

**INDIAN MARITIME UNIVERSITY**  
(A Central University, Govt. Of India)  
**B. Tech(Marine Engineering)**  
Semester II  
End Semester Examination-June-2022  
**Basic Thermodynamics**  
**(UG11T4205)**

**Time: 3 Hours**  
**Date: 24.06.2022**

**Max Marks:70**  
**Pass Marks: 35**

**Part – A**

**Q (1) Multiple Choice Question**

**Answer the following**

**(10x1=10 Marks)**

(i) Control volume is

- (a) Open system where mass can enter or leave.
- (b) Closed system where mass can not enter or leave.
- (c )Open system where mass can not enter or leave.
- (d) Closed system where mass can enter or leave.

(ii) Zeroth law of thermodynamics defines

- (a) Conservation of energy
- (b) Thermal equilibrium
- (c ) Work and heat conversion
- (d) Enthalpy

(iii) Sum of all the microscopic forms of energy is called

- (a) Kinetic energy
- (b) Heat energy
- (c ) Internal energy
- (d) Work energy

(iv) The first law of thermodynamics defines

- (a) Conservation of energy
- (b) Entropy
- (c )Thermodynamic process
- (d) Exergy

(v) The second law of thermodynamics defines

- (a) Conservation of mass
- (b) Direction of a process
- (c) Temperature scale
- (d) None of the above

(vi) Heat is an example of

- (a) High grade energy
- (b) Low grade energy
- (c) Unavailable energy
- (d) Available energy

(vii) Tidal power is an example of

- (a) High grade energy
- (b) Low grade energy
- (c) Unavailable energy
- (d) Available energy

(viii) The maximum work output obtainable from a certain heat input in a cyclic heat engine is called

- (a) Unavailable energy
- (b) Exergy
- (c) Low grade energy
- (d) High grade energy

(ix) The third law of thermodynamics defines

- (a) Entropy
- (b) Enthalpy
- (c) Internal energy
- (d) Absolute zero temperature

(x) For reversible adiabatic process the change in entropy is

- (a) positive
- (b) negative
- (c) zero
- (d) unity

### **Part – B**

#### **Q (2) Short Answer Question**

**Answer the following**

**(5x2=10 Marks)**

- (i) What is Zeroth law of thermodynamics.
- (ii) What is steady flow process.
- (iii) What is state postulate.
- (iv) Explain Point function and Path function
- (v) What is Exergy and Dead State?

### **Part – C**

#### **Long Answer Question**

#### **Answer any 5 out of 7 questions (5x10=50 Marks)**

**Q(3) (a)** Prove that work done during a reversible compression process of an ideal frictionless fluid is given by the area under the curve plotted on a p-v diagram where p=pressure of the fluid and v=specific volume of the fluid.

**(marks 5)**

**(b)** A unit mass of a fluid at a pressure of 3 bar and with specific volume of  $0.18 \frac{m^3}{kg}$ , contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to law  $p = \frac{c}{v^2}$ , where c is a constant. Calculate the work done during the process.

**(marks 5)**

**Q(4) (a)** What is specific heat at constant volume and constant pressure? Why solids and liquids have only one specific heat?

**(marks 3)**

**(b)** Find the specific volume, enthalpy and internal energy of wet steam at 18 bar and dryness fraction 0.85

**(marks 7)**

**Q(5) (a)** Derive the general expression for change in entropy of a gas in terms of temperature and volume

**(marks 5)**

**(b)**  $0.03 m^3$  of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and  $15^{\circ}C$ . The gas is compressed isothermally and reversibly until the pressure is 4.2 bar. Calculate the change of entropy, the heat flow, and the work done. Molar mass of nitrogen = 28 kg/kmol. Assume nitrogen as perfect gas.

**(marks 5)**

**Q(6) (a)** State first law of thermodynamics.

**(marks 2)**

**(b)** In a certain steam plant the turbine develops 1000 kW. The heat supplied to the steam in the boiler is 2800 kJ/kg, the heat rejected by the steam to the cooling water is 2100 kJ/kg and the feed pump work required

to pump the condensate back into the boiler is 5 kW. Calculate the steam flow rate. **(marks 4)**

**( c )** Explain non-flow energy equation. **(marks 4)**

**Q(7)** Derive steady flow energy equation. **(marks 10)**

**Q (8)** In the gas turbine unit the gas flows through the turbine at 17 kg/s and the power developed by the turbine is 14000kW. The specific enthalpies of the gases at inlet and outlet are 1200 and 360 kJ/kg respectively. The velocity of gases at inlet and outlet are 60 and 150 m/s respectively. Calculate the rate at which the heat is rejected from the turbine. Find also the area of the inlet pipe given that the specific volume of the gas at inlet is  $0.5 \frac{m^3}{kg}$ . **(marks 10)**

**Q(9) (a)** Air enters a compressor at  $10^5$  Pascal and  $25^\circ\text{C}$  having volume of  $1.8 \text{ m}^3/\text{kg}$  and is compressed to  $5 \times 10^5$  Pascal isothermally. Calculate (i) Work done (ii) Change of Internal energy and (iii) Heat transferred **(marks 5)**

**(b)** Explain phase change process of a pure substance with T-v diagram **(marks 5)**

**====End of Question Paper====**