Hall Ticket Number:

Code No. : 13506 S

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (Mech. Engg.-: CBCS) III-Semester Supplementary Examinations, May/June-2018

Thermodynamics

Time: **3** hours Max. Marks: **70**

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

Part-A (10 × 2 = 20 Marks)

1. Distinguish between intensive and extensive properties of thermodynamics.
2. Can we do ideal gas thermometer experiment at high pressures? Why?
3. Define specific heats at constant volume and at constant pressure.
4. What are the limitations of the First law of Thermodynamics?
5. What is the principle of increase of entropy?
6. State second law of Thermodynamics.
7. Draw the vapour dome of water on T-s and h-s coordinates.
8. Write Clapeyron Equation and its importance.
9. State Amagat's law.
10. Write expressions for Thermal efficiency of Otto and Diesel cycles.

Part-B (5 × 10 = 50 Marks)

11. a) Consider an electric refrigerator located in a room. Determine the direction of the work and heat interactions (in or out) when the following are taken as the system: [3]
    i) the contents of the refrigerator
    ii) all parts of the refrigerator including the contents
    *iii)*everything contained within the room during a chilling winter day.

    b) Explain the working of constant volume gas thermometer with neat sketch. [7]

12. a) 0.2 m^3 of air at 4 bar and 130^{0}C is contained in a system. A reversible adiabatic expansion takes place till the pressure falls to 1.02 bar. The gas is then heated at constant pressure till enthalpy increases by 72.5 kJ. Determine [5]
    i) the work done
    ii) the index of expansion, if the above processes are replaced by a single reversible polytropic process giving some work between the same initial state and final states. take c_p=1 kJ/kgK and c_v=0.714 kJ/kgK.

    b) Develop an expression for the work done in an adiabatic process. [5]

13. a) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If the work output of A is twice that of B, find [5]
    i) The intermediate temperature between A and B
    ii) The efficiency of each engine
    *iii)*The heat rejected to the cold sink

    b) An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400 K, rejects 42 MJ at a temperature of 200 K, and delivers 15 kWh of mechanical work. Evaluate the claim of inventor. [5]

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14. a) A piston/cylinder contains 1 kg water at 20^0C with volume 0.1 m^3. By mistake someone locks the piston preventing it from moving while we heat the water to saturated vapor. Find the final temperature and the amount of heat transfer in the process. [4]

    b) One-tenth percent of 1 m^3 capacity closed vessel is occupied by water and remaining by steam in thermal equilibrium with water at 10 bar pressure. This vessel is heated by external means. The pressure at the end of heating is 12 bar. After heating, 25% mass is blown-off from the vessel. Determine: (i) quality of steam at the beginning (ii) Degree of super heat at the end of heating process (iii) Heat supplied by external means (iv) Final specific volume of steam in the vessel. [6]

15. a) An engine working on Otto cycle with the following data : [5]
    Maximum temperature = 1227°c.
    Exhaust temperature = 427°c,
    ambient conditions = 1bar and 27°c.
    Determine the compression ratio, maximum pressure and efficiency.

    b) Represent Otto cycle, Diesel cycle, Dual cycle on P-v and T-s Co-ordinates and compare them. [5]

16. a) Along with the definitions of reversible and irreversible process, explain the following cases (cycle) are reversible or not. Support your answer. [5]
    i) a steel bar is heated from 20^0C to 100^0C by means of heater and cooled down to initial temperature by means of water.
    ii) Human is inhaling and exhaling air.

    b) What is the property derived from the first law of Thermodynamics? Prove that characteristic of the system is a property? [5]

17. Answer any ***two*** of the following:
    a) State and prove Clausius inequality. [5]
    b) You want a pot of water to boil at 105°C. How heavy a lid should you put on the 15cm diameter pot when Patm = 101 kPa? [5]
    c) Draw the Rankine cycle on P-v and T-s coordinates. Explain/represent different possible cases of steam entry into the turbine. [5]