514

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

DEPARTMENT OF AGRICULTURAL AND BIO-RESOURCES ENGINEERING

2017/2018 RAIN SEMESTER EXAM. PME 514-REFRIGERATION, PRESERVATION AND STORAGE OF AGRIC. PRODUCT.

INSTRUCTION: ATTEMPT NO.1 AND ANY OTHER FOUR (4) QUESTIONS. TIME: 3HRS

1(a) Define food preservation. what are its advantages. (b) Discuss the various methods of food preservation. (c) Food spoilage is due to the physical and chemical changes taking place in it. Discuss.

2(a) Derive an expression for the work done by a single-stage, single- acting reciprocating compressor during isentropic compression. (b) A single-stage, single- acting reciprocating compressor is required to compress 1.5m^3/min of vapour refrigerant from 1bar to 8bar . Find the power required to drive the compressor if compression of the refrigerant is (i) isothermal (ii) polytropic with polytropic index as 1.12 (iii) isentropic with isentropic index as 1.31.

3(a) What is the function of a condenser and how does it work in order to carry out its function (b) Write short note on methods of defrosting. (c) In an ammonia vapour compression system, the pressure in the evaporator is 2 bar. Ammonia at exit is 78% dry and at entry its dryness is 23%. During compression, the work done per Kg of ammonia is 175KJ. Calculate the C.O.P. and the volume of vapour entering the compressor per minute, if the rate of ammonia circulation is 3.7 Kg/min. The latent heat and specific volume at 2 bar are 1325 KJ/Kg and 0.58 m^3/Kg respectively.

$$\left[\frac{P_2}{P_1}\left(\frac{m^3}{m^3}\right) = 1\right]$$

4(a) Discuss the operation of a capillary tube in a refrigeration system and explain briefly why capillary tube is preferred to other throttling devices in a house hold refrigerators. (b) Differentiate between the physical and thermodynamic properties of a refrigerant. (c) How will you assign number to the refrigerant methyl chloride (CH_3Cl) and tetra chloro ethane ($C_2H_2Cl_4$). Give the chemical formula of the refrigerant R-22. (d) Explain the term 'heat rejection factor'.

5(a) Discuss briefly the different types of heat load which have to be taking into account in order to estimate the total heat load of a large restaurant for summer air conditioning. (b) An air conditioning system is to be designed for a restaurant with the following data: Outside design condition = 40 °C DBT, 28 °C WTB. Inside design condition = 25 °C DBT, 50% RH. Solar heat gain through walls, roof and floor =5.87KW. Solar heat gain through glass = 3.52KW. Occupants = 25, sensible heat gain per person =58W. latent heat gain per person = 58W. Internal lighting load = 15 lamps of 100W, 10 fluorescent tubes of 80W. Sensible heat gain from other sources = 11.63KW. Infiltration air = 15m^3/min. If 25% fresh air and 75% recirculated air is mixed and passed through the conditioner coil and the by-pass factor is 0.2, find the total heat gain and the office latent heat factor.

6 (a) Define the following (i) Tone of refrigeration (TR) (ii) Coefficient of performance(C.O.P) (iii) Relative coefficient of performance(R.C.O.P) and (iv) Cooling load. (b) State the common failures in heat exchangers and enumerate the properties to be considered for selection of material for heat exchangers. (c) In a counter-flow double pipe heat exchanger, water is heated from 25 °C to 65 °C by oil with a specific heat of 1.45KJ/Kg.°C and mass flow rate of 0.9Kg/s. The oil is cooled from 230 °C to 160 °C. If the overall heat transfer coefficient is 420 W/m^2 °C, calculate (i) The rate of heat transfer, (ii) The mass flow rate of water (iii) The surface area of the heat exchanger.

$Q = MC\theta$

$Q = U A \theta_m$