Paper ID [ME210]

(Please fill this Paper ID in OMR Sheet)

B.Tech. (Sem. - 4th)

APPLIED THERMODYNAMICS - II (ME - 208/210)

Time : 03 Hours **Maximum Marks : 60**

Instruction 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) What is the function of carburetor.

b) Explain why the cooling of IC Engine is necessary.

c) Explain the term slip and power input factor as applied to centrifugal compressor.

d) Explain the phenomenon of 'surging' in a centrifugal compressor.

e) Explain the term polytropic efficiency of compressor (2), 1.

f) What advantage is gained by splitting the turbine section of a gas turbine into two parts, namely compressor turbine and power turbine (3).

g) Compare a gas turbine with a steam turbine (2).

h) Explain the term Octane number (2).

i) Compare gas turbine and reciprocating engine.

j) What is 'Morse Test'.

Section - B

(4 × 5 = 20)

Q2) Draw the valve timing diagram for an average petrol engine. Give reasons for early opening of exhaust valve and late closing of inlet valves.

Q3) The following data refers to a test on a single cylinder oil engine working on four stroke cycle:
Diameter of brake wheel = 60 cm; rope dia = 3 cm; the dead load is 25kg, when the spring balance reading is 5 kg, and the engine is running at 400 rev/min. The indicator diagram has area = 4 cm^2, length = 6cm and spring stiffness is 12. The fuel consumption is 0.23 kg/b.h.p.-hr. and the fuel used has a calorific value 10500 kcal/kg. Taking cylinder bore 10 cm and piston stroke 15 cm calculate the B.H.P., I.H.P., mechanical and indicated thermal η of the engine.

Q4) Describe the function of impeller and diffuser in centrifugal compressor.

Q5) The centrifugal compressor of a gas turbine requires 3000 H.P. when running at 16000 rev/minute. The tip diameter of the impeller is 50 cm and the uniform width of casing of the vortex chamber between impeller and diffuser is 4cm. Measurements show that static pressure and temperature at a radius of 27 cm are 2.5 kg_f/cm^2 and 110°C. The atmosphere in the test house is 1 kg_f/cm^2. Assuming slip factor = 0.94 and neglecting friction in the vortex chamber, calculate :

(a) The mass flow

(b) The resultant speed at the section given

(c) The total temperature at the section given

It may be assumed that there is no prewhirl and the conditions in the vaneless space correspond to those of free vortex.

Q6) An axial compressor has a degree of reaction of 0.5 at the mean radius with relative air angles of 130° and 100° at rotor inlet and outlet respectively. The angles are measured in the same direction from the blade velocity direction. The overall stagnation pressure ratio is 3.5 and the stagnation isentropic efficiency is 85% when the inlet stagnation temperature is 330 K. The blade speed is constant at 200 *m/s* and the flow velocity is also constant in the compressor. The work done factor is 0.85. Find the stagnation polytropic efficiency and the number of stage.

Section - C

(2 × 10 = 20)

Q7) In a gas turbine plant, air is compressed from atmospheric conditions to the delivery pressure 4 bar and temperature 480 K. In the combustion chamber, a fuel of calorific value 45000 kJ/kg is injected and combustion takes place at constant pressure. The injection of fuel is so regulated that the air fuel ratio is 60 : 1. For a mass flow rate of 10kg/s design the turbine nozzle for throat and exist areas. The maximum temperature of blades is to be 873 K. Take c_p = 1.005 kJ/kg and γ = 1.4 both for air and gases.

Q8) Write a note on any two of the following :

(a) Ramjet

(b) Turbo prop

(c) Supercharging of IC engines

Q9) A four cylinder, four stroke engine is supplied with 15.25 kg of air/kg of octane fuel having heat value 10650 kcal/kg. Calculate (a) the compression ratio, (b) brake specific fuel consumption, (c) bore and stroke; (d) b.m.e.p. The following data may be assumed :- air standard efficiency = 0.53, relative efficiency = 0.70, mechanical efficiency = 0.8; volumetric efficiency = 0.8; stroke equal 1.25 times the bore ; suction conditions are 1 kg_f/cm^2 and 60°C the engine runs at 2400 rev/min and develops 96 brake power.