Indian Maritime University

(A Central University, Govt. Of India)

M.Tech (Marine Engineering and Management)

Semester - I

End Semester Examination December 2019

Applied Thermodynamics & Turbo-Machinery

(PG13T1101)

Date: 06.12.2019	**Max Marks: 60**
Time: 3 Hours	**Pass Marks: 30**

Part – A (compulsory)

Answer the following (10x2=20 Marks)

1. Explain what is the pinch point with respect to a combined cycle plant.
2. How are internal combustion engines classified with respect to air intake process employed.
3. Explain the meaning of Reheat Factor with reference to steam turbines.
4. Using a suitable thermodynamic diagram, show the advantage of employing multistage-compression with inter-cooling in an axial compressor.
5. Draw the velocity diagram of an axial multistage-axial compressor and explain.
6. What is a free power turbine ?
7. What is the importance of dimensional analysis of turbo-machinery ?
8. Sketch and label a thermodynamic cycle of an ideal Rankine cycle employing superheat, closed type feed water heater and a vacuum condenser.
9. Define volumetric efficiency of a reciprocating internal combustion engine.
10. What is an Engine Management System ?

Part – B

Answer any 4 out of 6 questions (4 x 10= 40 marks)

(a) A Single cylinder, four-stroke cycle CI (Compression Ignition) engine with 12.9 cm bore and 18.0 stroke, operating at 800 RPM, uses 0.113 kg of fuel in four minutes while developing a torque of 76 N-m. Calculate –

(a) Brake specific fuel consumption. (g/KW – hr)
(b) Brake mean effective pressure (kPa)
(c) Brake power (kW)
(d) Specific power (kW/cm^2)
(e) Output per displacement (kW/Liter)
(f) Specific volume (L/kW)

(6 Marks)

(b) Sketch an approximate valve timing diagram for a 4 stroke Spark Ignited Engine

(4 Marks)

11. A gas turbine cycle has two stages of compression, with an intercooler between the stages. Air enters the first stage at 100 kPa, 300 K. The pressure ratio across each compressor stage is 5 to 1, and each stage has an isentropic efficiency of 82%. Air exits the intercooler at 330 K. The maximum cycle temperature is 1500 K, and the cycle has a single turbine stage with an isentropic efficiency of 86%. The cycle also includes a regenerator with an efficiency of 80%.
    (a) Sketch a thermodynamic and component corresponding diagrams and label them.

    (3 Marks)

    (b) Calculate the temperature at the exit of each compressor stage and the cycle thermal efficiency.

    (7 Marks)

12.
    (a) In a single stage simple impulse turbine the steam flows at rate of 5 kg/s. It has rotor of 1.2 m diameter running at 3000 rpm. Nozzle angle is 18°, blade speed ratio is 0.4, velocity coefficient is 0.9, outlet angle of blade is 3° less than inlet angle. Determine blade angles and power developed.

    (6 Marks)

    (b) List different types of steam nozzles and explain nozzle efficiency.

    (4 Marks)

13. Obtain the dimensional analysis for a axial flow turbo-compressor for mass, efficiency and power functions.

    (10 Marks)

14. Explain with neat sketches various classifications of Internal combustion Engines.

    (10 Marks)

15. Explain with neat sketches a combined gas turbine and steam turbine plant for a single pressure system. Show the heat balance in the circuit and list efficiencies for Gas Turbine, Steam Turbine and the total plant.

    (10 Marks)

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