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Total No. of Questions : 18

B.Tech. (Agriculture Engineering) (Sem.–3)

THERMODYNAMICS AND HEAT ENGINE

Subject Code : BTAG-303-19

M.Code : 78589

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Write briefly :

1. Show that the internal energy is a property of the system.
2. What is a non-flow process?
3. What is a polytropic process? How it is different from adiabatic process?
4. What main conclusion can be drawn with respect to the efficiency of a Carnot engine?
5. State the importance of second law of thermodynamics.
6. What does the principle of entropy increase signify?
7. Why does entropy remains constant in a reversible adiabatic process?
8. What is an air standard efficiency?
9. List the assumptions made in the analysis of air standard cycles?
10. What do you understand by mean effective pressure?

SECTION-B

11. A fluid at pressure of 3bar and with specific volume of 0.18 m^3/kg contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to law :

$$p = \frac{C}{V^2}$$

Where C is a constant? Calculate the work done by the fluid on the piston.

12. A steam turbine operates under steady flow conditions. It receives 7500 kg/h of steam from the boiler. The steam enters the turbine at 2800 kJ/kg enthalpy, 70m/s velocity, and an elevation of 4m. The steam leaves the turbine at 2000 kJ/kg enthalpy, 140 m/s velocity, and an elevation of 1.5m. Heat losses from the turbine to surroundings amount to 1600 kJ/h. Calculate the output of the turbine.

13. Prove that all reversible engines operating between the same two heat reservoirs have the same efficiency.

14. In a certain heat exchanger, 60 kg of water is heated per minute from 225 K to 285 K by hot gases which enters in the heat exchanger at 425 K. If the flow rate of gases is 120 kg/min, estimate the net change in entropy. Take $c_{p(water)}$ = 4.186 kJ/kg – K and $c_{p\,(gas)}$ = 1 kJ/kg – K.

15. Derive an expression for air standard efficiency for an Otto cycle.

SECTION-C

16. A Diesel engine has a compression ratio of 14. The fuel is cut off at 0.08 of stroke. The relative efficiency is 52%. Find the massof fuel of calorific value 42000/kJ/kg which would be required per kWh.

17. A gas at 1 bar and 300 K is compressed adiabatically upto 10 bar and then expanded isothermally upto initial specific volume and then cooled at constant volume to initial conditions. Find work, heat and change in internal energy per kg of gas for each process and for the entire processes. Take R=297 J/kg-K and y = 1.4.

18. a) Prove that the heat absorbed or rejected during a polytropic process is

$$\frac{\gamma - n}{\gamma - 1} \times \text{Polytropic work done and}$$

polytropic specific heat is given by the expression.

$$c_n = c_\upsilon \left(\frac{\gamma - n}{1 - n} \right)$$

b) A Diesel engine has a compression ratio of 14. The fuel is cut off at 0.08 of stroke. The relative efficiency is 52%. Find the mass of fuel of calorific value 42000 kJ/kg which would be required per kWh.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.