

MSc DEGREE EXAMINATION MAY 2026

(Fourth Semester)

Branch – PHYSICS

APPLIED THERMODYNAMICS AND STATISTICAL MECHANICS

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Zeroth law of thermodynamics is: a) kinetic energy of molecules of a gas is zero b) ideal gas does not contain molecules c) if two systems are separated in thermal equilibrium with a third system then they themselves are in thermal equilibrium with each other d) absolute zero temperature cannot be attained.	K1	CO1
	2	An engine works between the temperatures 30K and 300 K. What is its efficiency? a) 50% b) 47% c) 90% d) 10%	K2	CO2
2	3	For a system of n particles, the total no of microstates is a) n b) n+1 c) 2^n d) 2^{n+1}	K1	CO1
	4	Which of the following is not typically optimized in a grand canonical ensemble? a) total energy b) temperature c) volume d) chemical potential	K2	CO2
3	5	Deduction of Planck's law is possible on the basis of ----- statistics a) Fermi-Dirac b) Classical c) Maxwell-Boltzmann d) Bose-Einstein	K1	CO1
	6	The total translational energy of n diatomic molecules is ----- a) nKT b) 3nKT c) 2nKT d) 1.5nKT	K2	CO2
4	7	What happens to the internal energy of a monoatomic ideal gas when it is heated at constant volume? a) remains the same b) decreases c) increases. d) fluctuates	K1	CO1
	8	The specific heat capacity of a diatomic gas at constant volume is a) 5/2 b) 5R/2 c) 7R/2 d) R	K2	CO1
5	9	According to Debye's theory , the atomic heat of a solid at low temperature varies as a) proportional to its absolute temperature b) proportional to square of its absolute temperature c) proportional to cube of its absolute temperature d) independent of temperature	K1	CO1
	10	What is the term used to describe the state of matter where negative temperatures occur? a) absolute zero b) Bose-Einstein condensate c) Fermi gas d) superfluid	K2	CO1

Cont...

SECTION - B (35 Marks)Answer **ALL** questions**ALL** questions carry **EQUAL** Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	State first law of thermodynamics. Give its physical significance. What are the limitations of the first law?	K2	CO2
	(OR)			
	11.b.	Derive the Maxwell's thermodynamic relations.		
2	12.a.	Define and explain the terms Micro and Grand Canonical Ensemble.	K3	CO3
	(OR)			
	12.b.	Define phase space, mu space and G space.		
3	13.a.	Obtain the rotational partition function of diatomic molecules.	K3	CO3
	(OR)			
	13.b.	Classify the following particles according to BE and FD statistics: 1. alpha particle, 2. hydrogen atom, 3. hydrogen molecule, 4. positron, 5. lithium ion (${}_3\text{Li}^{6+}$)		
4	14.a.	Explain the ideal gas in a gravitational field.	K4	CO4
	(OR)			
	14.b.	Define most probable, average and root mean square speed.		
5	15.a.	Explain briefly about the Electron gas.	K4	CO4
	(OR)			
	15.b.	Write a note on the Blackbody radiation.		

SECTION -C (30 Marks)Answer **ANY THREE** questions**ALL** questions carry **EQUAL** Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Calculate the workdone in a Carnot's cycle of operation. Deduce the efficiency of a Carnot's engine.	K6	CO5
2	17	State and explain Liouville's theorem.	K5	CO4
3	18	Compare the basic postulates of MB, BE and FD statistics.	K4	CO3
4	19	Give the experimental verification of Maxwell's-Boltzmann's law of distribution of molecular speeds.	K6	CO5
5	20	Describe the Debye's theory of the specific heat of a solid.	K5	CO4

Z-Z-Z END