

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°C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C. 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 $\gamma=1.4$, and $C_p=1.005$ 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 $C_p = 1.005$ kJ/kg K and $\gamma=1.4$

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 coefficient 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°C. If the fixed

and moving blades at this stage, have inlet angle of 30° and exit angle 20° . 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°C Dry bulb temperature & 60% RH is mixed with outdoor air at 40°C 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°C & 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 $250\text{m}^3/\text{min}$ 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°C , the condenser temp is 25°C & the refrigerant is sub cooled by $+6^\circ\text{C}$ 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

Te mp $^\circ\text{C}$	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

