Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S7 (S, FE) / S7 (PT) (S, FE) Examination May/June 2024 (2015 Scheme)

**Course Code: ME405**

**Course Name: REFRIGERATION AND AIR CONDITIONING**

Max. Marks: 100 Duration: 3 Hours

Refrigeration table and psychrometric chart may be permitted in the exam hall

**PART A**

***Answer any three full questions, each carries 10 marks.*** Marks

1 a) A simple air-cooled system is used for an aeroplane having a load of 10 tones. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. The pressure increases to 1.013 bar due to ramming. The temperature of the air is reduced by 50°C in the heat exchanger. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25°C. Determine power required to take the load of cooling in the cabin; and. COP of the system. Assume that all the expansions and compressions are isentropic. The pressure of the compressed air is 3.5 bar. (10)

2 a) Define refrigeration effect and tonnes of refrigeration. (3)

b) A heat pump is used to transfer heat from a reservoir ($T_C$ = 250 K) to a higher-temperature reservoir ($T_H$ = 300 K). The work done on the pump is 500 J. (1) What is the entropy change for the cycle? (2) Calculate values of Heat rejected and heat absorbed. (3) Determine the coefficient of performance. (7)

3 a) What are the methods of improving the COP of simple saturation VCR system? (3)

b) Explain the working of vortex tube refrigerator with neat sketch. List out the advantages of vortex tube refrigerator. (7)

4 a) What is wire drawing effect in a compressor? (3)

b) 28 tons of ice from and at 0°C is produced per day in an ammonia refrigerator. Temperature range in the compressor is from 25°C to -15°C. The vapour is dry and saturated at the end of compression and an expansion valve is used. Assuming a coefficient of performance of 62% of the theoretical, calculate the power required to drive the compressor and actual COP. (7)

**PART B**

***Answer any three full questions, each carry 10 marks.***

5 a) Explain the working of cascade refrigeration system. What is the need of cascading the refrigerator in industry? (3)

b) Explain the working of compound compression system with water intercooler and liquid flash cooler. Draw the p-h diagram of the system. (7)

6 a) Define ODP and GWP of refrigerants. What is the need of these indexing for refrigerants? (3)

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| | b) | Explain the working of steam jet refrigeration system with neat sketches. What is the need of ejector in steam jet refrigeration system? | (7) |
| 7 | a) | Explain the various food preservation methods used in industry. | (3) |
| | b) | Explain the need of a cooling tower used in refrigeration system and also list the various types of cooling towers. | (7) |
| 8 | a) | List the various types of controls used in refrigeration system. | (3) |
| | b) | Explain the working of flooded type evaporator with neat sketch. What are the advantages and disadvantages of the flooded type evaporator? | (7) |

## PART C

***Answer any four full questions, each carries 10 marks.***

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| 9 | a) | Define dew point temperature, wet bulb temperature and dry bulb temperature. | (3) |
| | b) | What are various psychrometric processes? Represent all the psychrometric process in psychrometric chart. | (7) |
| 10 | a) | Explain the comfort chart and effective temperature. | (3) |
| | b) | Air at 20°C, 40% relative humidity is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1kg of former with 2kg of latter (on dry basis). Find the final condition (humidity and enthalpy) of air. | (7) |
| 11 | a) | Define RSHF, GSHF and ADP. | (3) |
| | b) | The following data are given for the space to be air conditioned: Outside air conditions = 40°C DBT and 50% RH, inside design conditions= 26°C DBT and 50% RH, Apparatus Dew point = 10°C; By pass factor of the cooling coil = 0.2. The return air from the room is mixed with the outside air before entry to the cooling coil in the ratio of 3:1 by mass If 20 $m^3$/min of fresh air is supplied find: i) Condition of air leaving the coil ii) Capacity of cooling coil in TR iii) Room sensible heat factor. | (7) |
| 12 | a) | A laboratory having an unusually large latent heat gain is required to be air conditioned. The design conditions and loads are as follows: Summer design conditions: 40°C DBT, 27°C WBT. Inside design conditions: 25°C DBT, 50% RH. Room sensible heat: 34.9 kW. Room latent heat: 18.6 kW. The ventilation air requirement is 85 cmm. Determine the following: (i) Ventilation load. (ii) Room and effective sensible heat factors. (iii) Apparatus dew point and amount of reheat for economical design. (iv) Supply air quantity. (v) Condition of air entering and leaving coil and supply air temperature. (vi) Grand total heat. Assume 0.05 bypass factor. | (10) |
| 13 | a) | Explain year-round air-conditioning system with neat sketch. Explain the components included in the system. | (10) |
| 14 | a) | Explain various methods of duct design. | (10) |

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