AJEENKYA
D Y PATIL UNIVERSITY

EOT Evaluation– Summer Term (2-Jul-2019)

School: School of Engineering. **Program:** B-Tech- Mechatronics

Course: Fundamentals of Thermodynamics **Course Code**: MTE202

Semester: IV **Max Marks:** 50 **Qualifying Marks:** **Duration (mins):** **120**

Note:1) Answers to the should be written in Answer Sheet Provided.
2) Figures to the right indicate full marks.
3) Neat diagrams **must be drawn** wherever necessary.
4) Use of only electronic pocket calculator is allowed.
5) Assume suitable data, if necessary.
6**) Question 1a & 1b are compulsory**; Solve any 5 problems from the 7 problems in Q2-Q8

Q1. Choose the correct Alternative:

1. Mark the correct Alternative:
   (a) Specific volume of water decreases on freezing
   (b) Boiling point of water decreases with increasing pressure
   (c) Specific volume of CO2 increases on freezing
   (d) Freezing temperature of water decreases with increasing pressure.
2. The latent heat of vaporisation at critical point is:
   (a) less than zero (b) greater than zero (c) equal to zero (d) none of the above.
3. With the increase in pressure:
   (a) boiling point of water increases and enthalpy of evaporation increases
   (b) boiling point of water increases and enthalpy of evaporation decreases
   (c) boiling point of water decreases and enthalpy of evaporation increases.
4. Dryness fraction of steam is defined as
   (a) mass of water vapour in suspension/(mass of water vapour in suspension + mass of dry steam)
   (b) mass of dry steam/mass of water vapour in suspension
   (c) mass of dry steam/(mass of dry steam + mass of water vapour in suspension)
   (d) mass of water vapour in suspension/mass of dry steam.
5. Only throttling calorimeter is used for measuring
   (a) very low dryness fraction upto 0.7 (b) very high dryness fraction upto 0.98
   (c) dryness fraction of only low pressure steam (d) dryness fraction of only high pressure steam.
6. In isentropic process
   (a) $W = 2(u_2 - u_1)$ (b) $W = (u_2 - u_1)^2$
   (c) $W = u_2 - u_1$ (d) $W = (u_2 - u_1)^{1/2}$
   (e) none of the above.
7. Second law of thermodynamics defines
   (a) heat (b) work (c) enthalpy
   (d) entropy (e) internal energy
8. For a reversible adiabatic process, the change in entropy is
   (a) zero (b) minimum (c) maximum
   (d) infinite (e) unity.
9. Which of the following statements is correct according to Clausius statement of second law of thermodynamics?
   (a) It is impossible to transfer heat from a body at a lower temperature to a body at a higher temperature
   (b) It is impossible to transfer heat from a body at a lower temperature to a body at a higher temperature, without the aid of an external source.
   (c) It is possible to transfer heat from a body at a lower temperature to a body at a higher temperature by using refrigeration cycle
   (d) None of the above.

10. The change of entropy, when heat is absorbed by the gas is
    (a) positive (b) negative (c) positive or negative
11. The air standard Otto cycle comprises
    (a) two constant pressure processes and two constant volume processes
    (b) two constant pressure and two constant entropy processes
    (c) two constant volume processes and two constant entropy processes
    (d) none of the above.
12. For same compression ratio
    (a) thermal efficiency of Otto cycle is greater than that of Diesel cycle
    (b) thermal efficiency of Otto cycle is less than that of Diesel cycle
    (c) thermal efficiency of Otto cycle is same as that for Diesel cycle
    (d) thermal efficiency of Otto cycle cannot be predicted.
13. In air standard Diesel cycle, at fixed compression ratio and fixed value of adiabatic index (γ)
    (a) thermal efficiency increases with increase in heat addition cut-off ratio
    (b) thermal efficiency decreases with increase in heat addition cut-off ratio
    (c) thermal efficiency remains same with increase in heat addition cut-off ratio
    (d) none of the above.
14. Thermal efficiency of closed cycle gas turbine plant increases by
    (a) reheating (b) intercooling
    (c) regenerator (d) all of the above
15. In a two stage gas turbine plant, reheating after first stage
    (a) increases work ratio (b) decreases work ratio
    (c) does not affect work ratio (d) none of the above.
16. The Fourier's law of heat transfer by conduction is expressed as
    (a) $Q = kA^2\, dt/dx$ (b) $Q = kA\, dt/dx$
    (c) $Q = k^2A\, dx/dt$ (d) $Q = k^3A\, dx/dt$

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17. The thermal conductivity is expressed as
    (a) W/mK (b) W/m^2K
    (c) W/hmK (d) W/h^2m^2K.
18. Heat transfer from higher temperature to low temperature takes place according to
    (a) Fourier law (b) First law of thermodynamics
    (c) Second law of thermodynamics (d) Zeroth law of thermodynamics.
19. Stefan-Boltzmann law is expressed as
    (a) $Q = \sigma AT^4$ (b) $Q = \sigma A^2T^4$ (c) $Q = \sigma AT^2$ (d) $Q = AT^4$.
20. The quantity of heat radiation is dependent on
    (a) area of the body only (b) shape of the body only
    (c) temperature of the body only (d) on all (a), (b) and (c).

