M.E. AUTOMOBILE ENGINEERING FIRST YEAR SECOND SEMESTER EXAM-2018

ADVANCED REFRIGERATION AND AIRCONDITIONING METHODS **Time -- Three hours** **Full Marks – 100**

Answer any **Five** questions.
All questions carry equal marks.

Answers to the different parts of the same questions are to be given serially. Use of Steam Tables, Refrigerant Tables and Psychometric Chart are allowed. Psychometrics charts on which graphical solutions for problems are carried out are to be attached with the answer script.

Q.1.a) Following Ewing's Construction, show that when the maximum COP for a vapour compression cycle occurs with the inlet condition of refrigerant to the compressor in the two phase region, the COP is equal to that of a reversed Carnot cycle operating between the evaporator temperature and the temperature of superheated discharge vapour from the compressor. 15

b) Show that, for evaporator temperature t_0= -15^{0}C and condensing temperature t_k =30^{0}C, for isobutene, the suction state to be compressor for maximum COP lies in the superheated vapour region. 05

Q.2.a) A Freon 22 condensing unit is specified to give 40 TR capacity for air conditioning under standard operating conditions of 40^{0}C condensing and 5^{0}C evaporating tempetures. What would be its capacity in TR for food freezing for which the evaporator tempeture is -35^{0}C? 15

b) Discuss the effects of superheating of refrigerant in the evaporator on the performance of a simple saturated vapour compression refrigeration cycle. 05

Q.3.a) Explain the limitation of using a simple vapour compression cycle for the production of low temperature refrigeration? 10

b) Explain the flash gas removal method and the flash intercooling method used in compound vapour compression refrigeration system. 10

Q.4.a) Derive the expression of COP and the heat transfer rates in the absorber, genetor and condenser of a vapour absorption plant using Lithium Bromide-Water system. 10

b) Derive the expression of maximum COP of a vapour absorption refrigeration system. 10

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Q.5. A vapour absorption refrigeration plant of 15 TR capacity works on Lithium Bromide-water. The salient data at various points in the circuit are given below:-

Concentration of Lithium Bromide in the binary mixture at generator inlet=0.48
Concentration of Lithium Bromide in the binary mixture at generator exit=0.58
Specific enthalpy of binary mixture at generator inlet = -35KJ/Kg
Specific enthalpy of binary mixture at generator exit towards absorber = 65KJ/Kg
Temperature of dry saturated vapour leaving generator = 100^0C
Temperature of condensate leaving the condenser as saturated liquid = 30^0C
Refrigerant leaves evaporator as dry saturated vapour at 2^0C

Find out i) Mass flow rate of strong solution entering the generator,
ii) Mass flow rate of weak solution leaving the generator towards the absorber.
iii) Specific rich solution circulation
iv) Maximum COP available from the system
v) Heat transfer rates in the generator, absorber and condenser
vi) Actual COP available and relative COP of the system 20

Q.6.a) Find the tip speed, diameter and width of shrouds at impeller outlet for a 600TR, R22 centrifugal compressor for air conditioning using simple saturation cycle. Condenser and evaporator temperatures are 40^0C and 5^0C. Design speed is 2950 rpm. Assume adiabatic efficiency of compressor as 0.85, and head coefficient as 0.59. Check mach number at outlet. 15

b) A centrifugal compressor with an impeller diameter of 45 cm is running at 4200 rpm. Refrigerant 12 is used and the suction condition is dry saturated at 5^0C and 3.6255 bar. Determine the maximum pressure ratio developed by the compressor. Is it adequate if condensing temperature is 40^0C? 05

Q.7.a) Explain the summer air conditioning system with ventilation air and bypass factor of the cooling coil using schematic diagram on psychrometric chart. 10

b) Elaborate the heat load estimation for a summer air conditioning system mentioning all the contributing factors for heat load. 10

Q.8. a) The air-handling unit of an air-conditioning plant supplies a total of 4500 cmm of dry air which comprises by weight 20 per cent fresh air at 40^0C DBT and 27^0C WBT, and 80 per cent recirculated air at 25^0C DBT and 50 per cent RH. The air leaves the cooling coil at 13^0C saturated state. Calculate the total cooling load, and room heat gain. 10

b) Write short notes on
i) Use of air washer for different types of psychrometric processes.
ii) Thermostatic Expansion valve. 5+5