INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

END SEMESTER EXAMINATION December 2017

Programme: B.Tech (Marine Engineering) **Semester:** IV

Subject Name: Marine Heat Engine & Air-conditioning

Subject Code: UG11T2406/UG11T1406 **Date:** 19.12.2017

Maximum Marks: 100 **Pass Marks:** 50

PART – A Marks: 10X3=30

(All questions are compulsory)

1. (a) What do you understand by the term bypass factor? Explain by means of a process diagram the Bypass factor of a cooling coil & heating coil.

   (b) Differentiate between the Dry bulb, Wet bulb and Dew point temperature

   (c) What do you understand by Slip and Slip factor of a centrifugal compressor

   (d) What do you understand by modified Rankine cycle? Discuss.

   (e) What are the energy losses in steam turbines?

   (f) Discuss the difference between Impulse & reaction turbines with respect to Pressure Drop, Area of Blade channels & efficiency.

   (g) What are parameters to be controlled for comfort air conditioning?

   (h) Define a ton of refrigeration, Express the value in kJ/min

   (i) State the methods of increasing the thermal efficiency of a Rankine cycle.

   (j)State the merits and demerits of closed cycle gas turbine over open cycle gas turbine.

PART – B Marks: 5X14=70

(Answer any 5 of the following, use of Steam Tables allowed)

2. In a gas turbine plant working on Brayton Cycle, the air at inlet is 27^0C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800^0C. The turbine and compressor efficiencies are each 80%. Find the following,

   a) The compressor work

   b) The turbine work,

c) Heat supplied,

d) Overall cycle efficiency,

e) Turbine exhaust temperature.

Mass of air may be considered as 1 kg. Draw T-S diagram. Take γ=1.4, and Cp=1.005 kJ/kg-k.

(4+4+2+2+2)

3.In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and exhaust pressure is 0.2 bar. Determine:

a) The pump work,

b) The turbine work,

c) The Rankine cycle efficiency,

d) The condenser heat flow,

e) The dryness at the end of expansion.

Assume flow rate of 9.5 kg/s. (4+4+2+2+2)

4. A Centrifugal Compressor running at 16000 rpm takes air at 17°C and compresses it through a pressure ratio of 4 with an isentropic efficiency of 82%. The blades are radially inclined and the slip factor is 0.85. Guide vanes at inlet give the air an angle of pre-whirl of 20° to the axial direction; take the mean diameter of the impeller eye as 200 mm and absolute air velocity at inlet as 120m/s.

Calculate:

Impeller Tip Diameter (10)

Draw Velocity Diagram for Inlet and Outlet (4)

Take Cp = 1.005kj/kg K and γ=1.4

5. In a single stage impulse turbine the isentropic enthalpy drop is 251 kJ/kg occurs in the nozzle having efficiency of 90% and nozzle angle of 20°. The blade velocity co-efficient is 0.9 and the ratio of blade velocity to steam velocity is 0.5. The steam mass flow rate is 8kg/s and velocity of steam entering is 50m/s. Determine:

The blade angles at inlet and outlet if the steam enters blade smoothly

and leaves axially (10)

Blade efficiency (4)

6. At a particular stage of a reaction steam turbine, the mean blade speed is 60m/s. Steam is at a pressure of 3 bar with temperature of 200^0C. If the fixed

and moving blades at this stage, have inlet angle of 30^0 and exit angle 20^0 . Determine

a) Draw Velocity Diagram (4)
b) Determine blade height at this stage , If the blade height is 1/10 of mean blade diameter and steam flow is 10 Kg/s (4)
c) Power developed by a pair of fixed and moving blade rings at this stage (3)
d) The heat drop required by the pair if the steam expand with an efficiency of 85% (3)

7. Room air at 20^OC Dry bulb temperature & 60% RH is mixed with outdoor air at 40^OC Dry bulb temperature & 40% RH in the ratio of 4:1. The mixture is passed through a cooling coil whose temperature is maintained at 9^OC & whose bypass factor is 0.25.Find

(a) Condition of air at inlet of coil. (5)

(b) Condition of air leaving the coil (5)

(c) If $250m^3$/min of air is supplied to the room, what is the refrigeration load in tons. (4)

8. A food storage plant requires 10 kW for operating the refrigerating system with Ammonia as refrigerant. The evaporator temperature is (-) 10^oC , the condenser temp is 25^oC & the refrigerant is sub cooled by $+6^oC$ before it is throttled .The quality of vapor leaving the evaporator is 0.98 dry. Determine

(a) The condition of vapor entering the condenser & evaporator (4)

