

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) - EXAMINATION – SUMMER 2017****Subject Code: 2140106****Date: 06/06/2017****Subject Name: Basic Engineering Thermodynamics****Time: 10:30 AM to 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	Short Questions	14
	1 In an isolated system there is no interaction between system and surrounding. (True / False?)	
	2 PMM1 is possible. (True / False?)	
	3 Heat transfer is boundary phenomena. (True / False?)	
	4 First law of thermodynamics defines the concept of temperature measurement. (True / False?)	
	5 $[COP]_{HP} = [COP]_R + 1$ (True / False?)	
	6 Friction present in the system leads to irreversibility. (True / False?)	
	7 Mechanical work is high grade energy. (True / False?)	
	8 In adiabatic process there is only work interaction between system and surrounding. (True / False?)	
	9 $[COP]_{HP} = \frac{Q_2}{W}$ (True / False?)	
	10 The available energy is also known as	
	11 A quasi-static process is also called Process.	
	12 For same compression ratio, efficiency of Diesel cycle isthan efficiency of Otto cycle.	
	13 Brayton cycle is also known asCycle	
	14 PMM2 violates the Law of thermodynamics.	
Q.2	(a) Differentiate between intensive and extensive properties.	03
	(b) No work transfer is involved in free expansion – Justify.	04
	(c) Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure and 0.95 m ³ /kg volume, and leaving at 5 m/s, 700 kPa and 0.19 m ³ /kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. Calculate (i) the rate of shaft work input to the air in kW (ii) The ratio of the inlet pipe diameter to outlet pipe diameter.	07
	OR	
	(c) Show that violation of Kelvin-Planck statement leads to violation of Clausius statement.	07
Q.3	(a) Show that energy is a property of a system.	03
	(b) Explain what do you understand by thermodynamic equilibrium.	04
	(c) Explain the operation of a cyclic refrigerator plant with a block diagram.	07

OR

- Q.3** (a) Define the following terms: **03**
Steady flow process, MER, Close system.
- (b) Derive SFEE for insulated nozzle stating all assumptions made. **04**
- (c) A reversible heat engine operates between two reservoirs at temperatures of 600 °C and 40 °C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40 °C and – 20 °C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Calculate **07**
(i) Heat transfer to the refrigerant and the net heat transfer to the reservoir at 40 °C.
(ii) Given that the efficiency of the heat engine is and the COP of the refrigerator are each 40 % of their maximum possible values, calculate heat transfer to the refrigerant and the net heat transfer to the reservoir at 40 °C.
- Q.4** (a) A domestic food freezer maintains a temperature of – 15 °C. The ambient air temperature is 30 °C. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s what is the least power necessary to pump this heat out continuously? **03**
- (b) Explain the types of irreversibility. **04**
- (c) What is the reversible cycle that represents simple steam power plant? **07**
Mention four reversible processes which constitute the cycle and draw the flow diagram, $p - v$ diagram and $h - s$ diagram of this cycle.

OR

- Q.4** (a) Explain Avogadro's law. **03**
- (b) Derive MAXWELL's equations. **04**
- (c) With neat sketch explain Carnot vapor cycle. **07**
- Q.5** (a) Derive an equation for combined gas law. **03**
- (b) Establish relationship between C_p and C_v . **04**
- (c) Derive expression for the efficiency of Otto cycle. **07**

OR

- Q.5** (a) Derive an expression for pdV work for isothermal process. **03**
- (b) Write down the four processes which constitute the Brayton cycle. Show Brayton cycle on $p - v$ diagram and $T - s$ diagram. **04**
- (c) A gas turbine works on Brayton cycle. The initial condition of the air is 25 °C and 1 bar. The maximum pressure and temperature are limited to 3 bar and 650 °C. Determine the following: **07**
(i) cycle efficiency
(ii) heat supplied per kg of air
(iii) heat rejected per kg of air
(iv) work output per kg of air
