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

B.Tech. (Marine Engineering) - Semester IV
December 2015 End Semester Examinations

Marine Heat Engine & Air Conditioning
Subject Code: UG11T2406/UG11T1406

Time: 3 hrs | Max Marks: 100
Date: 29.12.2015 | Pass Marks: 50

Part-A **(10x3=30 Marks)**

Compulsory Questions

1.a) Explain Compounding of Steam Turbine.
b) Explain Degree of Reaction.
c) Explain Stage Efficiency and Overall Efficiency of a Steam Turbine.
d) Describe Advantages of using Super Heated Steam in a Vapour Cycle.
e) Explain Regenerative Vapour Cycle.
f) Describe Effect of Two Stage Compression with Inter cooling of Air in a Brayton Cycle.
g) Explain Dual Cycle.
h) Explain Slip and Slip Factor of a Centrifugal Air Compressor.
i) Explain Heat Pump Cycle.
j) Explain Principle of Winter Air Conditioning.

Part- B **(5 X 14 = 70 Marks)**

Answer any Five from the following

2. Steam from the Nozzle of a single –wheel Impulse Turbine discharges with a velocity of 900m/s and Nozzle angle is 20° .The Blade Velocity is 300 m/s and the Blade Velocity Coefficient is 0.7. Blades are symmetrical. Calculate for a mass flow of 1 kg/s
   a) The Blade inlet angle (6)
   b) The Driving force on the wheel (4)
   c) The Diagram Efficiency (4)

3. In a Reaction steam turbine the nozzle angle is 20° and absolute velocity of the steam at inlet to the moving blades is 240m/s. The blade velocity is 210m/s. If the blading is designed for 50% reaction, determine:
   a) The blade angle at Inlet and exit (8)
   b) Diagram Power for a steam flow of 1kg/s (4)
   c) The Diagram efficiency (2)

4. A Centrifugal Compressor running at 18000 rpm takes air at 17°C and compresses it through a pressure ratio of 5 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. The mean diameter of the impeller eye is 300 mm and absolute air velocity at inlet is 120m/s. Calculate :
   Impeller Tip Diameter (10)
   Draw Velocity Diagram for Inlet and Outlet (4)
   Take Cp = 1.005kj/kg K and y(GAMA)= 1.4

5. In a reheat cycle, the initial steam pressure and maximum temperature are 150 bar and 550°C respectively. If the condenser pressure is 0.1 bar and moisture at the condenser inlet is 5% and assuming ideal processes, determine: (Neglect Pump Work)
   a) The Reheat pressure (8)
   b) The Cycle efficiency (4)
   Draw T-S Diagram (2)

6. A Gas Turbine working on Brayton Cycle has following data:
   a) Compressor Inlet air temperature = 311 K
   b) Compressor pressure ratio = 8
   c) Combustion Chamber Pressure Drop= 5% of the inlet pressure of Combustion Chamber.
   d) Turbine inlet temperature= 1367 K
   e) Turbine exit and compressor inlet pressure are atmospheric.
   f) Compressor and Turbine efficiencies are 0.87 and 0.90 respectively
   Draw the T-S Diagram (4)
   Calculate the Cycle Efficiency (10)
   Take Cp of Air and Gas same=1.005kj/kg and y(GAMA) for Air and Gas= 1.4

7. A simple R-12 plant is to develop 6 tonnes of refrigeration. The condenser and evaporator temperatures are to be 40°C and -10°C respectively.
   Draw Block Diagram and p-h diagram (4)
   Determine:
   a) Volume Flow rate handled by Compressor in m^3/s (2)
   b) Flash Gas percentage after throttling (2)
   c) Heat Rejected to Condenser in KW (2)
   d) COP (4)

   For R-12:
   At p1=(p sat at -10°C) 2.912 bar, h1= 183.19 kj/kg, s1= 0.7019kj/kg K, v1= 0.077m^3/kg
   hf= 26.87 kj/kg and hfg= 153.3 kj/kg
   At p2=(p sat at 40°C)=9.6066bar, h3(Enthalpy of Saturated Liquid at 40°C)=74.59kj/kg
   s2= 0.7019 kj/kg K and h2= 209.41kj/kg

8. An Air Conditioning System is designed under following conditions:

   Outdoor Condition : 30°C DBT(Dry Bulb Temperature) R.H.= 70%
   Required Indoor Condition: 22°C DBT, and 70% R.H
   Amount of Free Air Circulated: 3.33 m^3/s
   Coil Dew point temperature: 14°C
   Required condition is achieved first by cooling and then dehumidification by heating.

   Calculate: a) Cooling Coil in Tonnes b) Capacity of Heating Coil in KW (10)
   Draw the Process Diagram (4)

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