

VRK/KS/14/3019/3431

Faculty of Engineering & Technology
Seventh Semester B.E. (Mech. Engg.)/Seventh
Semester B.E. P.T. (Mech.) Examination
REFRIGERATION AND AIR CONDITIONING
(Elective-II)
Sections—A & B

Time—Three Hours]

[Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

- (1) All questions carry marks as indicated.
- (2) Answer **THREE** questions from Section A and **THREE** questions from Section B.
- (3) Assume suitable data wherever necessary.
- (4) Illustrate your answers wherever necessary with the help of neat sketches.
- (5) Use of Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
- (6) Use of non-programmable calculator is permitted.

SECTION—A

1. (a) Explain the methods to improve COP of Simple VCRS. 4
- (b) During the test of a refrigerating plant using F-12, the following observations were made :
 Working temp. Range = 45°C and -15°C . Temp

erature. of refrigerant at the entry and exit of condenser = 65°C and 32°C .

Rate of flow of cooling water = 13 kg/min.

Rise in temp. of cooling water = 8°C .

Mean effective pressure in compressor = 3.4 bar.

Ice produced in 8 hrs = 360 kg.

Water temp. supplied for icemaking = 27°C .

Latent heat of ice = 336 kJ/kg

Bore of compressor = 90 mm

Stroke of compressor = 70 mm

RPM of compressor = 500

Compressor is double acting.

Find :

- (i) Theoretical COP of system.
- (ii) Actual COP of system.
- (iii) Mass flow of F-12 per min.

Assume average specific and heat for liquid is 0.97 kJ/kg K and for superheated vapour is 0.65 kJ/kg K. 9

2. (a) Explain with neat sketch 'three fluid vapour absorption' system. 5
- (b) Write short notes on any two :
 - (i) Properties of an ideal refrigerant
 - (ii) GWP and ODP
 - (iii) Effect of pressure drops on VCRS. 8

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3. (a) Explain with neat sketch 'two stage cascade refrigeration system'. 5
- (b) A two stage compression with water intercooler, liquid subcooler and liquid flash chamber ammonia refrigeration system operates between overall pressure limits of 14 bar and 2 bar. The temperature of desuperheated vapour and subcooled liquid refrigerant are limited to 30°C . The flash tank separates dry vapour at 5 bar pressure and the liquid refrigerant then expands to 2 bar. Estimate the COP of the machine and power required to drive the compressor if the mechanical efficiency = 80% and load one evaporator = 10 TR. 8
4. A refrigeration installation using F-12 comprises one compressor, one condenser and three evaporators of capacities 10 TR, 20 TR and 30 TR respectively. The temperatures to be maintained in these evaporators are 10°C , 5°C and -10°C , respectively. Each evaporator is fitted with an individual expansion valve and back pressure valve. The condenser temp. is 40°C with a subcooling of refrigerant upto 30°C , at the exit of condenser. The refrigerant leaves evaporator in a dry saturated state. Determine.
- Mass flow in each evaporator
 - Compressor Power
 - COP of the system. 13

5. (a) Explain with neat sketch Claude System for liquefaction of air. Also draw the thermodynamic cycle on T-s diagram. 5
- (b) Write short notes on any two :
- Air refrigeration system
 - Vortex tube
 - Joule-Thomson coefficient and inversion curve. 9

SECTION-B

6. (a) Define the following terms :
- Specific humidity
 - Relative humidity
 - Dew point temperature
 - Enthalpy of moist air. 4
- (b) The sling psychrometer reads 40°C DBT and 28°C WBT. Calculate the following.
- Specific humidity
 - Relative humidity
 - Vapour density in air
 - Dew point temperature and
 - Enthalpy of mixture per kg of dry air. Assume atm pressure to be 1.03 bar. 9
7. (a) Discuss mechanism of heat exchange of human body with surrounding environment. 5

- (b) A restaurant is required to be maintained at 22°C DBT and 70% RH. The ambient conditions are 30°C DBT and 80% RH. The amount of free air circulated is $200 \text{ m}^3/\text{min}$. The required conditions are first achieved by cooling and dehumidifying through a cooling coil having ADP of 14°C and then by heating. With the help of psychrometric chart, evaluate.
- Capacity of cooling coil in TR and its BPF.
 - Amount of water vapour removed by cooling coil in kg/hr.
 - Capacity of heating coil in kW and its surface temperature assuming BPF = 0.2.
8. (a) Write in brief about various components of cooling load estimate. 7
- (b) Describe summer air conditioning system with the help of flow diagram and psychrometric process (for hot and dry outdoor conditions) 6
9. (a) The following data relates to A/C office
Occupancy = 30
Outdoor conditions = 30°C DBT, 25°C WBT
Inside conditions = 25°C DBT, 50% RH
Total sensible heat load = 2790 kJ/min
Total latent heat load = 1045 kJ/min
Assume 40% fresh air to be cooled through cooling apparatus with ADP of 10°C . Find
- By pass factor of coil
 - Quantity of fresh air supplied
 - Cooling coil load in TR.

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- (b) Define terms :

(i) RSHF

(ii) GSHF

(iii) ERSHF.

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10. (a) What are the various methods used for duct design ? Explain any one of them in detail. 5

- (b) What are the grills and diffusers ? Explain criteria for choosing them for certain application. 4

- (c) Explain the following :

(i) Throw

(ii) Spread

(iii) Drop.

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