Register No: ……

B.E. DEGREE EXAMINATIONS: APRIL/MAY 2011

Fourth Semester

AERONAUTICAL ENGINEERING

U07AR404: Propulsion - I

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions

PART A (10 x 1 = 10 Marks)

1. Gas turbine engine works on_____

a) Open brayton cycle b) Closed brayton cycle c) Rankine cycle d) Carnot cycle

2. Which engine has low noise_____

a) Piston engine b) Turbojet c) Turboprop d) Turbofan

3. In subsonic flow the shape of nozzle is _____

a) Convergent b) Divergent c) Straight d) Perpendicular

4. Buzz is an airflow instability caused by_____

a) The isentropic wave b) The sound wave c) The shock wave d) The acoustic angle

5. Combustion is a _____process

a) Isochoric b) Endothermic c) Isobaric d) Exothermic

6. Lean-burn combustion indicates the uses of _____

a) Excess air b) Less air c) More fuel d) More fuel and air

7. The mass flow rate at chocking condition is _____

a) Negligible b) Minimum c) Infinity d) Maximum

8. The condition for over expanded nozzle flow _____

a) $P_e<P_b$ b) $P_e>P_b$ c) $P_e=P_b$ d) $P_e\leq P_b$

9. A Stage in compressor consists of a_____

a) Stator and guided vanes b) Stator only c) Rotor only d) Rotor and stator

10. The value of slip factor for 5numer of vanes in centrifugal compressor is _____

a) 100 b) 3 c) 0.3956 d) 0.09

PART B (10 x 2 = 20 Marks)

11. Define thrust.

12. Draw the T-S and V-S diagram of brayton cycle.

13. Write the uses of nozzle.

14. Write the different types of combustion chamber.

15. Write the uses of flam holder.
16. Define combustion.
17. What is under expanded nozzle flows?
18. Define Thrust reversal.
19. Define degree of reaction.
20. Find the theoretical work done from the given data $\sigma=5$ and U=4m/s?

PART C (5 x 14 = 70 Marks)

21. a) A turbojet engine draws air at the rate of 1kg/s while flying at a speed of 900Kmph.The velocity of gases at the exit of the nozzle is 620m/s. The engine uses fuel at the rate of 0.0125kg/s of calorific value 45000kJ/kg. Find:
    (i) fuel-air ratio
    (ii) fuel consumption in kg/hr
    (iii) Thrust, thrust power and TSFC
    (iv) Propulsive power and propulsive efficiency
    (v) Thermal and overall efficiency of turbojet.

(OR)

b) (i) Describe the working of turbojet engine with illustrative sketches also draw T-S diagram. (10)
(ii) Explain any one thrust augmentation method. (4)

22. a) Air at 15 bar and 1000k enters a convergent-divergent nozzle with negligible velocity under steady state conditions. For a throat area of 30 cm^2, find:
    (i) The mass flow rate and the throat conditions.
    (ii) Also, find the pressure and temperature in the divergent portion where Mach number is 2 and the required exit area

(OR)

b) A de Laval nozzle has to be designed for an exit Mach number of 1.5 with an exit diameter of 200mm.find the required ratio of throat area to exit area. The reservoir conditions are given as P_0=1atmg; $T_0=20^oc$.find also the maximum mass flow rate through the nozzle. What will be the exit pressure and temperature?

23. a) Discuss the main factors of importance in assessing combustion chamber performance.

(OR)

b) (i) Explain the combustion process. (7)

(ii) Explain the flame-tube cooling method. (7)

24. a) (i) Derive an expression for mass flow rate corresponding to nozzle chocking conditions in terms of Total pressure, total temperature, throat area and ratio of specific heat. (10)

(ii) Write the difference between turbojet and turboprop engine. (4)

(OR)

b) The air flow through nozzle of inlet area $10cm^2$ at 80 m/sand temperature 28^0C pressure $700KN/m^2$ to an exit pressure $250KN/m^2$.Find mass flow rate and velocity at for one dimensional isentropic flow

25. a) With neat sketch and the necessary velocity triangles explain the principle of operation of centrifugal compressor .Derive expression for work done and pressure rise.

(OR)

b) Explain the elementary theory of axial flow compressor with neat sketch.

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