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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2017/Jan - 2018

Thermo Dynamics

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1	a.	Define the following with examples : i) Property ii) Cycle iii) Path function iv) Quasi static process v) Thermodynamics equilibrium vi) Macroscopic approach.	12
	b.	Consider an alcohol and a mercury thermometer that read exactly 0°C at the ice point and 100°C at the stem point. The distance between the two points is divided into 100 equal parts in both thermometers. Do you think these thermometers will give exactly the same reading at a temperature of, say 60°C? Explain.	4
	c.	Humans are most comfortable when the temperature is between 65°F and 75°F. Express these temperature limits in °C. Convert the size of this temperature range (10°F) to K, °C, and R.	4
2	a.	Distinguish between heat and work in the thermodynamics.	4
	b.	Derive the expression for the polytropic work in a closed system.	8
	c.	In an air expression for the compressed air has an internal energy 450 kJ/kg at the beginning of the expansion and an internal energy is 120 kJ/kg, calculate the heat flow to and from the cylinder.	8

UNIT - II

3	a.	State and explain the First law of the thermodynamics. Give its equation with reference to a cyclic and non-cyclic process.	8
	b.	1.5 kg of liquid is stirred in a conducting chamber. During the process 1.7 kJ of heat are transferred from the liquid to the surroundings, while the temperature of the liquid is rising to 15°C Find ΔE and W for the process.	4
	c.	Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg , and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The specific internal energy of the air leaving 1s 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 kW. Calculate the power required to drive the compressor and the inlet and outlet pipe cross sectional areas.	8
4	a.	What is a perpetual motion machine of first kind? Why is it impossible?	4

Contd…2

b. Apply steady flow energy equation to each of the following: 8

i) Boiler ii) Nozzle iii) Centrifugal pump iv) Heat Exchanger.

c. A blower handles 1 kg/s of air at 20°C and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/s and 150 m/s respectively. Find the exit air temperature, assuming adiabatic conditions. Take Cp of air is 1.005 kJ/kg-K. 8

UNIT - III

5 a. What is thermal energy reservoir? Explain source and sink. 4

b. Define reversible engine. Show that of all the reversible heat engines working between any two constant but different thermal reservoir temperature, the reversible reversed heat engine will have the maximum COP. 6

c. A reversible heat engine operates between two reservoirs at 827°C and 27°C. Engine drives a Carnot refrigerator maintaining -13°C and rejecting heat to reservoir at 27°C. Heat input to the engine is 2000 kJ and the net work available is 300 kJ. How much heat is transferred to refrigerant and total heat rejected to reservoir at 27°C? 10

6 a. Define Kelvin-Plant statement and Clausius statement of 2^{nd} Law of thermodynamics and shown that they are equivalent. 10

b. Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine a cold sink at a temperature of 4.4°C, if the work output A is twice that of B, find; 10

i) The intermediate temperature between A and B ii) The efficiency of each engine

iii) The heat rejected to the cold sink.

UNIT - IV

7 a. With the help of P-V and T-S diagram, derive an expression for the standard efficiency of a semi-diesel cycle. 10

b. An Otto cycle operates between maximum and minimum pressure of 600 kPa and 100 kPa. The minimum and maximum temperatures in the cycle are 27°C and 1600 K. Determine thermal efficiency of cycle and also show it on T-S and P-V diagram. 10

8 a. What are the draw backs of a single stage compressor for producing high pressure? How are these overcome by multistage compression? 4

b. Derive an expression to determine the volumetric efficiency of a reciprocating compressor, considering the ambient and the inlet conditions of the compressors are same. 6

c. A reciprocating compressor of single stage and double acting type is running at 200 rpm with mechanical efficiency of 85%. Air flows into compressor at the rate of 5 m^3/min measured at atmospheric condition of 1.02 bar, 27°C. The compressed air is leaving at 8 bar following polytropic process with index of 1.3. Compressor has clearance volume of 5% of stroke volume. The temperature rises by 10°C during suction of air from atmosphere into compressor. There occurs pressure loss of 0.03 bar during suction and pressure loss of 0.05 bar during discharge passage through valves. 10

Contd…3

Determine the dimensions of cylinder, volumetric efficiency and power input required to drive the compressor if stroke to bore ratio is 1.5.

UNIT - V

9 a. With neat sketches explain the working of vapour absorption refrigeration system. 6

b. What do you mean by refrigerant, refrigeration and refrigerator? 4

c. A refrigerator working on simple vapour compression cycle operates between the temperature of 25°C and -15°C with NH3, refrigerant. Ammonia is found to be dry after compression and no under cooling of liquid refrigerant occurs in cycle. Calculate; 10

i) Refrigerating effect ii) Mass flow rate per ton of refrigeration iii) COP

iv) Power per TR v) Represent on pH and TS diagram.

10 a. Define: i) Relative humidity ii) Specific humidity

iii) Dew point temperature iv) Enthalpy of humid air v) Degree of saturation. 10

b. For the atmospheric air at room temperature of 30°C and relative humidity of 60% determine partial pressure of air, humidity ratio, dew point temperature, density and enthalpy of air. 10

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