

Total No. of Questions : 6

Total No. of Printed Pages : 7

42038

EA-75

B. E. (IVth Sem.) (Mech. Engg.) CGPA Exam.-2011

### APPLIED THERMODYNAMICS & HEAT ENGINES

Paper - M-403

Time Allowed : Three Hours

Maximum Marks : 60

Note : Attempt all questions. There is internal choice from question number II to VI. Marks are allotted against each question. All parts of a question should be solved at one place.

Q.1 Attempt all sub-questions. Choose the correct answer in the following multiple choice questions—1½ each

(i) Which one of the following is an intensive property—

- ☒ (a) Pressure
- (b) Enthalpy
- (c) Entropy
- (d) Internal energy

EA-75

P.T.O.

(2)

(ii) Which one of the following is not a property of the system—

- (a) Volume  $V$
- ☒ (b) Heat  $h$   $h_w$
- (c) Temperature  $T$
- ☒ (d) Entropy

(iii) First law of thermodynamics is the law of conservation of—

- (a) Mass
- (b) Momentum
- ☒ (c) Energy
- (d) Kinetic energy

(iv) In air-standard cycle the working fluid considered is—

- ☒ (a) Mixture of fuel and air
- (b) Fuel only
- (c) Carbon di-oxide
- ☒ (d) Air only

(v) For an adiabatic process, the temperature and pressure are related as  $T_2/T_1 =$  —

- (a)  $(p_2/p_1)^{\frac{\gamma-1}{\gamma}}$
- (b)  $\left(\frac{p_2}{p_1}\right)^{\frac{1}{\gamma-1}}$
- ☒ (c)  $\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{\gamma-1}}$
- (d)  $\left(\frac{p_2}{p_1}\right)^{\frac{1}{\gamma}}$

EA-75

Contd. ....

(3)

(vi) A gas turbine works on the following cycle—

- (a) Otto
- (b) Dual
- (c) Stirling
- (d) Brayton

(vii) When air leaks into the condenser, its pressure —

- (a) Decreases
- (b) Increases
- (c) Remain constant
- (d) First decreases then increases

(viii) As compared to centrifugal compressor, the reciprocating compressor is used for compressing gases at—

- (a) Lower pressure ratio
- (b) Almost equal pressure ratio
- (c) Higher pressure ratio
- (d) None of the above

Q.II (a) What do you mean by thermodynamic equilibrium?

(b) A stationary mass of gas is compressed without friction from an initial state of  $0.4 \text{ m}^3$ , 2 bar to a final state of  $0.25 \text{ m}^3$  and 2 bar. There is a transfer of 43.5 KJ of heat from the gas during the process. How much does the internal energy of the gas change.

EA-75

Ther  
Chen  
mecho

64

(4)

or

(a) What are the limitations of the first law of thermodynamics ?

3

(b) A mass of 1.5 kg of air is compressed in a quasistatic process from 0.1 MPa to 0.7 MPa for which  $p v = \text{constant}$ . The initial density of air is  $1.16 \text{ kg/m}^3$ , find the work done by the piston to compress the air.

7

Q.III (a) What is Kelvin-Planck statement of second law of thermodynamics ? Explain.

3

(b) Using an engine of 40% thermal efficiency to drive a refrigerator having a COP of 6, what is the heat input to the engine for each MJ removed from the cold body by the refrigerator.

or

(a) What is the principle of increase of entropy ? Explain.

3

(b) An adiabatic vessel contains 2 kg of water at  $25^\circ\text{C}$ . By paddle wheel work transfer, the temperature of water is increased to  $30^\circ\text{C}$ . If the specific heat of water is assumed constant at  $4.187 \text{ kJ/Kg}^\circ\text{C}$ , find the entropy change of the universe.

7

Contd. ....

EA-75

30  
fag

KS.  
Chen

7  
PL  
P

(5)

Q.IV (a) What are the assumptions considered in an air standard cycle ? 3

(b) In an air standard otto cycle engine, the temperature at the end of compression stroke is 500 K and the maximum cycle temperature is 2400 K. If the engine delivers 700 KJ/Kg of net work find the thermal efficiency and compression ratio of the engine. 7

or

(a) For the same compression ratio and heat supplied compare otto and diesel cycle efficiencies. 3

(b) A heat engine working on diesel cycle draws in air at 1 bar and 300 K. The maximum pressure and temperature in the cycle are 70 bar and 2000 K respectively. Determine the air standard efficiency. 7

Q.V (a) What is a ramjet ? How is the thrust produced here ? 3

(b) A brayton cycle operates with air entering the compressor at 1 bar and 25°C. The pressure ratio across the compressor is 3 to 1, and the maximum temperature in the cycle is 650°C. Determine the compressor work and the thermal efficiency of the cycle. 6

EA-75

P.T.O.

(6)

or

(a) Explain the effect of pressure ratio on the net output and the efficiency of a brayton cycle. 3

(b) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar pressure and 300 K temperature. The pressure ratio is 5 and the maximum cycle temperature is limited to 1075 K. If the compressor and turbine efficiencies are 80% and 85% respectively, make calculations for the net work output. 6

Q.VI (a) Explain the advantages of multistage compression. 3

(b) A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm; and is driven at a speed of 1200 rpm. It is compressing CO<sub>2</sub> gas from a pressure of 120 KPa and a temperature of 20°C to a temperature of 215°C. Assuming polytropic compression with  $n=1.3$ , no clearance and volumetric efficiency of 100%, calculate the indicated power. 6

or

EA-75

Contd. ....

(7)

- (a) Discuss the effects of air leakage in a condenser. 3
- (b) Steam enters a condenser at  $36^{\circ}\text{C}$  and with barometer reading 760 mm. If the vacuum of 695 mm is produced, find the vacuum efficiency. 6