Download Anna University Questions, Syllabus, Notes @
www.AllAbtEngg.com

Reg. No. :

Question Paper Code : 52528

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Aeronautical Engineering

AE 6404 — PROPULSION – I

(Regulation 2013)

Time : Three hours

Maximum : 100 marks

(Use of GAS tables are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define thermal efficiency of an engine.

2. Draw the ideal and real cycle T-S diagram for a turbojet engine with afterburner.

3. What is the significance of using variable area nozzles in aircraft engines?

www.binils.com

4. List the advantages and disadvantages of can- annular combustion chamber.

5. What are effects of slip on the compressor blades?

6. How will you increase the pressure ratio across the stage of an axial flow compressor?

7. State the necessary design condition for free vortex staging of an axial flow turbine.

8. What are various types of loss must be accounted for the calculation of an overall blade loss coefficient?

9. Why the actual ramjet diffuser always irreversible?

10. What is major advantage of using supersonic combustion in ramjet engine?

Download Anna University Questions, Syllabus, Notes @
www.AllAbtEngg.com

PART B — (5 × 13 = 65 marks)

11. (a) Illustrate the variation of specific thrust and specific fuel consumption with respect to pressure ratio, turbine inlet temperature and flight Mach number for a turbojet engine. And discuss its effect on performance.

Or

(b) How an after burner does help to improve the takeoff thrust of an aircraft engine? And explain how it will affect the performance of an engine.

12. (a) (i) Derive an expression for isentropic efficiency of a subsonic diffuser. (6)

(ii) State the important factors affecting combustor design. (7)

Or

(b) How will you evaluate the performance of nozzle using dimensional coefficients?

13. (a) A centrifugal compressor runs at 10000 rpm and delivers 800 m^3/min of free air at a pressure ratio 5:1. The isentropic efficiency of compressor is 82%. The outer radius of impeller (Which is radial blade) is twice the inner one and neglects the slip coefficient. Assume that the ambient air conditions are 1 bar and 293 K. the axial flow velocity is 60 m/s and is constant throughout. Determine.

(i) Power input to the compressor. (4)

(ii) Impeller diameter at inlet and outlet and width at inlet. (5)

(iii) Impeller and diffuser blade angles at inlet. (4)

www.binils.com

Or

(b) An axial flow compressor takes in 1000 m^3/min of free air at 0.9 bar and 15°C. The blades are of aerofoil type having projected area and blade length as 20 cm^2 and 7 cm respectively. The blade ring mean diameter is 75 cm and speed is 7500 rpm. On each blade ring there are 75 blades and the blades occupy 10% of the axial area of the flow. Values of C_L and C_D are 0.6 and 0.05 respectively at zero angle of incidence. Assuming isentropic compression, calculate the pressure per blade ring and the power input per stage. Assume axial inlet.

14. (a) In a single- stage impulse turbine the nozzle discharges the fluid on to the blades at an angle of 65° to the axial direction and the fluid leaves the blades with an absolute velocity of 500 m/s at an angle of 30° to the axial direction. If the blades have equal inlet and outlet angles and there is no axial thrust. Determine the blade angles, power produces per kg/s of the fluid and the blade efficiency.

Or

www.AllAbtEngg.com www.PhotoShip.Net www.SmartPoet.net

Download Anna University Questions, Syllabus, Notes @
www.AllAbtEngg.com

(b) (i) Explain in detail about the limiting factors in turbine design. (6)

(ii) Classify the turbine cooling method, brief about the film cooling technique. (7)

15. (a) Show that the ideal ramjet engine gives the thrust per unit mass flow of air as $\dfrac{\mathcal{T}}{\dot{m}_a} = M\sqrt{\gamma RT_a}\left[(1+f)\sqrt{T_{04}/T_a}\left(1+\dfrac{\gamma-1}{2}M^2\right)^{-1/2} - 1\right]$.

Or

(b) A ramjet is travelling at Mach 3 at an altitude of 4572 m, the external static temperature is 258.4 K and the external static pressure is 57.1 kPa. The heating value of the fuel is 46520 kJ/kg. Air flows through the engine at 45.35 kg/s. the burner exit total temperature is 1944 K. Find the thrust, fuel ratio and TFSC. The specific heat ratio can be assumed to be 1.40.

PART C — (1 × 15 = 15 marks)

16. (a) Determine the specific thrust and SFC for a simple turbojet engine, having the following component performance at the design point at which the cruise speed and altitude are M 0.8 and 10000 m.

Compressor pressure ratio	8.0
Turbine inlet temperature	1200 K
Isentropic efficiency of compressor	87%
Isentropic efficiency of turbine	90%
Isentropic efficiency of intake	93%
Isentropic efficiency of nozzle	95%
Mechanical transmission efficiency	99%
Combustion efficiency	98%
Combustion pressure loss Δp_b	4% compressor delivery pressure
Ambient pressure at 10000 m	0.265 bar
Ambient temperature at 10000 m	223.3 K
Flight speed	299.5 m/s
Theoretical fuel / air ratio	0.0198

www.binils.com

Or

www.AllAbtEngg.com www.PhotoShip.Net www.SmartPoet.net

Download Anna University Questions, Syllabus, Notes @
www.AllAbtEngg.com

(b) For the mixed compression two–dimensional supersonic inlet shown Fig.16.b the free stream Mach number is 3.0. Three-shock system (two oblique and normal shocks) reduces the speed from supersonic to subsonic speeds. Calculate the following

(i) The overall total pressure ratio

(ii) The overall static pressure ratio.

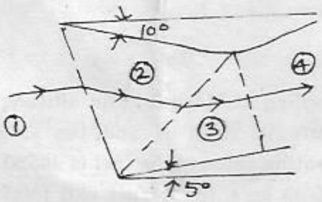

Fig 16.b.

www.binils.com

www.AllAbtEngg.com www.PhotoShip.Net www.SmartPoet.net