INDIAN MARITIME UNIVERSITY
(A Central University, Govt.of India)

May/June 2015 End Semester Examinations

SEMESTER – IV, B.TECH (MARINE ENGINEERING)

MARINE HEAT ENGINE & AIR CONDITIONING (T 2406 / T 1406)

Date:23.06.2015 **Max.Marks:100**
Time:-3 Hrs **Pass Marks:50**

PART – A **(3 x10 = 30 Marks)**
(Compulsory Questions)

1. a) Explain Working Principle of a Reaction Turbine.

   b) What is "Compounding" of Turbine? Explain Pressure Compounding.

   c) Draw Velocity Diagram of a single Stage Impulse Turbine and Explain Axial Thrust.

   d) Name the Components of a Simple Steam Power Plant and state their function?

   e) Explain DUAL CYCLE?

   f) Compare Brayton Cycle with Rankine Cycle?

   g) Explain the process of Pressure rise in a Centrifugal Compressor.

   h) What is Relative Humidity? How is it defined as the ratio of two mole fractions?

   i) Explain Reasons of Limitation of Highest Temperature and Pressure in a Vapour Cycle.

   j) What do you understand by Dry Bulb and Wet Bulb Temperatures? Define Dew Point Temperature.

PART – B **(5 x14 = 70 Marks)**
(Answer any five of the following)

2. a) In a simple Impulse Steam Turbine stage steam enters the nozzle at 15 bar, dry saturated with a velocity of 150 m/s. Nozzle angle is 20° and the seatm leaves Nozzle at 8 bar and enters into smooth blades.
   (Assume that Blade Velocity at inlet and exist is same)
   Considerting nozzle velocity co-efficient as 0.9 and blades to be equiangular, determine:
   a) the blade angles **(10)**
   b) the stage efficiency **(4)**

3. a) A Parson's reaction turbine has mean diameter of blades as 1.6 m and rotor moving at 1500 rpm. The inlet and outlet angles are 80° and 20° respectively. Turbine receives steam at 12 bar, 200°C and has isentropic heat drop of 26 kJ/kg. 5% of steam supplied is lost through leakage. Considering Horsepower developed in stage to be 600 hp,

(Assume that the specific volume remains constant throughout the stage) Calculate:

a) Stage efficiency **(10)**

b) Blade Height **(4)**

4. a) A Steam turbine operates on a regenerative cycle. Steam is supplied dry saturated at 30 bar and is exhausted to a condenser at 0.06bar. The condensate is pumped to a pressure of 3.0 bar at which it is mixed with bled steam from turbine at 3.0 bar. The resulting water, which is at saturation temperature is the pumped to the Boiler. For ideal cycle, neglecting feed pump work,

Draw Block Diagram and T-S Diagram. **(4)**

Calculate

a) Amount of Bleed steam required per Kg steam supplied **(6)**

b) Cycle efficiency of the plant **(4)**

5. A Gas turbine Plant runs at a pressure ratio of 7 and maximum temperature of 1000 K. Air enters the Compressor at 288 K. Compressor isentropic efficiency is 85% and isentropic efficiency of turbine is 90%. Calculate

a) Overall cycle efficiency **(10)**

b) Turbine Output **(4)**

Take Cp = 1.005 kj/kg K for Air & Gas; y = 1.4 for both Air & Gas

6. A Centrifugal compressor has a pressure ratio of 4/1 with isentropic efficiency of 80% when running at 1500 rpm and inducing air at 20°C. Guide vane at the inlet gives the air a pre-whirl of 25° to the axial direction at all radii and the mean diameter of the eye is 250 mm. The absolute air velocity is 150m/s.

At exit the blades are radially inclined and the impeller tip diameter is 590mm.

a) Draw the velocity diagram **(4)**

b) Calculate the SLIP FACTOR of the compressor **(10)**

7. A Vapour compression refrigeration cycle operates between the condenser temperature of 20°C and evaporation temperature of -10°C with carbon di oxide as refrigerant. Temperature after isentropic compression is 40°C and condensate leaves at 10°C before being passed through expansion valve. Determine:

a) COP **(10)**

b) Mass flow rate of CO2 required to get refrigeration effect of 2 kW. **(4)**

Properties of CO2 are as given below:

Temperature °C	Saturation Pressure bar	Specific Volume Vg m^3/kg	Enthalpy kJ/kg		Entropy kJ/kg.K		Specific Heat kJ/kg.K	
			hf	hg	sf	sg	Cpf	Cpg
20	57.27	-	144.11	299.62	0.523	1.0527	2.889	2.135
-10	26.49	0.014	60.78	322.28	0.2381	1.2324	-	-

8. For a Ship's Dinning Hall Air Conditioned Air at the rate of 0.8 m^3/s is required. Atmospheric air is at 15°C and relative humidity of 80%.

Conditioned air needed to be at 25°C and relative humidity of 50%

a) Draw the Diagrammatic Psychometric Chart **(4)**

b) Determine the mass of water added in kg/s **(8)**

c) Heat Transferred in kW **(2)**

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