GIET MAIN CAMPUS AUTONOMOUS,
GUNUPUR - 765022

Registration No: | | | | | | | | | | |

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B.TECH. DEGREE EXAMINATION-Nov-Dec.2018
End Semester Examination-I Semester

BBSES1032- Engineering Thermodynamics

(Regulations 2018)(Common to AEIE, BT, CHEM, Civil, ECE, EE, EEE and IT Branches)

(Regulations 2017)(Common to CSE, ECE, and IT Branches)

Time : 3 Hours Maximum : 100 Marks Question Code:082012

Answer ALL Questions

PART-A (10 X 2=20 Marks)

1. (a) Density is a **[CO1] [PO1]**

a) Intensive property b) Extensive property c) Magnetic property d) Non thermodynamic property

(b) In polytropic process PV^n = const, if n= ∞ the process is known as **[CO1] [PO1]**

a) Isothermal b)Isobaric c) Isochoric d) Adiabatic

(c) During throttling process **[CO2] [PO1]**

a)Internal energy does not change c)Pressure does not change
b)Entropy does not change d)Enthalpy does not change

(d) For First law of thermodynamics undergoes a cycle which statement is correct? **[CO2] [PO1]**

a) dQ = dU + dW b)$\sum Q = \sum W$ c)dQ = dH d) dQ = dH +dW

(e) A gas is compressed in a cylinder by a movable piston to a volume one-half its original volume. During the process 300 kJ heat left the gas and internal energy remained same. The work done on gas in Nm will be **[CO2] [PO1]**

(a) 300 Nm (b) 300000 Nm (c) 30 Nm (d) 3000 Nm

(f) PMM2 is the machine which violates _____ **[CO2] [PO1]**

(a)Kelvin-Planck statement b) Clausius statement
c) both a and b d) none of the above

(g) The condition for reversibility of a cycle is **[CO3] [PO1]**

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) Enthalpy for wet steam is

a) h_f b) h_g c) $h_f + xh_{fg}$ d) $h_g + Cp_s(T_{sup}-T_{sat})$ **[CO4] [PO1]**

(i) At critical point the equilibrium exists between **[CO4] [PO1]**

a) liquid & vapour b) solid & liquid c) solid & vapour d) solid, liquid & vapour

(j) The temperature at which a pure liquid transfers into vapour at constant pressure is called as **[CO4] [PO1]**

a) Vaporization temperature c)Normal temperature
b) Saturation temperature d)None of the above

PART-B (10 X 2=20 Marks)

2 a) Define internal energy **[CO1] [PO1]**
b) What is quasi-static process and write the condition **[CO1] [PO1]**
c) What is a PMM1? Why is it impossible? **[CO1] [PO1]**
d) What are the limitations of First law? **[CO2] [PO1]**
e) Show that the COP of a heat pump is greater than the COP of a refrigerator by unity **[CO2] [PO1]**
f) Draw P-V and T-S diagram for a carnot cycle? **[CO2] [PO1]**
g) Define Kelvin Planck and Clausius Statement? **[CO2] [PO1]**
h) How a refrigerator is different from a Heat Pump? **[CO2] [PO1]**
i) Define Triple point & Critical Point? **[CO4] [PO1]**
j) What is internal latent heat and how it is related to enthalpy of vaporization? **[CO4] [PO1]**

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PART-C (4 X 15=60 Marks)

3.a (i) Derive the expression for displacement work in a polytropic process. **[5][CO1] [PO1]**

(ii)Air initially at 75 kPa pressure, 1000 K temperature and occupying a volume of 0.12 m3 is compressed isothermally until the volume is halved and subsequently it undergoes further compression at constant pressure till the volume is halved again. Sketch the processes on p-V diagram and calculate the work-done. **[10][CO1] [PO2]**

(or)

b. (i). A vacuum gauge mounted over a condenser reads 0.66 met of Hg. What is the absolute pressure in the condenser when the atmospheric pressure is 101.325 KPa. **[5][CO1] [PO2]**

(ii) 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] [CO1] [PO2]**

4.a (i).Prove that internal energy is a property of the system. [5] **[CO2] [PO1]**

(ii) The power developed by the turbine in a certain steam power plant is 1200 kw. Heat supplied to the steam in the boiler is 3600 kJ/kg. Heat rejected from condenser is 2520 kJ/kg. Feed pump consume work to pump the condensate water back to boiler is 6 kw. Calculate the mass flow rate of steam in kg/sec. **[10][CO2] [PO2]**

(or)

b. (i) 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][CO2] [PO2]**

(ii) Derive SFEE for an open system and state the assumptions. **[5][CO2] [PO1]**

5.a (i) State and prove Carnot's theorem. [5] **[CO2] [PO1]**

(ii) A heat engine operating between two reservoirs at 1000K an 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40% of the maximum possible and the cop of the heat pump is 50% of the maximum possible, what is the temperature of the reservoir to which the heat pump rejects to it? What is the rate of heat rejection from the heat pump if the rate of heat supply to the engine is 50kW? [10] **[CO2] [PO2]**

(or)

b (i) 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] **[CO2] [PO2]**

(ii) 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] **[CO2] [PO2]**

6.a (i) With neat sketch Explain the working principle of 4 stroke IC engine? [5] **[CO2] [PO1]**

(ii) One kg of saturated steam of quality 0.75 at 5 bar is contained in a piston-cylinder assembly. Energy transfer as heat takes place to the steam till its temperature attains a value of 2000c. During this process the pressure remains constant at all times. Calculate [10] **[CO4] [PO2]**

I. Work done by the steam
II. Energy transfer as heat
III. Change in internal energy

(or)

b. (i) With neat sketch Explain the working principle of Refrigerator? **[5][CO2] [PO1]**

(ii) Steam at 1.8 MPa and 400^oC steadily enters a nozzle whose inlet area is 0.02 m2. The mass flow rate of steam through the nozzle is 5kg/s. Steam leaves the nozzle at 1.4 MPa with velocity of 275 m/s. Heat losses from the nozzle per unit mass of the steam are estimated to be 2.8 kJ/ kg. Determine **[10][CO4] [PO2]**

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