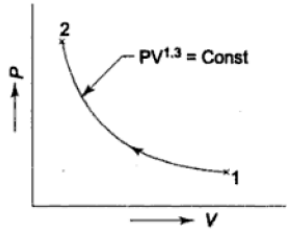
[10]

Q1b. Answer **Any-3-Only** of the following questions: Draw neat diagrams wherever necessary:

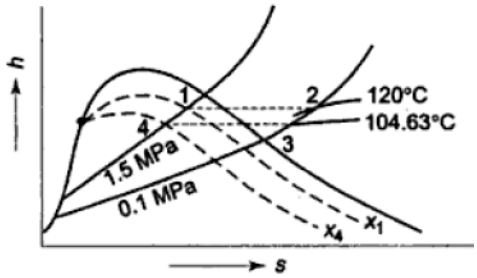
i. Briefly describe the working of a Throttling calorimeter using a schematic diagram.
ii. Explain the working of a Steam Power Plant based on a simple Rankine cycle.
iii. With the help of a T/S diagram or a h/s diagram elaborate the use of Reheat or Regeneration to improve the efficiency of the cycle.
iv. Elaborate the functioning of the Otto cycle with a diagram of an Engine and the PV diagram.
v. What are the various modes of heat transfer, elaborate the mehod to evaluate them.
vi. Explain the Brayton cycle and its application.

[15]

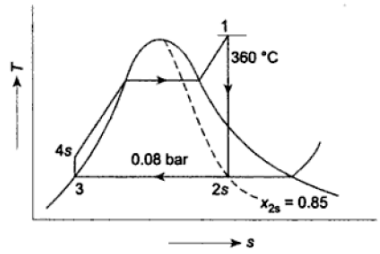
Q2. A fluid undergoes a reversible adiabatic compression from 0.5 MPa, 0.2 m^3 to 0.05 m^3 According to the law, $pv^{1.3}$= Constant. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process. [5]



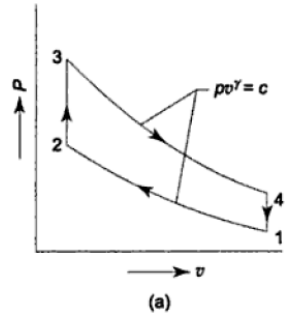
Q3 Steam flows in a pipeline at 1.5 MPa. After expanding to 0.1 MPa in a throttling calorimeter, the temperature is found to be 120°C. Find the quality of steam in the pipeline. What is the maximum moisture at 1.5 MPa that can be determined with this set-up if at least 5°C of superheat is required after throttling for accurate readings? [5]

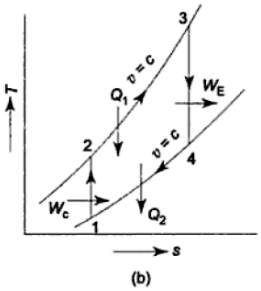


Q4. 1. A cyclic steam power plant is to be designed for a steam temperature at turbine inlet of **350°**C and an exhaust pressure of0.08 bar. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition. [5]

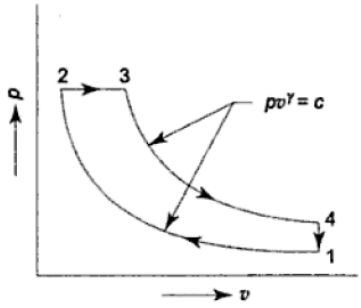


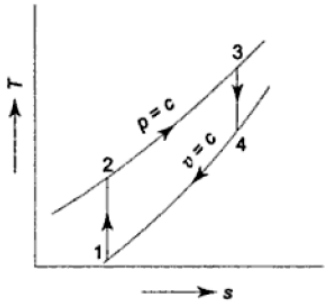
Q5. 1. An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency, and the mean effective pressure (For air, cp = 1.005, cv= 0.718, and R = 0.287 kJ/kg [5]





Q6. 2. in an air standard Diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate (a) the cut-off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency, and (d) the m.e.p. [5]





Q7. An engine equipped with a cylinder having a bore of 15 cm and a stroke of45 cm operates on an Otto cycle. If the clearance volume is 2000 cm^3, compute the air standard efficiency. [5]

Q8. A mild steel tank of wall thickness 12 mm contains water at 95°C. The thermal conductivity of mild steel is 50 W/m°C, and the heat transfer coefficients for the inside and outside the tank are 2850 and 10 W/m2°C, respectively. If the atmospheric temperature is 15°C, calculate:

(i) The rate of heat loss per m2 of the tank surface area;

(ii) The temperature of the outside surface of the tank. [5]