Register Number: ……

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Third Semester

AERONAUTICAL ENGINEERING

AER102: Aero Engineering Thermodynamics

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

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. Work done in free expansion process is

   (a) zero (b) minimum (c) maximum (d) positive

2. Isentropic flow

   (a) Irreversible adiabatic flow (b) perfect gas flow

   (c) Frictionless reversible flow (d) reversible adiabatic flow

3. The air standard diesel cycle is less efficient than Otto cycle for the

   (a) Same compression ratio and heat addition (b) Same pressure and heat addition

   (c) Same rpm and cylinder dimensions (d) Same pressure and compression ratio

4. For the same temperature limits and heat input, the most efficient cycle is

   (a) Diesel cycle (b) Brayton cycle (c) Carnot cycle (d) Otto cycle

5. The clearances in compressors

   (a) Increases the work done on air/kg (b) Decreases the work done on air/kg

   (c) Increases the amount of air intake (d) has no effect on work done/kg of air

6. The most efficient process of compression is

   (a) Adiabatic (b) Isothermal

   (c) Isentro (d) Any of the above three as the efficiency of all the three process is equal

7. Choose the wrong statement

   (a) A refrigerant should have high latent heat

   (b) A refrigerant should have positive evaporating pressure

   (c) A refrigerant should have high critical temperature

   (d) A refrigerant should have low thermal conductivity

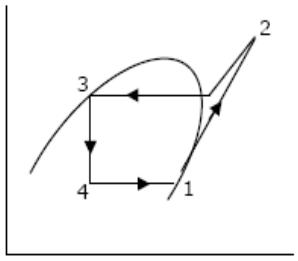
8. The vapor compression cycle is represented as shown in figure. The coordinate system used in the figure is

(a) P-H

(b) T-S

(c) P-S

(d) H-S



9. In an unsaturated air the state of vapour is

(a) Wet (b) superheated (c) Saturated (d) unsaturated

10. During sensible cooling, wet bulb temperature

(a) Decreases (b) increases (c) Remains constant (d) can increase or decrease

PART B (10 x2 = 20 Marks)

11. State First law of thermodynamics.
12. State Kelvin Planck's and Clausius statement.
13. State the assumptions in air standard cycles.
14. Sketch the P-V diagram and T-S diagram for a ideal Diesel cycle.
15. What are applications for air compressors?
16. Draw the PV diagram of a compression cycle in a compressor.
17. List out the properties of an ideal refrigerant.
18. Define TONS of refrigeration.
19. The atmospheric conditions are $20^{o}C$ and specific humidity of 0.0095 kg/kg of dry air. Calculate (i) partial pressure of vapour (ii) Relative humidity.
20. Define dew point temperature using T-S diagram.

PART C (5 x14 = 70 Marks)

21. a) (i) 0.3 kg of air at 1.5 bar pressure and $87^{o}C$ temperature at condition 1 is compressed polytropically to condition 2 at pressure 7.5 bar, index of compression being 1.2. It is then cooled at constant pressure to condition 3 and then finally heated at constant temperature to its original condition 1. Find the net work done and heat transferred. (Assume R = 0.287 kJ/kg K, C_p = 1.005 kJ/kg K, γ = 1.4) (10)

(ii) Derive the expression work done for a polytropic process (4)

(OR)

b) (i) Air expands from 3 bar to 1 bar in a nozzle. The initial velocity is 90 m/s. The initial temperature is 150^{o}C. Calculate the velocity of air at the exit of the nozzle. (7)

(ii) A heat engine is supplied with 278 kJ/sec of heat at temperature of 283^{o}C and heat rejection takes place at 5^{o}C. There are two cases of heat rejection of 208 kJ/sec and 139 kJ/sec. Classify which one of the results reported is a reversible and which is an irreversible cycle? (7)

22. a) An oil engine with 20 cm cylinder diameter and 30 cm stroke works on the theoretical diesel cycle. The initial pressure and temperature of air used are 1 bar and 30^{o}C. The cut-off is 10% of the stroke. Find the following (i) pressure and temperature at all salient points; (2) Theoretical air standard efficiency; (3) mean effective pressure; (4) The power of engine if the working cycles per minute are 400.

(OR)

b) Sketch the P-V diagram and T-S diagrams for a diesel cycle. Derive the thermal efficiency for the same.

23. a) (i) Derive a suitable expression for minimum work done in two stage air compressor. Assume perfect inter cooling. (8)

(ii) Determine the minimum number of stages required in an air compressor which admits air at 1 bar, 27^{o}C and delivers at 180 bar. The maximum discharge temperature at any stage is limited to 150^{o}C. Consider the index for polytropic compression as 1.25 and perfect optimum intercooling between the stages. Neglect the effect of clearance. (6)

(OR)

b) (i) A single stage air compressor is required to compress 72 cubic meter of air per minute from 15^{o}C and 1 bar to 8 bar pressure. Find the temperature at the end of compression, work done and heat rejected during each of the following processes:

(a) Isothermal (4)

(b) Adiabatic (4)

(ii) Polytropic compression following; the law $PV^{1.25}$ = constant (6)

24. a) An air refrigerator working on Bell- Coleman cycle takes the air into compressor at 1 atm and -7^{o}C and it is compressed isentropically to 5.5 atm and cooled to 18^{o}C at same pressure. It is then expanded in an expansion cylinder to 1 atm and then it is discharged into the refrigerating chamber. Find COP and work done of the system if (a) the expansion is isentropic and (b) the expansion follows the $PV^{1.25}$ = constant. Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg K and $C_v = 0.718$ kJ/kg K for air.

(OR)

b) A food storage locker requires refrigeration capacity of 50 kW. It works between a condenser temperature of 35^{o}C and an evaporator temperature of -10^{o}C. The refrigerant is ammonia. It is sub-cooled by 5^{o}C before entering the expansion valve. Assume dry saturated vapour leaving the evaporator. Assume a single cylinder, single acting compressor operating at 1000 rpm with stroke equal to 1.2 times the bore. Determine (a) the power required (b) The cylinder dimensions.

Saturation temperature ^{o}C	Pressure bar	Enthalpy (kJ/kg)		Entropy (kJ/kg K)		Specific volume (m^3/kg)		Specific heat (kJ/kg K)	
		Liquid	Vapour	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
-10	2.9157	154.056	1450.22	0.82965	5.7550	-	0.417	-	2.492
35	13.522	366.072	1488.57	1.56605	5.2086	1.7023	0.095	4.556	2.093

25. a) Explain the following Psychrometric processes using suitable figures and charts

1. Sensible heating
2. Sensible cooling
3. Cooling and dehumidification
4. Heating and dehumidification

(OR)

b) The dry and wet bulb temperature of atmospheric air at 1atm (101.325 kPa) pressure are measured with Sling psychometer and determined to be 25^{o}C and 15^{o}C respectively. Determine.

(a) Specific humidity

(b) Relative humidity

(c) Enthalpy of air

****