GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

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1st Semester (BACK PAPER) Examination-Nov/Dec 2019

BBSES1032 Basics of Thermodynamics

Time : 3 Hours Maximum : 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) 10 x 2=20 Mark

Q.1. Answer *All* Questions

a Absolute scale of degree Celsius scale is
a) Rankine scale b) Kelvin scale c) Rumor scale d) Fahrenheit scale

b In an isothermal process, the internal energy of gas molecules
a)Increases (b) decreases c) remains constant (d) may increase / decrease depending on the properties of the gas

c In the polytropic process equation pv^n = constant, if n = 0, the process is termed as
(a)Constant volume (b) constant pressure (c) constant temperature (d) adiabatic

d Steady flow occurs when
a) Conditions do not change with time at any point
b) Conditions are same at adjacent points at any instant
c) Condition change steadily with the time d) None of these

e What is the final amount of fluid in the vessel if the system is in steady state?
a)Same as the initial amount b)Twice the initial amount c) Zero d) None of the mentioned

f The change in entropy of an isolated system is _____
a) Zero b)One c)all of the above d)None of the above

g The condition for reversibility of a cycle is
a) $\oint \frac{\delta Q}{T} < 0$ b)$\oint \frac{\delta Q}{T} > 0$ c)$\oint \frac{\delta Q}{T} = 0$ d) None of the above

h At the critical point of pure substance
a) The entropy of the system is zero is zero b)The latent heat of vaporization is zero
c)The enthalpy of substance is zero d) None of the above

i Which vapour behaves like a perfect gas
a) Dry vapour b) Wet vapour c) Superheated vapour d) Drysaturated vapour

j The temperature at which a pure liquid transfers into vapour at constant pressure is called as
a) Vaporization temperature b) Normal temperature c)Saturation temperature d) None of the above

PART – B: (Short Answer Questions) 10X2=20 Marks

Q.2. Answer *ALL* questions

a Write two differences for microscopic and macroscopic approach in thermodynamics.

b Convert 40 cm mercury, vacuum to absolute pressure in kPa when barometer reads 760 mm of Hg.

c The temperature of a system is increased by 27^0 C. what are the corresponding values in ^{0}F and K scale.

d What is a PMM1? Why is it impossible?

e What is steady flow?

f What is a nozzle?

g Can a Carnot engine produce 100% efficiency?

h Define Clausius inequality?

i What are two basic types of internal combustion engine? What are the fundamental differences between the two?

j How the quality of a wet steam is determined? Represent the constant quality line for wet steam at different pressures on a P-V diagram?

PART – C: (Long Answer Questions) 4X15=60 Marks

Answer *ALL* questions

Q.3

a An ideal gas of volume 0.2 m3 at a pressure of 2 Mpa and 600K is expanded isothermally to 5 times of initial volume. Calculate work done by the gas. 5

b Two thermometer one Centigrade scale other Fahrenheit scale are immersed in a fluid. After thermometer reach equilibrium with the fluid it is noted that both thermometer indicate same numerical value. Find the 10

identical numerical value shown by thermometers. What would be the corresponding temperature of fluid expressed in Kelvin (K) and Rankine (R).

OR

c Derive the expression for displacement work in a polytropic process. 5

d A gas system comprised by a piston and cylinder undergoes a change of state such that PV= constant. If the process begins at a pressure 300 kPa and a volume of 0.015 m3 and proceed until the pressure falls to half of its initial value, determine the magnitude and direction of work transfer. 10

Q.4

a A certain mass of air initially at 150 kPa,0.13m^3 is compressed in a reversible polytropic process at 700kPa.During this process, heat transfer to air is 20kJ and the internal energy of air increased by 50kJ. Find the final volume of air. 5

b A turbine operates under steady flow condition receiving air at pressure 15 bar, internal energy 2700 kJ/kg, specific volume 0.17 m^3/kg and velocity 100 m/sec. Exhaust air from the turbine is at 0.1 bar with internal energy 2175 kJ/kg, specific volume 15 m^3/kg and velocity 300 m/sec. The intake is 3 m above the exhaust. The turbine develops 35 kw and heat lost over the surface of turbine is 20 kJ/kg. Determine the air flow rate through the turbine. 10

OR

c A perfect gas flow through a nozzle where it expands in a reversible adiabatic process. The inlet condition are 22 bar, 5000C, 38 m/sec. Exit pressure is 2 bar. Determine the exit velocity and exit area if the flow rate is 4 kg/sec. Assume R = 190 J/kgk, $\gamma = 1.35$ 5

d Air enters a centrifugal compressor at 1 bar, 300K at the rate of 12kg/min through a pipe 10cm in diameter. It leaves the compressor at 450K & 3 bars, through a 5cm diameter pipe. The inlet and exit of the compressor are at elevations of 1m and 2m respectively. If the heat transfer rate from the compressor to the environment is 9kJ/min, determine the work transfer in kJ/kg. 10

Q.5

a A gas initially at 1.5 bar pressure, 0.15 m3 volume and 300 K was compressed polytropically ($PV^{1.25}$= const.) to 15 bar pressure. Determine the heat transfer and change in entropy. 5

b Two reversible heat engines are arranged in series in such a way that the heat rejected by the first engine is absorbed by the second engine. The first engine receives 400kJ of heat from a reservoir at 600^0C, while the second engine rejects heat to a reservoir having temperature 0^0C. If the work output of the first engine is 2.5 times that of the second. Determine efficiency of both the engines. 10

OR

c An inventor claims to have developed an engine that takes 105MJ of heat from a source of 400K and rejects 42 MJ of heat to a sink of 200 K respectively. Would you advise to invest the money on this engine in the market? 5

d A carnot engine (E_1) efficiency η_1 operates between a temperature of T_1 and T_2 rejects its waste heat at its sink temperature T_2 to another carnot engine(E_2) efficiency η_2 which operates between a temperature limit of T_2 and T_3. Another setup a carnot engine (E3) efficiency $\eta 3$ operating directly between temperature T_1 and T_3. Prove that $\eta_3 = \eta_1 + \eta_2 - \eta_1 \eta_2$ 10

Q.6

a With neat sketch Explain the working principle of Heat Pump? 5

b A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250^{o}C. The mass of the liquid present is 9 kg. Find the pressure, mass of mixture, specific volume, and enthalpy. 10

OR

c Determine the temperature and quality for water at pressure of 300kPa and at each of these specific volume: i) 0.5m^3/kg ii) 0.97m^3/kg? 5

d A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250^{o}C. The mass of the liquid present is 9 kg. Find the pressure, mass of mixture, specific volume, and enthalpy. 10

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