Sem-V / Prod CBGS- / Thermal Engg. / 08 06 201

**Q.P. Code : 608600**

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

**N.B. :** (1) Question No. 1 is **compulsory**.
(2) Attempt any **three** from the remaining **five** questions.
(3) Assume suitable **data** wherever **necessary**.



1. (a) With the help of P-v diagram, show that work done reduces with intercooler added between two stages of a reciprocating air compressor. **20**
   (b) Distinguish between parallel and counter flow heat exchangers?
   (c) What are the drawbacks of simple carburetor and list other types of carburetors?
   (d) What do you mean by overall heat transfer coefficient? Obtain an expression for it?
   (e) Define the following :
   (i) Ton of refrigeration, (ii) COP,
   (iii) Dry air, (iv) Specific humidity,
   (v) Dew point temperature

2. (a) Derive an expression for volumetric efficiency of a single stage single acting reciprocating air compressor with clearance. What is the effect of clearance on work required to drive the compressor? **8**
   (b) A two stage single acting reciprocating compressor takes in air at the rate of 0.2 $m^3$ /s. The intake temperature and pressure of air are 0.1MPa and 18°C. The air is compressed to a final pressure of 0.7MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both the stages is 1.3 and the compressor runs at 600rpm. Neglecting clearance, find : (i) Intermediate pressure; (ii) The total volume of each cylinder; (iii) The power required to drive the compressor; (iv) The rate of heat rejection in the intercooler. **12**



3. (a) The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature 28° C. The pressure of the air after compression is 8 bars. The isentropic efficiencies of compressor and turbine are 83% and 86% respectively. The air fuel ratio used is 85:1. If the flow rate of air is 4.5 kg/s, find: i) power developed; ii) thermal efficiency. Take $C_p$ =1; $\gamma$ = 1.4 and calorific value is 42000kj/kg. **12**
   (b) With a neat sketch, explain the ignition system of a petrol engine. **8**

**[TURN OVER**

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4. (a) A load test is performed on a single cylinder four stroke diesel engine having compression ratio of 15. The speed ofthe engine is 2500rpm, air and fuel consumption were found to be 3.0kg/min and 9kg/hr respectively. The torque applied on the brake drum was 190N-m. Rate of cooling water circulation is 15kg/min. and temperature rise was found to be 40°C. The exhaust gas temperature was found to be 420°C. Calculate brake power, bsfc and brake thermal efficiency of this engine. Also draw the heat balance sheet on minute basis. Take calorific value of the fuel as 43500kj/kg; Ambient temperature =30° C; $C_p$ for exhaust gases 1.2kj/kg. **12**

   (b) Compare vapor compression and vapor absorption refrigeration systems. **8**

5. (a) Write a short note on psychrometric chart and represent few processes on the chart and briefly explain them. **8**

   (b) A steam pipe is covered with two layers of insulation. The thickness of the inner and outer layers is 40mm and 60mm respectively. The thermal conductivities of insulations are 0.186 and 0.1046 W/mK respectively. The steam pipe itself is of steel with k = 58W/mK and has inner and outer diameter of 160 and 180 mm respectively. The steam passing through the tube is at temperature 350°C. The outer surface of the insulation is surrounded by ambient air having temperature 30°C. The inside and outside film coeffients are 30 and 6.98 W/m2K respectively. Determine the heat loss per unit of pipe and layer contact temperatures. **12**

6. (a) 20 tons of ice from and at 0° C is produced per day in an ammonia refrigerator. The temperature range in the compressor is from 25°C to -15°C. The vapor is dry and saturated at the end of compression and an expansion valve is used. Assuming a coefficient of performance of 65% of the theoretical, calculate the power required to drive the compressor. Take Latent heat of ice as 335kj/kg. Use the following properties: **12**

| Temp. | Enthalpy(kj/kg) | | Entropy of | Entropy of |
|---|---|---|---|---|
| °c | Liquid | Vapor | Liquid(kj/kg.k) | Vapor(kj/kg.k) |
| 25 | 100.04 | 1319.22 | 0.3473 | 4.4852 |
| -15 | -54.56 | 1304.99 | -2.1338 | 5.0585 |

   (b) What do you mean by Logarthmic Mean Temperature Difference and derive an expression for LMTD in case of parallel flow heat exchanger. **8**