

**Government College of Engineering, Aurangabad**  
(An Autonomous Institute of Government of Maharashtra)

**S. E. (Mechanical) Examination**

End Semester Examination Nov 2016

**ME243: ENGINEERING THERMODYNAMICS**

*Time: Three Hours*

*Max. Marks: 60*

*“Verify the Course Code and check whether you have got the correct question paper”*

*N.B:-*

- 1. All questions are compulsory.*
- 2. Figures to the right indicate full marks.*
- 3. Assume suitable data if necessary and state it clearly.*
- 4. Use of non-programmable calculator is allowed.*
- 5. Use of Steam tables is permitted.*

**Q.1) Attempt any Two**

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- i) What is heat transfer? What are its positive and negative directions? Show that heat is a path function and not the property?
- ii) What you understand by thermodynamic equilibrium?
- iii) In one of the sections of the heating plant in which there are no pumps enters a steady flow of water at a temperature of 50°C and a pressure of 3 bar ( $h = 240$  kJ/kg). The water leaves the section at a temperature of 35°C and at a pressure of 2.5 bar ( $h = 192$  kJ/kg). The exit pipe is 20 m above the entry pipe. Assuming change in kinetic energy to be negligible, evaluate the heat transfer from the water per kg of water flowing.

**Q.2) Attempt any Two**

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- i) Why is the Carnot cycle on T-s plot a rectangle?
- ii) Show that “efficiency of all reversible heat engines operating between the same temp. levels is the same”.
- iii) An inventor claims to have developed a refrigerator that maintains the refrigerated space at 2°C while operating in a room where the temperature is 25°C and that has a COP of 13.5. Is this claim reasonable?

**Q.3) Attempt any Two**

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- i) A Steam at 10 MPa and 600°C is throttled to 2 MPa. Determine the exit condition of the steam.
- ii) Two boilers one with superheater and other without superheater are delivering equal quantities of steam into a common main. The pressure in the boilers and main is 20 bar. The temperature of steam from a boiler with a superheater is 350°C and temperature of the steam in the main is 250°C. Determine the quality of steam supplied by the other boiler. Take  $c_{ps} = 2.25$  kJ/kg.

iii) Explain the following processes of steam:

- a) Constant volume heating or cooling
- b) Constant pressure heating or cooling

Q.4) Attempt any **Two**

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- i) Explain working of Otto-cycle and show that efficiency of Otto-cycle depends only on the compression ratio.
- ii) An isentropic air turbine is used to supply 0.1 kg/sec of air at  $0.1 \text{ MN/m}^2$  and at 285 K to a cabin. The pressure at inlet to the turbine is  $0.4 \text{ MN/m}^2$ . Determine the temperature at turbine inlet and the power developed by the turbine. Assume  $C_p = 1.0 \text{ kJ/kg-K}$ .
- iii) A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by  $70^\circ\text{C}$ , its efficiency is doubled. Find the temperature of the source and the sink.

Q.5) Attempt any **Two**

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- i) Write the characteristics of an ideal fuel.
- ii) How the analysis of exhaust and flue gas is carried out using ORSAT apparatus.
- iii) The ultimate analysis of a sample of coal gave the following analysis by weight, C = 65%,  $\text{H}_2 = 6\%$ , S = 1.5% and  $\text{O}_2 = 18\%$ . Find the HCV & LCV of this coal using Dulong's formula.