mach number at the exit of the diffuser is 0.3 and the area ratio between the inlet and outlet of the diffuser is 0.695. Find the Mach number of air at inlet to the diffuser	**8**	**CO1**
10.	Derive an expression for the Mach number of flow downstream of normal shock, in terms pf the Mach number upstream of the shock. State the assumptions made. (OR) (a). How would you describe critical components for design of Burners and list various components? (b). What do you mean by afterburner? What are the components required for the afterburner and its design parameters? (c) Discuss about the flame stability with and without afterburner	**8**	**CO 3**
Section C (Attempt ALL questions) **(2 X 20M =40 Marks)**			
11.	Explain the assumptions in Ideal cycle analysis using the T-S Diagram for Turbojet after burner engine. Derive the expressions for specific thrust, specific fuel consumption, exit Mach numbers,		

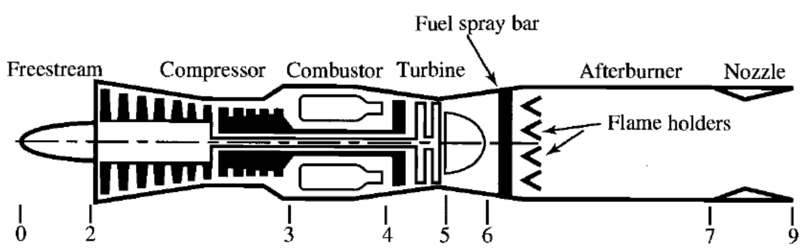
	Velocity ratio, thermal efficiency, Propulsive efficiency and Over all efficiency.	**20**	**CO3, CO4**



(OR)

Consider a turbo jet after burner engine with losses, calculate the performance of a turbofan engines, Specific Thrust, Specific Fuel Consumption, Exit Velocity Ratio, Thermal Efficiency, Propulsive Efficiency using real cycle analysis for the following data

$$M_0 = 2,\ T_0 = 390^\circ\text{R},\ \gamma_c = 1.4,\ c_{pc} = 0.24\ \text{Btu/(lbm}\cdot{}^\circ\text{R)}$$
$$\gamma_t = 1.33,\ c_{pt} = 0.276\ \text{Btu/(lbm}\cdot{}^\circ\text{R)},\ h_{PR} = 18{,}400\ \text{Btu/lbm}$$
$$\gamma_{AB} = 1.30,\ c_{pAB} = 0.295\ \text{Btu/(lbm}\cdot{}^\circ\text{R)},\ \pi_{d\max} = 0.98,\ \pi_b = 0.98$$
$$\pi_{AB} = 0.98,\ \pi_n = 0.98,\ e_c = 0.89,\ e_t = 0.91,\ \eta_b = 0.99$$
$$\eta_{AB} = 0.96,\ \eta_m = 0.98,\ P_0/P_9 = 1,\ T_{t4} = 3000^\circ\text{R}$$
$$T_{t7}=3400^0\ \text{R},\ \pi_c=14.$$



$$\frac{F}{\dot{m}_0} = \frac{a_0}{g_c}\left[(1+f+f_{AB})\frac{V_9}{a_0} - M_0 + (1+f+f_{AB}) \times \frac{R_{AB}}{R_c}\frac{T_9/T_0}{V_9/a_0}\frac{1-P_0/P_9}{\gamma_c}\right]$$

	$$\eta_P = \frac{2g_c V_0(F/\dot{m}_0)}{a_0^2[(1+f+f_{AB})(V_9/a_0)^2 - M_0^2]}$$ $$\eta_T = \frac{a_0^2[(1+f+f_{AB})(V_9/a_0)^2 - M_0^2]}{2g_c(f+f_{AB})h_{PR}}$$		
12.	Air enters a compressor which has the following properties, Isentropic flow $T_{t1} = 518.7°R$, $P_{t1} = 14.70$ psia, $\omega = 1000$ rad/s, $r = 12$ in. $\alpha_1 = \alpha_3 = 40$ deg, $\dot{m} = 50$ lbm/s, $M_1 = M_3 = 0.7$ $u_2/u_1 = 1.1$, $P_{t3}/P_{t1} = 1.3$ Gas is air. Note: For air, $\gamma = 1.4$, $c_p = 0.24$ Btu/(lbm · °R), $Rg_c = 1716$ ft^2/(s^2 · °R) $c_p g_c = 6006$ ft^2/(s^2 · °R) Determine the following parameters using velocity triangles of the axial compressor. a. Inlet and outlet velocity components for both rotor and stator b. Temperature and pressures at the respective stages c. Flow annulus area at the each stage using MFP (M_1)= 0.4859, MFP (M_2)= 0.5260 d. Degree of Reaction for a single stage	**20**	**CO5**