

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)

MAY/JUNE 2018 END SEMESTER EXAMINATION

B. Tech(Marine Engineering)

Semester: IV

Marine Heat Engine & Air Conditioning (UG11T1406/UG11T2406)

Date: 20-06-2018

Time: 3 Hrs

Maximum Marks:100

Pass Marks:50

Part-A

Marks: 10 x 3= 30

(All Questions are compulsory)

1.
 - a. Why CARNOT Cycle is not practicable for a steam power plant?
 - b. Explain Binary Vapour Cycle.
 - c. Explain Dual Cycle.
 - d. Explain Regenerative Brayton Cycle.
 - e. Explain Effect of Multi stage Compression and Inter cooling on a Brayton Cycle
 - f. What is Compounding w.r.t a Steam Turbine. Explain Velocity Compounding with the help of Pressure- Velocity Diagram
 - g. What is a Stage of a Turbine? Explain Stage Efficiency and Degree of Reaction of a Reaction Turbine.
 - h. What is a Flash Chamber? What is its advantage in Refrigeration?
 - i. Explain DRY & WET Compression and state reasons for preferring Dry Compression in Refrigeration Cycle.
 - j. Explain Difference Between Specific Humidity and Relative Humidity
What are their importance in Air conditioning system?

Part- B

Marks: 5 x 14= 70

(Answer any 5 of the following 7 questions)

2. a) Explain Nozzle Efficiency and derive a relation between Nozzle Efficiency and Steam Velocity over a Nozzle.
- b) In a Impulse Turbine, steam exits the nozzle with a velocity of 600 m/s , at an angle of 25° to the plane of rotation of the blade. The mean Blade Speed is 255 m/s, exit angle of the Blade is 30°
Blade Velocity Co-efficient is 0.9.

- i) Draw Velocity Diagram indicating the flow directions
Calculate:
- ii) Entry angle of the Blade 2
- iii) Work Done per kg of steam flow per sec 2
- iv) Diagram Efficiency 1
- v) End Thrust 1
3. a) Establish that in a Parson`s Reaction Turbine 6
Degree of Reaction = $\frac{1}{2}$
- b) In a Parson`s reaction turbine the Rotor is of 1 mtr Dia and runs at 3000 rpm. Stage Efficiency is 0.8; Blade Velocity Co-efficient-0.7 and Blade outlet angle is 20° .
Determine Isentropic Enthalpy Drop in the Stage. 8
4. a) Explain Reheat Vapour Cycle with Block Diagram and T-S Diagram 4
- b) A steam Power Plant operates with Regenerative Rankine Cycle with One Open Feed Water Heater.
Steam Enters the Turbine at 200 bar and 650°C and Condenser Pressure is 0.05 bar. Feed Water Heater works at 8 bar.
Draw the T-S diagram and calculate: (Neglecting Pump Works)
- i) Mass flow rate of steam extracted for Feed Heating per kg/s steam flow through the Turbine. 6
- ii) Thermal efficiency of the cycle 4
5. A Brayton Cycle Gas Turbine Power Plant operates at overall pressure ratio of 1:14. Maximum and Minimum temperatures of the cycle are 927°C and 27°C , respectively. Compression is carried out in 2- stages of equal pressure ratio with perfect Inter Cooling. Expansion is carried out in single stage, Isentropic efficiency of both Compression stage is 0.85 and isentropic efficiency of expansion stage is 0.9
Draw T-S diagram and Considering both Air & Gas $C_p=1.005 \text{ kJ/kg}$; $\gamma=1.4$
Determine: i) Compressor work 4
ii) Turbine work 4
iii) Heat supplied 2
iv) Thermal efficiency of the cycle 4
6. a) With neat sketch, describe main components of a centrifugal compressor and explain their functions. 6

- b) Explain Process of increase in pressure of Air in a Centrifugal Compressor 2
- c) Explain Pre-whirl and pre-whirl vanes 3
- d) Explain Slip and Slip Factor 3
7. a) Explain Refrigeration Effect and COP of a Refrigerator 3
- b) Describe important properties of a Refrigerant 4
- c) A refrigeration system has Air leaving refrigerated space at 7°C and 1 bar. Air is then Compressed isentropically to 5 bar. Air at 5 bar is then cooled to 27°C and expanded isentropically to 1 bar pressure and discharged to refrigerated space. Calculate COP of the system. 7
8. a) Explain with neat sketch:
 i) Summer Air conditioning
 ii) Winter Air Conditioning
 and describe function of each component 6
- b) In an Air-conditioning system , Atmospheric air is at 15°C and 80% relative humidity and supply Air is to be at 25° and 50% relative humidity. Flow rate of conditioned Air is 0.8 cub.mtr/ s. Determine:(Use Psychometric chart)
 Mass flow rate and Heat transferred 4 +4
- N.B:
 Psychometric chart used for solving the problem must be attached with answer sheet and has to be duly endorsed by invigilator.
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