

Roll No.

Total No. of Questions : 09]

[Total No. of Pages : 02

B.Tech.(Sem. - 3rd)
APPLIED THERMODYNAMICS - I

SUBJECT CODE : ME - 209

Paper ID : [A0805]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours

Maximum Marks : 60

Instructions to Candidates:

- 1) Section - A is **Compulsory**.
- 2) Attempt any **Four** questions from Section - B.
- 3) Attempt any **Two** questions from Section - C.

Section - A

Q1) **(10 × 2 = 20)**

- a) Define 'stiochiometric air' and 'excess air'.
- b) Differentiate between 'carbonisation' and 'gasification'.
- c) What is 'once through' boiler.
- d) Define 'equivalent evaporation' and 'boiler efficiency'.
- e) Compare Rankine cycle with Carnot cycle in terms of efficiency and work ratio.
- f) Explain the significance of critical pressure ratio.
- g) What are the conditions for maximum efficiency of a reaction turbine?
- h) Why compounding is necessary for turbines?
- i) Define 'isothermal efficiency' and 'polytropic efficiency' of a reciprocating air compressor.
- j) Define 'vacuum efficiency' and 'condenser efficiency'.

Section - B

(4 × 5 = 20)

Q2) 5 m³ of free air per minute at 1.01 bar and 18°C is compressed by a single stage double acting compressor to 8 bar. Speed = 300 rpm. Pressure and temperature of air at the end of suction stroke are 0.98 bar and 30°C. L/D = 1.2, and clearance ratio is 0.04. Estimate the power required to operate the compressor, volumetric efficiency and cylinder diameter. Assume $\eta_m = 88\%$, and index of compression = 1.3.

- Q3)** Calculate the vacuum efficiency and condenser efficiency if the following data were available in a test on condenser. Condenser vacuum = 700 mm of Hg. Barometer reading = 754 mm of Hg. Hot well temperature = 30°C, inlet temperature of cooling water = 12°C. Outlet temperature of cooling water = 26°C.
- Q4)** A steam turbine develops 185 kW with consumption of 16.5 kg/kWhr. The pressure and temperature of steam entering the nozzle are 12 bar and 230°C. The steam leaves the nozzle at 1.2 bar. The diameter of the nozzle at throat is 7 mm. Find out number of nozzles.
- Q5)** With the help of a neat sketch describe the working of a locomotive boiler. Name the various boiler mountings.
- Q6)** The ultimate analysis of a solid fuel is as follows; C = 78%, O₂ = 3%, H₂ = 3%, S = 1%, moisture = 5% and ash content = 10%. Calculate the mass of air supplied and mass of product of combustion per kg of fuel if 30% of excess air is supplied for combustion.

Section - C

(2 × 10 = 20)

- Q7)** A steam power plant running on Rankine cycle has steam entering HP turbine at 20 MPa, 500°C and leaving LP turbine at 90% dryness. Considering condenser pressure of 0.005 MPa and reheating occurring up to the temperature of 500°C. Find out:
a) The pressure at which steam leaves HP turbine
b) The thermal efficiency
- Q8)** 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, and velocity coefficient is 0.9, Outlet angle of blade is 3° less than inlet angle. Determine blade angles and power developed.
- Q9)** Write short notes on the following:
a) Governing of steam turbines
b) Binary vapour cycle

