
B.E. / B.Tech DEGREE END SEMESTER EXAMINATIONS, MAY 2012

MECHANICAL ENGINEERING BRANCH

(19)

FOUTH SEMESTER

ME 9254 THERMAL ENGINEERING - I

INSTRUCTIONS

Answer All Questions

Assume any data required suitably with proper justification

Time : 3 Hrs **Max Marks : 100**

PART A (10 x 2 = 20 Mark)

1. Draw the p –v and T – s diagram for Diesel cycle and properly label all the processes and energy transfers.
2. What do you understand by an isentropic process? How does the pressure and temperature change during isentropic expansion process?
3. What is the influence of clearance volume on specific work and volumetric efficiency?
4. What are the advantages of multi-stage compression?
5. What is the need for flywheel in IC Engines?
6. How does the suction process of diesel engine differ from that of petrol engine?
7. What is the stoichiometric Air to Fuel ratio for methane?
8. What is the purpose of IC engine exhaust gas analysis?
9. Why does regeneration lead to increase in Brayton cycle efficiency?
10. List any two important materials used for Gas turbine power plant with suitable reasons.

PART B (5 x 16=80 Mark)

11). In an engine working on Otto cycle, the temperature and pressure at the beginning of the cycle are 32°C and 1.01 bar respectively. The compression ratio is 12. The heat supplied per kg of air is 400 kJ. Determine (i) pressure and temperature at all salient points, (ii) specific work output (iii) Air standard efficiency and (iv) mean effective pressure (16)

12) a) (i) Draw the p-v diagram for the compression of air in a reciprocating compressor without clearance volume and drive the equation for the specific work requirement if the compression is isothermal. (6)

(ii) A single stage single acting air compressor receives 75 m^3/min at 1.013 bar and 15°C. The pressure and temperature in the cylinder during induction are 1 bar and 12°C. The delivery pressure is 8 bar, and index of compression and expansion is 1.25. The clearance volume is 7% of swept volume. Calculate i) specific work, (ii) mass flow rate of air, (iii) volumetric efficiency and (iv) power required to drive the compressor. (10)

(OR)

b) i) Derive the expression for the optimum intercooler pressure if the intercooling is perfect. (6)

(ii) A three-stage single-acting reciprocating compressor delivers 100 kg/min. The intake pressure and temperature of air are 100 kPa and 17°C. The air is compressed to a final pressure of 850 kPa, by a process with a compression index of 1.3. The intermediate pressure is ideal and intercooling is perfect. Neglecting clearance, determine, the intermediate pressures and the power required to drive the compressor. (10)

13) a) (i) List down the major components of an IC engine and identify their specific functions (8)

(ii) Compare the actual valve timing diagram with the ideal valve timing diagram of a diesel engine (8)

(OR)

b) Give the detailed comparison of petrol engines with diesel engines, based on

(i) engine components,

(ii) operating parameters,

(iii) performance parameters and

(iv)applications. (16)

14) a) (i) List the desirable properties of petrol and diesel engine fuels. (6)

(ii) Explain various stages of combustion in diesel engine and show how knocking occurs. (10)

(OR)

b) A four cylinder four-stroke S.I. engine has a compression ratio of 10 and bore of 100 m and stroke of 120mm. The volumetric efficiency of each cylinder is equal to 80%. The engine operates at a speed of 4500 rpm, with an air-fuel ratio 16. If the calorific value of fuel is 44 MJ/kg, atmospheric density is 1.12 kg/m^3, mean effective pressure in the cylinder is 5.5 bar and mechanical efficiency of the engine is 80%, determine i) the indicated thermal efficiency, ii) the brake power and (iii) break thermal efficiency (16)

15) a) i) What are the merits and demerits of gas turbines over IC engines? (6)

ii)The gas turbine has an overall pressure ratio of 8:1 and a maximum cycle temperature of 1100°C. The ambient temperature is 20°C and the isentropic efficiencies for the compressor and turbine are 85 % and 90 % respectively. Calculate the power output in kilowatts for an air flow of 15 kg/s. Also calculate also the thermal efficiency. (10)

(OR)

b)i) Explain the effect of intercooling in Gas turbine cycle with the help of T – s diagram. (6)

ii) In a gas turbine plant, air is compressed through a pressure ratio of 6:1 from 27°C. It is then heated to the maximum permissible temperature of 1100°C and expanded in two stage turbine with perfect reheating. Calculate (i) the net work per kg of air, (ii) the work ratio and (iii) the cycle efficiency. (10)