Hall Ticket Number:

Code No. : 13515 S

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (Mech. Engg.: CBCS) III-Semester Supplementary Examinations, June-2019

Thermodynamics

Time: **3** hours Max. Marks: **60**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks

1. Write the key difference between control mass and control volume.
2. Define with a neat sketch the Zeroth-law of thermodynamics.
3. Explain the difference between an exact differential and an inexact differential of thermodynamic quantity?
4. Show the isobaric and isochoric processes on a P–v diagram with respect to saturation lines.
5. Define with a neat sketch the Coefficient of Performance (COP) of a Carnot heat pump.
6. Explain with a neat sketch the Clausius statement.
7. Define the critical point and the triple point of a pure substance.
8. Determine whether water at 200°C and 0.1 m^3/kg is a compressed liquid, a superheated vapor, or a mixture of saturated liquid and vapor.
9. What is the key difference between gas power cycle and vapor power cycle?
10. State Dalton's law for a binary mixture solution.

Part-B (5 × 8 = 40 Marks)

11. a) A barometer to measure absolute pressure shows a mercury column height of 725 mm. The temperature is such that the density of the mercury is 13,550kg/m^3. Find the ambient pressure. [3]

    b) Explain the working principle of a constant volume gas thermometer with a neat sketch. [5]

12. a) Define boundary work of a system (control mass) and derive the expression for polytropic process. [3]

    b) 2 kg of gas occupying 0.7m^3 had an initial temperature of 15°c. It was then heated at constant volume until its temperature becomes 135°c. How much heat was transferred to the gas? What was its final pressure? Assume C_p = 1.01 kJ/kg K, R = 0.29 kJ/kg K. [5]

13. a) Find the power output and the low temperature heat rejection rate for a Carnot heat engine that receives 6 kW at 250°C and rejects heat at 30°C. [3]

    b) A piston-cylinder device with 2 kg water at 1000 kPa, 250°C is cooled with a constant loading on the piston. This isobaric process ends when the water has reached a state of saturated liquid. Find the work and heat transfer and sketch the process on a T–s diagram. [5]

14. a) Show all three phases on a P–T diagram and indicate the critical point and the triple point. [3]

    b) Water at 120°C with a quality of 25% has its temperature raised 20°C in a constant volume process. What is the new quality and pressure? Show the process on a T–v diagram. [5]

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15. a) Show the ideal Rankine cycle on a T–s diagram with respect to saturation lines. [2]

    b) Develop an expression for determining the air standard efficiency of an Otto cycle. [6]

16. a) Explain with a thermodynamic example the meaning of dimensional homogeneity. [2]

    b) A 2 m^3 insulated vessel contains saturated vapor steam at 4 MPa. A valve on the top of the tank is opened, and steam is allowed to escape. During the process any liquid formed collects at the bottom of the vessel, so only saturated vapor exits. Calculate the quality of steam and total mass that has escaped when the pressure inside reaches 1 MPa. [6]

17. Answer any ***two*** of the following:

    a) Water at 1000 kPa and 250°C is brought to saturated vapor in a piston-cylinder assembly with an isothermal process. Find the specific work and heat transfer. [4]

    b) Determine the specific enthalpy and specific internal energy of steam at a pressure of 12 bar i) when the steam is having a dryness fraction of 0.8, ii) when the steam is super-heated to a degree of super heat of 20°c. [4]

    c) Write the four assumptions invoked in air standard gas power cycles. [4]