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Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Marine Heat Engine and Air-Conditioning

Time: 3 hrs.

Max. Marks:100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. What is compounding? What are the different types of compounding? Explain with a neat sketch velocity compounding. (10 Marks)
- b. Prove that maximum blade efficiency for single stage impulse turbine with equiangular rotor blades is given by

$$\eta_{b,max} = (1 + cb) \frac{\cos^2 \alpha_1}{2}$$

where α_1 is the nozzle angle at inlet and blade, cb is velocity co-efficient. (10 Marks)

- 2 a. Prove that for Parsons Reaction turbine

$$\eta_{b,max} = \frac{2 \cos^2 \alpha_1}{1 + \cos^2 \alpha_1} \quad (10 \text{ Marks})$$

- b. A single stage impulse turbine has a diameter of 1.5m and running at 3000RPM. The nozzle angle is 20° . Ratio of relative velocity at outlet to that at inlet is 0.9. The outlet angle of the blade is 3° less than inlet angle. Steam flow rate is 6kg/s speed ratio 0.45.

Draw the velocity diagram and the following

- i) Velocity of whirl
- ii) Axial thrust
- iii) Blade angles
- iv) Power developed.

(10 Marks)

- 3 a. Draw T.S diagram of Rankine cycle using dry saturated steam and develop the equation for the Rankine cycle efficiency. (10 Marks)
- b. Sketch the flow diagram and corresponding T.S diagram of reheat vapour cycle and derive an expressions for reheat cycle efficiency. (10 Marks)

- 4 a. With the help of a schematic and T.S diagram. Explain the working of a Binary vapour cycle. (10 Marks)
- b. In a single heater regenerative cycle and the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10bar the feed water heater is a direct contact type which operates at 50bar find the efficiency and steams rate of the cycle. (10 Marks)

PART – B

- 5 a. Compare open cycle and closed cycle gas turbines. (08 Marks)
- b. Draw neat line diagram and T.S diagram for the following gas turbine cycles. (12 Marks)
- i) Regeneration
 - ii) Inter cooling
 - iii) Reheating.

- 6 a. What do you mean by refrigerant, refrigeration, and refrigerator? (04 Marks)
- b. Explain the working of a Vapour absorption refrigeration system. (10 Marks)
- c. A single compressor system using Freon – 12 has three evaporators of 10 ton, 20ton, and 30ton capacity, all operating at same temperature of -10°C , the condenser pressure is 9.5944 bar 40°C and the liquid is subcooled in the condenser by 10°C the discharge from the evaporator is dry saturated and the compression is to be assumed isentropic. Determine
- The refrigerating effect in kJ/kg of flow rate
 - Rate of the refrigerant in kg/min and
 - The theoretical power required. (06 Marks)
- 7 a. With a suitable diagram explain the working principle of a centrifugal compressor. (10 Marks)
- b. A centrifugal compressor runs at 1500RPM and produces stagnation pressure ratio of 4 between the impeller inlet and outlet. The stagnation condition of air at the compressor inlet are 1 bar and 25° respectively. The absolute velocity at the compressor intake is axial. If the compressor has radial blades at the exit such that Relative velocity at the exit = 135m/s and the total to total efficiency of the compressor is 0.78. Draw the velocity triangle at the exit of the rotor and compute the slip as well as the slip co-efficient. Rotor diameter at the outlet is 58cm. (10 Marks)
- 8 a. Define the following clearly.
- Specific humidity
 - Relative humidity
 - Degree of saturation
 - Dew point temperature
 - Wet bulb temperature. (10 Marks)
- b. With neat sketch, briefly describe a winter Air conditioning system. (10 Marks)

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