Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech**
PCME4402

7th Semester Regular / Back Examination 2017-18
REFRIGERATION AND AIR CONDITIONING
BRANCH(S) : MECH
Time: 3 Hour
Max Marks: 70
Q Code : B275

Question No.1 which is compulsory and any five from the rest
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Write down the relationship between COP of Heat Pump and COP of Refrigerator.

b) Define the term Tonne of Refrigeration (TR).

c) Why is the throttling valve not replaced by an isentropic turbine in the ideal vapor-compression refrigeration cycle.

d) A refrigerator operates on the ideal vapor compression refrigeration cycle with R-134a as the working fluid between the pressure limits of 120 kPa and 800 kPa. If the heat removal from the refrigerated space is 32 kJ/s, determine the mass flow rate of the refrigerant.

e) Discuss the advantages of compound compression with intercooler over single stage compression.

f) Name a refrigerant which works as Primary, Secondary as well as tertiary refrigerant.

g) Inter-cooling during multi-stage compression is effective with NH_3 as a refrigerant than R-12. Why?

h) Define the term thermodynamic wetbulb temperature.

i) Write down factors affecting human comfort.

j) Define the term by-pass factor.

Q2 **a)** The atmospheric air at pressure 1 bar and temperature -5°C is drawn in the cylinder of the compressor of a Bell-Coleman refrigerating machine. It is compressed isentropically to a pressure of 5 bar. In the cooler, the compressed air is cooled to 15°C, pressure remaining the same. It is then expanded to a pressure of 1 bar in an expansion cylinder, from where it is passed to the cold chamber. Find: **(5)**
(i) the work done per kg of air.
(ii) C.O.P of the plant.
For air assume law for expansion $pv^{1.2} = C$, law for compression $pv^{1.4} = C$ and specific heat of air at constant pressure is 1kJ/kgK.

b) An air refrigerator working on Bell-Coleman cycle takes air into the compressor at 1 bar and -5°C. It is compressed in the compressor to 5 bar and cooled to 25°C at the same pressure. It is further expanded in the expander to 1 bar and discharged to take the cooling load. The isentropic efficiency of the compressor is 85% and the isentropic efficiency of the expander is 90%. Find the followings: **(5)**
(i) Refrigeration capacity of the system if the air circulation is 40 kg/min.
(ii) kW capacity of the motor required to run the compressor.
(iii) C.O.P of the system.

Q3 **a)** In a vapor compression refrigeration system using R-12, the evaporator pressure is 1.4 bar and the condenser pressure is 8 bar. The refrigerant leaves the condenser sub-cooled to 30^{o}C. The vapor leaving the evaporator is dry and saturated. The compression process is isentropic. The amount of heat rejected in the condenser is 13.42 MJ/min. Determine: **(5)**

(i) Refrigerating capacity
(ii) Refrigerating load in TR
(iii) Compressor input in kW
(iv) C.O.P

b) Refrigerant-134a enters the compressor of a refrigerator as superheated vapor at 0.14 MPa and -10^{o}C at a rate of 0.05 kg/s and leaves 0.8 MPa and 50^{o}C. The refrigerant is cooled in the condenser to 26^{o}C and 0.72 MPa and is throttled 0.15 MPa. Disregarding any heat transfer and pressure drops in the connecting lines between the components, determine: **(5)**

(i) the rate of heat removal from the refrigerated space.
(ii) the power input to the compressor.
(iii) the isentropic efficiency of the compressor.
(iv)C.O.P of the refrigerator.

Q4 An ammonia refrigeration system working between 1.4 bar and 10 bar is provided with flash intercooler at 4 bar and compression is carried out in two stages. The refrigerant leaves the condenser in saturated liquid and leaves the evaporator in saturated vapor. If the mass flow through the evaporator is 0.3 kg/s. **(10)**

(i) Calculate the power required to run the system.
(ii) evaporator load in TOR.

Q5 **a)** Explain the working principle of Electrolux refrigeration system. **(5)**

b) Discuss the advantages of vapour absorption system over compression refrigeration system. **(5)**

Q6 **a)** What are the desirable properties of an ideal refrigerant. **(5)**

b) Discss in detail, the secondary refrigerants. **(5)**

Q7 **a)** A room 7m x 4mx 4m is occupied by an air water vapor mixture at 38^{o}C. The atmospheric pressure is 1 bar and the relative humidity is 70%. Determine the humidity ratio, dew point, mass of dry air and mass water vapor. If the mixture of air-water vapour mixture is further cooled at constant pressure until the temperature is 10^{o}C; find the amount of water vapour condensed. **(5)**

b) The amount of air supplied to an air conditioned hall is 300 m3/min. The atmospheric conditions are 35^{o}C DBT and 55% RH. The required conditions are 20^{o}C DBT and 60% RH. Find out the sensible heat and latent heat removed from the air per minute. Also find sensible heat factorfor the system. **(5)**

Q8 **a)** Write short note on the factors affecting comfort air-conditioning. **(5)**

b) Describe Sol Air temperature. **(5)**