U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec.-2019

Basic Thermodynamics

Time: 3 hrs *Max. Marks: 100*

Note: i) PART - A is compulsory. **Two** marks for each question.

ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	Define Reversible process.	2
b.	What is the efficiency of a Carnot cycle working between temperature limits 1400°C and 350°C?	2
c.	Determine the enthalpy of steam available at 15 Bar and 0.9 dry.	2
d.	Show that $COP_{HP} = COP_R + 1$.	2
e.	Air occupies a volume of 0.3 m^3 at a pressure of 2 Bar and 350°K. Determine its mass.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	Explain the following: i) Control volume ii) Quasistatic Process iii) Zeroth law of thermodynamics	9
b.	It is proposed to construct a new scale with the value 5°N assigned to ice point and 20°N to steam point. The pressure of an ideal gas at constant temperature is considered as a thermometric property; i) Set up a linear relationship between pressure and temperature in °N and new scale, what is the Kelvin absolute zero on this scale? ii) Find a relation between °N and °K	9
c.	A spherical balloon contains 5 kg of air at 200 kPa and 500°K. The balloon material is such that the pressure inside is always proportional to the square of the diameter. Determine the work done, when the volume of the balloon doubles as a result of heat transfer.	9
	UNIT - II	**18**
2 a.	State the first law of thermodynamic for closed system undergoing a cyclic process and show that energy is a property of the system.	9
b.	A vessel contains 0.12 m^3 of air at 1.05 Bar and 90°C. The gas is compressed to a volume of 0.03 m^3 according to the law PV^n = constant. The final pressure in 5.85 Bar. Find the value of index '*n*' and the work done during the compression process.	9

Contd…2

c. In a steady flow process the mass flow of fluid is 10 kg/min the properties of fluid at entrance are P_1 = 2 Bar, V_1 = 20 m^3/ kg, velocity 120 m/s, U_1 = 251 kJ/kg. The exit condition are P_2= 6 Bar, V_2 = 10 m^3/s, velocity = 200 m/s, U_2= 837 kJ/kg. The fluid receives heat at the rate of 126 kJ/s and rises in elevates by 30 m. Calculate the power output from the system. 9

UNIT - III **18**

3 a. Define pure substance. Draw temperature-volume diagram and mention salient points on the neat diagram. 9

b. Steam is compressed reversibly and adiabatically from a pressure of 1.4 Bar and 0.9 dry to a pressure of 13 Bar. Determine; 9

i) Final temperature ii) Increase in specific enthalpy iii) Work done on steam

Take C_p of steam = 2.09 kJ/ kg-K

c. Sketch and explain combined throttling and separating colorimeter and show that $x = x_1 * x_2$. 9

UNIT - IV **18**

4 a. Define the two statements of II-law of thermodynamics show that violation of Claussius statement violation the Kevin plank statement. 9

b. A carnet engine operates between two reservoirs at temperature of 1000 K and 300 K. The engine drives a reversible refrigerator which operates between 300 K and 250 K. The heat transfer to the engine in 2000 kJ and the net output of the combined system of engine and refrigerator is 200 kJ. Evaluate the heat transfer from the reservoirs at 250 K to the refrigerator and the net heat transfer to the reservoir at 300 K. 9

c. A reversible engine working in a cycle takes 4800 kJ of heat from a source at 800 K per minute and develops 20 kW power. The engine rejects heat to two reservoirs at 300 K and 360 K. Determine the heat rejected to each sink. 9

UNIT - V **18**

5 a. Derive two important thermodynamic relations and hence derive an expression for change in entropy of an ideal gas. 9

b. 3 m^3 of air at 200°C and 9 Bar is heated until its temperature reaches to 250°C and pressure 10 Bar. Calculate the heat and work transfer and changes in enthalpy and entropy. 9

Take C_p = 1.025 kJ/ kg-K and C_v = 0.725 kJ/kg-K

c. A thermal energy source at 800°K losses 2000 kJ of heat to a sink at, i) 500 K ii) 750 K. Determine which heat transfer process is more irreversible. 9

* * *