Code No: 53017 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, November/December - 2016
THERMODYNAMICS
(Common to ME, AE, AME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1.a) What is the concept of continuum? How density and pressure are defined using this concept.

b) Consider in a particular Celsius scale, assigned the value of 0^0C to steam point and 100^0C to ice point.

i) Using ideal gas as the thermometer medium set up a relationship between 0^0C and pressure for a constant volume thermometer. Proceed to derive the correlation between the two Celsius scales. At what temperature are the two scales are numerically equal?

ii) What is the numerical value of absolute zero for the particular scale? What is 200K in ^{0}C?

[7+8]

2.a) For a polytropic process, derive the following relation:

$Q_{1\text{-}2} = \frac{\gamma-n}{\gamma-1} \times$ polytropic work transfer and $Q_{1\text{-}2} = \frac{\gamma-n}{n-1} \times$ adiabitic work transfer.

b) 1kg of gas expands reversibly according to linear law from 4.2 bar to 1.4 bar. The initial and final volumes are $0.004m^3$ and $0.02m^3$, respectively. The gas is then cooled at constant pressure and finally compressed isothermally back to its initial state of 4.2 bar and $0.004m^3$. Calculate the work done in each process stating its direction. Sketch the cycle on a p-v diagram.

[7+8]

3.a) Prove that the Kelvin Plank and Clausius statement of the second law of thermodynamics are equivalent to each other.

b) Three Carnot engines C_1, C_2 and C_3 operate in series between two heat reservoirs, which are at temperatures of 1000K and 400K. Calculate the temperature of the intermediate reservoir if the amount of work produced by these engines in the proportion of 5:4:3.

[7+8]

4.a) Draw a saturation curve on a T-s diagram and mention the different states of water on it.

b) A cylinder of 50-litre capacity contains oxygen at 18^0C and at a pressure of 10MPa. Calculate:

i) the mass of oxygen in the cylinder,
ii) the molar volume
iii) the density of oxygen.

The molecular mass of oxygen 32kg/kmol.

[7+8]

5.a) What are the salient features of work transfer?

b) A gas initially at a pressure of 510 kPa and a volume of 142 liters undergoes a process and has a final pressure of 170 kPa and a volume of 275 liters. During the process, the enthalpy decreases by 65kJ. Take C_v= 0.718 kJ/kg. K. Determine:
i) change in internal energy,
ii) specific heat at constant pressure, and
iii) specific gas constant. [7+8]

6.a) What is an adiabatic saturation? When does the wet bulb temperature equal the saturation temperature?

b) At steady state, 100m^3/min of dry air at 32^{0}C and 1 bar is mixed adiabatically with a stream of oxygen (O_2) at 127^{0}C and 1 bar to form a mixed stream at 47^{0}C and 1 bar. The kinetic and potential energy effects are negligible. Determine:
i) Mass flow rates of dry air and oxygen in kg/min
ii) The mole of fraction of dry air and oxygen in the existing mixture and
iii) Time rate of entropy production, in kJ/K.min. [7+8]

7.a) Discuss the deviation of Stirling and Ericsson cycles from Carnot cycle.

b) A high-speed oil engine operating on a dual combustion cycle has a pressure of 1 bar and a temperature of 50^{0}C before compression. Air is then compressed isentropically to 1/15th of its original volume. The maximum pressure is twice the pressure at the end of isentropic compression. If the cut-off ratio is 2, determine the temperature at the end of each process and a deal efficiency of the cycle. Take Υ=1.4. [7+8]

8.a) What are the causes of irreversibilities in an actual refrigeration cycle? Explain with the help of a T-s diagram.

b) A refrigerator used R-12 as a working fluid and it operates on an ideal vapour compression cycle. The temperature of refrigerant in the evaporator is -20^{0}C and in the condenser is 40^{0}C. The refrigerant is circulated at the rate of 0.03 kg/s. Determine the coefficient of performance and capacity of refrigeration plant in the TR. [7+8]

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