INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)
M. Tech. (Marine Engineering & Management)
End Semester Examination June/July 2019
SEMESTER – II
Cryogenic and LNG Vessels [PG13E1201]

Date : 29.06.2019 — Maximum Marks : 100

Time : 3 hrs. — Pass Marks : 50

Answer any Five (05) Questions. Assume any Missing Data.
All Questions carry equal marks (5 X 20 = 100 Marks)

Q. No. 1 :

(a) Draw the Schematic Representation of Simple Claude Process along with its T-S Diagram.

06

(b) Find the COP of a Philips Refrigerator with nitrogen as the working fluid operating between a maximum pressure of 10 atm. and a minimum pressure of 01 atm. using the thermodynamic data for the real gas. A temperature of 100K is to be maintained while rejecting heat to an ambient sink at 300K. Find the effect of regenerator effectiveness (ϵ) on the COP of the Philips Refrigerator. For 100% effective regenerator, the data at various points on the T-s diagram are given below.

Point No.	Temperature (K)	Pressure (atm)	Specific Volume, V (cc/mol)	Specific Entropy (J/g-K)
1	300	03	285.71	4.10
2	300	10	71.43	3.72
3	100	3.5	71.43	2.90
4	100	01	285.71	3.28

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Q. No. 2 :

(a) Based on the Throttling Expansion for lowering temperature, show the Schematic Representation of Simple Linde Hampson Process and also the corresponding T-S diagram.

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(b) What are the methods available for continuous production of cold or low temperature processes ? Write in brief the inherent differences of the above processes.

04

Q. No. 3 :

(a) With a neat diagram depicting all the components of a General Heat Conduction Equations, derive the following well-known equations :
  (i) Laplace Equation
  (ii) Fourier Equation
  (iii) Poisson's Equation

  09

(b) Mention the shapes in which the equation (iii) above is extremely useful.

  03

Q. No. 4 :

(a) With a neat diagram, describe briefly the following two boiling processes, namely,
  (i) Pool Boiling, and (ii) Flow Boiling.

  06

(b) Ammonium vapours at 34°C are condensed on a square array of 25 X 25 horizontal tubes. Outside diameter of tubes is 30 mm. and length of each tube is 1.6 m. The surface temperature of the tubes is maintained at 22°C. Assuming the following equation :

$$h_{av} = 0.725 \frac{[K^3 \rho_L (\rho_L - \rho_V) g \lambda]^{0.25}}{nD\mu(T_g - T_w)}$$

Calculate the rate of condensation of ammonium vapours. Given, Density of ammonia vapour = 0.6894 kg/m^3 ; Density of liquid ammonia = 600 kg/m^3 ; Viscosity of ammonia = 0.21 X 10^{-3} N-s/m^2 ; Thermal conductivity = 0.51W/mK ; and Latent heat of condensating vapour = 11.25 kJ/kg.

  06

Q. No. 5 :

(a) Describe the types of Thermal Insulation.

  03

(b) Mention the Desirable Properties of Insulating Materials.

  03

(c) Write in brief the scope of Thermal Insulation for Cryogenic services.

  06

Q. No. 6 :

(a)   Discuss the most two important problems to be tackled in Heat Exchangers.

04

(b)   With a neat diagram mentioning Temperature, and Flow of Hot and Cold Fluid, in Parallel Flow System, prove the Effectiveness of Heat Exchanger ($\in$) can be as follows :

$$\in = \frac{1 - exp\,[-NTU\,(1+CR)]}{1+CR}$$

Where UA / C_{min} = NTU and C_{min} / C_{max} = Capacity Rate Ratio (CR) of a heat exchanger.

08

Q. No. 7 :

(a)   For LNG steam vessel, why LNG is burnt in boiler during passage ?   04

(b)   Explain Custody Transfer System (CTS) with block diagram.   08

Q. No. 8 :

(a) Explain ESDS with Logic block diagram used for Gas carrier vessel operations.

06

(b) Show cargo tank dome arrangement of a Gas Carrier.

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