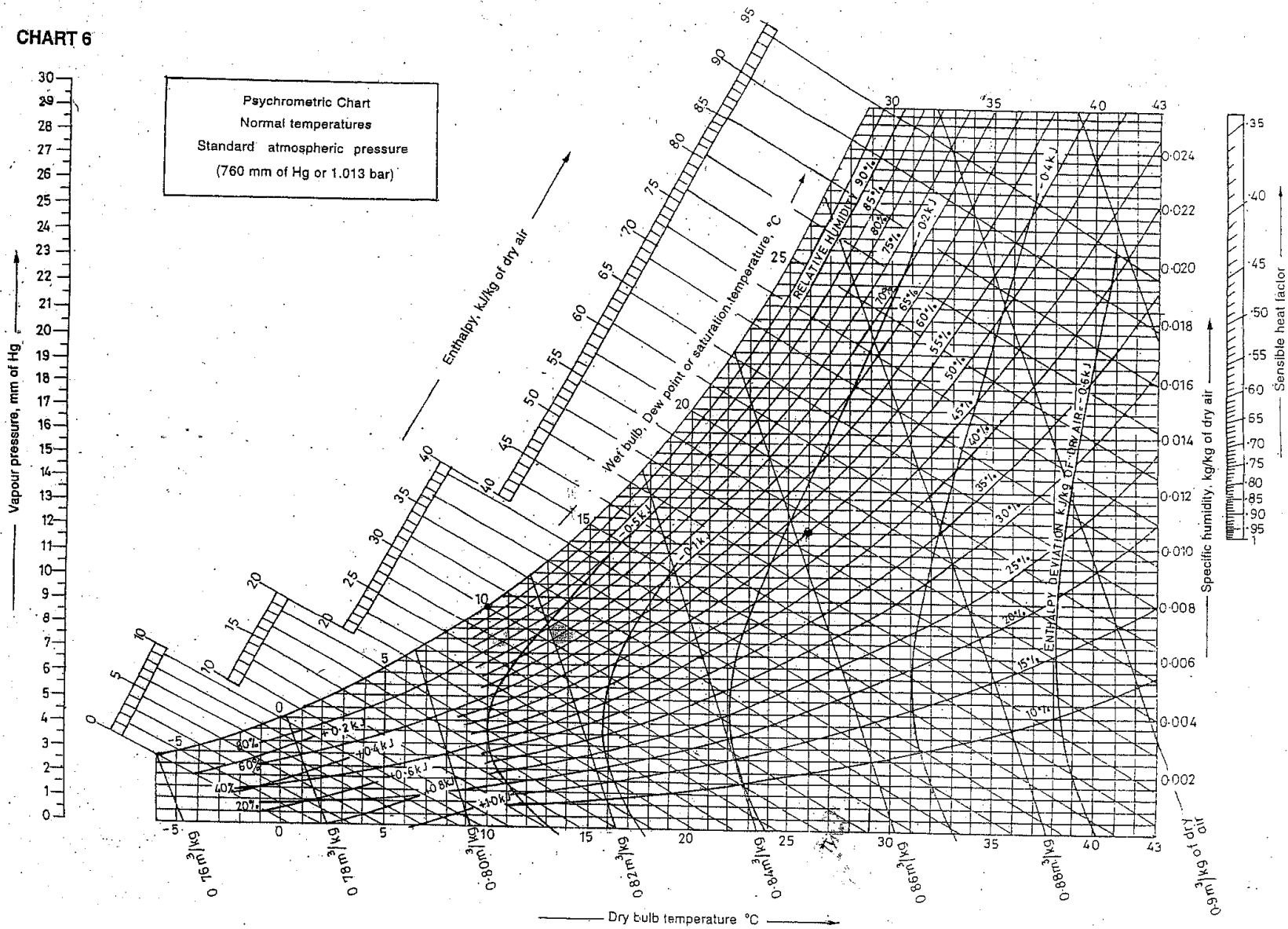
(b) COP of the Plant (6)

(c) Capacity of the plant (4)

Properties of Ammonia are given below

Temp ^oC	Liquid		Vapor		specific heat kJ/kg K	
	Enthalpy h_f kJ/kg	Entropy s_f kJ/kg K	Enthalpy h_g kJ/kg	Entropy s_g kJ/kg K	Liquid	Vapor
25	298.8	1.1234	1465.0	5.0355	4.6	2.8
(-)10	135.2	0.5440	1432.0	5.4730		

CHART 6


Psychrometric Chart
Normal temperatures
Standard atmospheric pressure
(760 mm of Hg or 1.013 bar)
Vapour pressure, mm of Hg
Enthalpy, kJ/kg of dry air
Wet bulb, Dew point or saturation temperature, °C
RELATIVE HUMIDITY
ENTHALPY DEVIATION kJ/kg OF DRY AIR
Specific humidity, kg/kg of dry air
Sensible heat factor
Dry bulb temperature °C
0·76m³/kg
0·78m³/kg
0·80m³/kg
0·82m³/kg
0·84m³/kg
0·86m³/kg
0·88m³/kg
0·9m³/kg of dry air