Register Number: ……..

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Third Semester

AERONAUTICAL ENGINEERING

U07AR301: Aero Engineering Thermodynamics

(Steam Tables/Refrigerant Charts to be permitted)

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

Answer all Questions:-

PART A (10 x 1 = 10 Marks)

1. An isolated system is one, which
   A) permits the passage of energy and matter across the boundaries
   B) permits the passage of energy only
   C) does not permit the passage of energy and matter across it
   D) permits the passage of matter only

2. Control volume refers to a
   A) specified mass B) fixed region in the space C) closed system D) none of the above

3. Efficiency of the Carnot cycle is given by
   A) $(T_1 + T_2) / T_I$ B) $(T_I - T_2) / T_I$ C) $T_I / (T_I + T_2)$ D) $T_I / (T_I - T_2)$

4. The Carnot engine is irreversible due to

   A) friction between moving parts B) losses from working fluid in transit

   C) high speed D) both A and B

5. A system is said to be consisting of a pure substance when
   A) it is homogeneous in composition
   B) it is homogeneous and invariable in chemical aggregation
   C) it has only one phase
   D) it has more than one phase

6. At its critical point, any substance will

   A) exist all the three phases simultaneously B) change directly from solid to vapour

   C) lose phase distinction between liquid and vapour D) behave as an ideal gas

7. A refrigerating machine working on Reversed Carnot cycle takes out 2kW per minute of heat from the system while working between temperature limits of 300K and 200 K. COP and power consumed by the cycle will be

   A) 1, 1 kW B) 1, 2 kW C) 2, 1 kW D) 2, 2 kW

8. Refrigeration is generally produced by
   A) melting of a solid B) non-sublimation of a solid
   C) non-evaporation of a liquid D) treatment of metals

9. Compressed air is used

   A) to drive pneumatic tools B) to stop engines C) to generate torque D) to provide lubrication

10. The advantage of multistage compression is
    A) it improves volumetric efficiency for a given pressure ratio
    B) it increases cost of the compressor
    C) it does not produce uniform torque
    D) it does not provide effective lubrication

PART B (10 x 2 = 20 Marks)

11. Differentiate between intensive and extensive properties giving examples.
12. What is an isothermal Process? Derive an expression for the Work done during an Isothermal Process.
13. What are the assumptions in air standard cycles?
14. What is the physical significance of mean effective pressure?
15. What is meant by triple point of steam?
16. What is meant by Specific Steam Consumption in a rankine cycle?
17. What are the components in the vapour compression refrigeration system?
18. What are the important parameters to be considered in the selection of a refrigerant?
19. Why is clearance provided in a reciprocating compressor?
20. Explain the effect of inter-cooling in a multi stage reciprocating compressor.

PART C (5 x 14 = 70 Marks)

21. (a) A certain quantity of air has a volume of 0.028 m^3 at a pressure of 1.25 bar and 25°C. It is compressed to a volume of 0.0042 m^3 a law $pv^{1.3}$ = constant. Find the final temperature and work done during compression. Also determine the reduction in pressure at a constant volume to bring back to its original volume.

(OR)

(b) An engine working on Dual cycle the Pressure and Temperature at the beginning of cycle are 100°C and 1 bar. The compression ratio is 10, the max pressure is limited to 70 bar and total heat supplied of air is 1680 kJ. Find the following:

(i) Pressure and Temperature at all salient point (7)

(ii) Determine the efficiency of the Engine (7)

22. (a) Dry saturated steam at a pressure of 10.0 bar is expanded in a nozzle to a pressure of 0.7 bar. With the help of a Mollier diagram, find the velocity and dryness fraction of steam issuing from the nozzle if the friction is neglected. Also find the velocity and dryness fraction of steam. If 5% of the heat drop is lost in friction.

(OR)

(b) Show the Otto cycle on P-V and T-S diagrams. Derive expressions for the efficiency and mean effective pressure and plot their variation with compression ratio.

23. (a) A Vapour Compression Refrigerator uses R-12 as refrigerant and the liquid in the evaporator is at -15°C. The temperature of this refrigerant at the delivery of the compressor is 15°C. When the vapour is condensed at 10°C, find the COP, if:

(i) There is no under-cooling (7)

(ii) The liquid is cooled by 5°C before expansion by throttling (7)

Find the increase inCOP. Take the Specific Heat at Constant Pressure for Super Heated Vapour as 0.64 kJ/mg K and that for liquid as 0.94 kJ/kg K. The table provides the properties of the refrigerant.

Temperature in °C	Enthalpy		Entropy	
	Liquid	Vapour	Liquid	Vapour
-15	22.3	180.88	0.0904	0.7051
10	45.4	191.76	0.1750	0.6921

(OR)

(b) Explain the working principles of vapour absorption refrigeration with a neat sketch.

24. (a) (i) State Kelvin-Planck and Clausius statements of second law of Thermodynamics.

(ii) Show that both the above statements are equivalent in all respects.

(iii) A heat engine operates between a source at 600°C and a sink at 20°C. Determine the minimum rate of heat rejected if the work output is 2 kW. Estimate the same if the engine operates at 40% of ideal efficiency.

(OR)

(b) (i) Derive the area-velocity relation and show that a convergent divergent nozzle is needed for supersonic flow. (7)

(ii) A turbojet engine operates between the pressure limits of 35 kPa and 350 kPa.The inlet air temperature is 1370 K. Calculate the momentum thrust of the engine per unit mass flow rate assuming isentropic compression and expansion and inlet velocity to be 100 m/s. The nozzle inlet velocity may be taken to be zero. (7)

25. (a) Derive an expression for the optimum intermediate pressure of two stage reciprocating compressor with perfect intercooling. **(OR)**

(b) Discuss in detail various types of Air Compressors with suitable diagrams.

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