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**BME-032**

# DIPLOMA IN MECHANICAL ENGINEERING (DME)

# ADVANCED LEVEL CERTIFICATE COURSE IN MECHANICAL ENGINEERING (DMEVI/ACMEVI)

01340

## Term-End Examination

## June, 2014

## BME-032 : REFRIGERATION AND AIR-CONDITIONING

*Time : 2 hours* *Maximum Marks : 70*

***Note :*** *Attempt any **five** questions including Question no. 1 which is **compulsory**. Use of scientific calculator is permitted. Use of refrigeration charts and tables are permitted.*

**1.** (a) Answer the following questions in brief : *2×3=6*

(i) Draw simple vapour compression cycle on p-h diagram and write the name of different processes.

(ii) Write the definition and formula of specific humidity and relative humidity.

(iii) Write the function of following components in a refrigeration system : compressor, condenser, expansion valve and evaporator.

(b) Choose the most appropriate choice in the following objective type questions : *1×8=8*

(i) A Carnot refrigerator operates between 320 K and 240 K temperatures. Its coefficient of performance (COP) will be

(A) 4

(B) 3

(C) 0·25

(D) None of the above

(ii) If evaporator pressure decreases, coefficient of performance (COP) of vapour compression cycle will

(A) increase

(B) remain same

(C) decrease

(D) either increase or decrease depending upon the refrigerant

(iii) The thermodynamic process in expansion device of vapour compression system is considered to be

(A) Throttling

(B) Isothermal expansion

(C) Reversible adiabatic expansion

(D) None of the above

(iv) The following refrigerant is considered to be ozone friendly because it does not harm ozone layer :

(A) R-12

(B) R-22

(C) R-11

(D) R-134a

(v) The temperature and relative humidity in air-conditioning (for human comfort) are maintained as

(A) 28°C and 70%

(B) $25 \pm 1$°C and $50 \pm 5$%

(C) $30 \pm 1$°C and $60 \pm 5$%

(D) 22°C and 50% respectively

(vi) One ton of refrigeration is equivalent to cooling at a rate of

(A) 50·4 kcal/min

(B) 3·5167 kJ/s

(C) Both (A) and (B)

(D) None of the above

(vii) If clearance is increased in reciprocating compressor, compression work

(A) increases

(B) decreases

(C) remains same

(D) may increase or decrease depending upon value of clearance factor

(viii) Which statement is ***not*** correct ?

(A) Capillary tube is used as expansion device in domestic refrigerators.

(B) Reciprocating type compressors are used in small capacity refrigeration systems.

(C) Electrical power is mainly used to run vapour absorption systems.

(D) Electrical power is used to run vapour compression systems.

2. (a) List various applications of refrigeration and air-conditioning and describe them in brief. *10*

(b) An ice plant produces 100 kg ice at – 10°C from water at 5°C in 24 hours. Calculate the capacity of plant in tons. If it consumes 2 kW power, what will be COP of plant ? (Given : $C_p$ of water = 4·19 kJ/kg-K, $C_p$ of ice = 2·0 kJ/kg-K and latent heat of fusion of ice = 335 kJ/kg). *4*

3. (a) What is the effect of following on performance of simple vapour compression cycle ?

(i) Increase in condenser pressure.

(ii) Suction vapour superheat.

Show the effects by drawing cycle on p-h diagram. *6*

(b) What are the main differences between a vapour compression and vapour absorption system ? Draw a lithium bromide water vapour absorption system and explain its working. *2+6*

4. (a) Draw a neat sketch of an evaporative condenser and explain its working. *5*

(b) Write main differences between flooded and dry expansion evaporator. Describe the working of dry expansion evaporator. *1+4*

(c) Derive the formula of clearance volumetric efficiency of a reciprocating compressor as given below :

$$\eta_{cv} = 1 + C - C\left(\frac{p_2}{p_1}\right)^{1/r}$$

where C is clearance factor, $\frac{p_2}{p_1}$ is pressure ratio and r is ratio of specific heats ? *4*

5. (a) Write the functions of a thermostatic expansion valve. Where is it used ? Also list different parts of which it comprises. *4*

(b) 1000 kg of fruits enter at 25°C into a freezing chamber maintained at –10° C. Freezing takes place at – 10°C after 6 hours. The latent heat of freezing is 110 kJ/kg and specific heat of fruits is 1·35 kJ/kg-K. Calculate the refrigeration capacity of plant in tons. *5*

(c) Describe in brief the various desirable thermodynamic properties of refrigerants. *5*

**6.** (a) What do you mean by thermodynamic wet bulb temperature or adiabatic saturation ? Explain with suitable illustration. *5*

(b) Define the following : *3*

(i) Degree of saturation

(ii) Specific humidity

(c) Write short notes on the following : *2×3=6*

(i) Comfort air-conditioning

(ii) Air blast freezer

(iii) Transport refrigeration