T.E - II / Thermal Engg. / PROD

16.12.14

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Q.P. Code : 14994

(3 Hours) **[Total Marks : 80**

N.B. : (1) Question No. **1** is **compulsory.**
(2) Attempt any **THREE** questions out of remaining **FIVE** questions.
(3) Assume suitable **data** wherever **required.**
(4) Assumptions made should be stated clearly.

1 (a) Derive equation for work during polytropic compression in single stage reciprocating air compressor neglecting clearance. **5**

(b) Explain working of two stroke engine with neat sketch. **5**

(c) Define : **5**
- (i) Black body
- (ii) Emissive power
- (iii) Emissivity.

(d) Explain vapour absorption refrigeration system with neat sketch. **5**

2. (a) Two stage single acting air compressor takes air in at 1 bar, 300k. Air is discharged at 10 bar. The intermediate pressure is ideal and intercooling is perfect. the index of compression is .1.3 in both stages, the mass flow rate of air is 0.1 kg/s. Determine : **10**
- (i) Power required to drive the compressor.
- (ii) Saving in power required as compared with single stage machine for same service.
- (iii) Heat rejected in intercooler.

(b) (i) Derive expression for air standard efficiency of Brayton cycle. **5**

(ii) Define mean effective pressure, Mechanical efficiency and volumetric efficiency of 1C engine. **5**

3. (a) An eight cylinder, four stroke engine of 9cm bore and 8cm stroke with a compression ratio of 7 is tested at 4500 rpm on a dynamometer which has 54cm arm. During a 10 min. test the dynamometer scale beam reading was 42kg and the engine consumed 4.4kg of gasaline having calorific value of 44000 kj/kg. Air at 27°C and 1 bar was supplied to the carburetter at the rate of 6kg/min. Find (i) the brake power delivered (ii) The brake mean effective pressure (iii) the brake specific fuel consumption (iv) the brake thermal efficiency (vi) the volumetric efficiency and (vii) the air fuel ratio. **10**

(b) A gas turbine unit receives air at 1 bar and 300 K and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. the fuel has a heating value of 44186 kj/kg and the fuel-air ratio is 0.017 kj/kg of air. The turbine efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency. For products of combustion, Cp = 1.147 kj/kg k and r = 1.333. **10**

4. (a) (i) Explain battery ignition system with neat sketch. 5
(ii) State and explain fourier's law of heat conduction. 5

(b) A counter flow double pipe heat exchanger using superheated steam is used to heat the water at a rate of 3kg/S. The steam enters the exchanger at 180°C and leaves at 130°C. The inlet and exit temperature of water are 30°C and 80°C respectively. The overall heat transfer coefficient is 820 W/m²k. Calculate the heat transfer area required. What would be the increase in surface area, if fluids flow in parallel ? Take Cp of water as 4.187 kj/kg.K. 10

5. (a) (i) Explain regeneration in gas turbines with neat sketch and T-S diagram. 5
(ii) Derive expression for LMTD in case of parallel flow heat exchanger. 5

(b) In a standard vapour compression refrigeration cycle, operating between an evaporator temperature of - 10°C and a condenser temperature of 40°C, the enthalpy of the regurgitant, Freon.12, at the end of compression is 220 kj/kg. Show the cycle diagram on T-s plane, calculate : 10

(i) The C.O.P. of the cycle.
(ii) The refrigerating capacity and the compressor power, assuming a refrigerant flow rate of 1kg/min. Freon - 12 property table is given below.

t(°C)	P(MPa)	hf(kj/kg)	hg(kj/kg)
-10	0.2191	26.85	183.1
40	0.9607	74.53	203.1

6. (a) Represent the following processes on psychrometric chart. 10
(i) Sensible cooling and dehumidification
(ii) Sensible heating and humidification.

(b) Write the desirable properties of the refrigerant. 5

(c) Define : 5
(i) Ton of refrigeration
(ii) Specific humidity
(iii) Degree of saturation
(iv) Dew point temperature
(v) Wet bulb temperature.
