INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)
End Semester Examinations- June-July 2019

Semester – IV

B.Tech (Marine Engineering)

Marine Heat Engines & Air Conditioning

(UG11T1406 UG11T2406)

Date: 05-07-2019 Maximum Marks: 100
Time: 3 Hrs Pass Marks: 50

PART –A (3X10=30 Marks)

Compulsory Questions

1. (a) Define Degree of reaction
   (b) Explain the purpose compounding with respect to steam turbine in brief.
   (c) Name the components of a simple steam power plant and state their function.
   (d) State the methods of improving the efficiency of a Rankine cycle.
   (e) Draw T-S diagram for an ideal gas turbine cycle with a perfect inter cooler.
   (f) Draw T-S diagram for an ideal gas turbine cycle with a perfect reheater.
   (g) Define slip and slip factor as applied to centrifugal compressors.
   (h) State the use of diffuser in a centrifugal compressor.
   (i) Define the term "Relative Humidity" related to psychrometry.
   (j) Define "Dry Bulbs Temperature" , "Wet Bulbs Temperature" and "Dew Point Temperature".

PART – B (14 X5 = 70 Marks)

(Answer any five questions)

2. The velocity of steam, leaving the nozzle of an impulse turbine is 1200 m/s and the nozzle angle in 20^0 , the blade velocity is 400 m/s and blade velocity coefficient is 0.85, assuming no losses, calculate by analytical method (using trigonometric formulae) for a mass flow rate of 2 kg/s and symmetrical blading, (a) blade angles, (b) tangential force, (c) power developed by the turbine. (6+4 +4)

3. A centrifugal compressor delivers 10 m^3/s of air running at 10,000 rpm. The air is drawn in at 1 bar, 300k and delivered at 4 bar. The isentropic efficiency is 80%. Blades are radial at outlet and constant flow velocity is 64 m/s. The outer diameter of impeller is twice the inner and slip factor may be taken as 0.9.

   Calculate : (i) Temperature of air at outlet, (ii) power required to drive the compressor, (iii) impeller diameter at inlet and outlet, (iv) impeller blade angle at inlet, (v) Diffuser blade angle at inlet.

   (Take C_P =1.005 KJ/KgK, γ = 1.4). (3+4+4+3)

4. In a reheat cycle, steam at 500^0C expands isentropically in H.P turbine till it is saturated vapour. It is reheated at constant pressure to 400^0C and then expands isentropically in LP turbine to 40^0C. If the maximum moisture content is limited to 15% at the turbine exhaust, find (i) reheat pressure (ii) the pressure of steam at the inlet to H.P turbine (iii) net specific work output (iv) cycle efficiency (v) steam rate. (Assume all ideal process and neglect feed pump work). (2+3+3+3+3)

5. A gas turbine plant runs at a pressure ratio of 6 and maximum temperature of 1000K. Air enters the compressor at 300K. compressor is entropic efficiency is 85% and isentropic efficiency of turbine is 90%.

   Calculated (a) overall cycle efficiency, (b) specific turbine output.

   (Take : C_P = 1.005 KJ/KgK for air and Y = 1.4, for both air and gas).

   (10+4)

6. A refrigerant is dry saturated at compressor inlet at temperature -10^0C and condenses in condenser at 45^0C. The compression is isentropic. Temperature at the inlet of expansion valve is 35^0C, mass flow rate of the retrigger and is 300 kg/hr, C_P of vapour refrigerant = 1.09 KJ/Kgk and C_P of liquid refrigerant = 0.246 kJ/KgK. The properties of refrigerant are,

Temp (^{0}C)	Enthalpy (KJ/Kg)		Entropy (KJ/KgK)	
	Liquid	Vapour	Liquid	Vapour
-10	45.4	460.7	0.183	1.637
45	133.0	483.5	0.485	1.587

Calculate : (a) capacity of plant in tons of refrigeration, (b) power required to drive the compressor, (c) Coefficient of Performance of the plant.

(6+4+4)

7. Atmosphere air at 76 cm of Hg barometric pressure has 25^{0}C DBT and 15^{0}C WBT. With the help of psychrometric chart or steam table, determine (a) the relative density (b) the humidity ratio (c) the dew point temperature (d) the enthalpy of air per kg of dry air (e) the partial pressure of vapour.

(3+3+3+3+2)

8. An Ammonia refrigerator work between -4^{0}C and 26^{0}C. The refrigerent is dry saturated vapour at the end of isentropic compression. Refrigerant is saturated liquid at the end of condensation. Calculate (a) refrigerating effect, (b) compressor power, (c) COP for the mass flow rate of refrigerant equal to 1 kg/s.

The properties of refrigerant are.

Temp (^{0}C)	Enthalpy (KJ/Kg)		Entropy (KJ/KgK)	
	Liquid	Vapour	Liquid	Vapour
-4	181.55	1457.29	0.9324	5.672
26	322.47	1483.81	1.424	5.306

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