Enrolment No/Seat No.: _____

R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT

(An Autonomous College U/s UGC Act 1956)

B.Tech. SEMESTER-II, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1ME202 **DATE: 09-01-2026**

SUBJECT NAME: BASICS OF THERMODYNAMICS

TIME: 11:00 AM to 01:30 PM **TOTAL MARKS: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Bloom's Taxonomy Levels (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

	Marks	BL	CO
Q.1 Multiple-Choice Questions	**[05]**		
(a) Which of the following best describes a thermodynamic process?	**1**	**R**	**1**
(i) A process where the system is in equilibrium **(ii)** A change in the state of a system **(iii)** A system that remains at constant pressure **(iv)** A reversible transformation of energy			
(b) The Second Law of Thermodynamics primarily deals with:	**1**	**R**	**2**
(i) The conservation of energy. **(ii)** The efficiency of energy conversion. **(iii)** The flow of energy through a system. **(iv)** The direction of energy transfer.			
(c) The standard enthalpy of formation of a compound is defined as the enthalpy change when	**1**	**R**	**3**
(i) One mole of a compound is formed from its element in their standard states **(ii)** One mole of compound is completely combusted in oxygen **(iii)** One mole of compound is dissolved in water **(iv)** Elements react at any temperature and pressure			
(d) In a bomb calorimeter, the higher calorific values (HCV) of a fuel is determined because	**1**	**U**	**4**
(i) Water vapour formed during combustion is allowed to escape **(ii)** Combustion occurs at constant pressure			

(iii) Heat released includes the latent heat of condensation of water vapour

(iv) Fuel is burned in an open atmosphere

(e)	During combustion_____always remains inert.	**1**	**U**	**5**

(i) Oxygen

(ii) Hydrogen

(iii) Nitrogen

(iv) carbon

Q.2 Attempt Any Two **[10]**

(a)	Define: State, Path, Process, Cycle, Point function.	**5**	**R**	**1**
(b)	Write a short note on thermodynamic equilibrium.	**5**	**U**	**1**
(c)	Explain the quasi-static process with a neat sketch.	**5**	**U**	**1**

Q.3 Attempt Any Two **[10]**

(a)	Explain Carnot cycle for heat engine with neat sketch and also derive the equation of its efficiency.	**5**	**U**	**2**
(b)	What is irreversibility? State various types of irreversibility and explain them.	**5**	**U**	**2**
(c)	In a gas turbine unit, the gas flow through the turbine is 15 Kg/Sec. and the Power developed by the turbine is 12000 KW. The enthalpies of gases at inlet and Outlet are 1260 KJ/Kg and 400 KJ/Kg respectively, and the velocity of gases at the Inlet and outlet are 50 m/s and 110 m/s respectively. Calculate (i) the rate at which Heat is rejected from the turbine, and (ii) The area of the inlet pipe given that the Specific volume of gases at inlet is 0.45 m3 /kg.	**5**	**A**	**2**

Q.4 Attempt Any Two **[10]**

(a)	Explain construction and working of Bomb calorimeter with neat sketch.	**5**	**U**	**5**
(b)	Briefly explain adiabatic flame temperature, Enthalpy of formation.	**5**	**U**	**5**
(c)	Explain Junkers gas calorimeter with neat sketch.	**5**	**U**	**5**

SECTION B

	Marks	BL	CO
Q.5 Multiple-Choice Questions	**[05]**		
(a) According to the Second Law of Thermodynamics, for any spontaneous process in an isolated system, the entropy (S)	**1**	**R**	**3**
(i) Always remains constant. **(ii)** Can never decrease. **(iii)** Always decreases. **(iv)** Is equal to the heat transfer divided by temperature only for irreversible processes.			
(b) Availability (also known as Exergy) is defined as	**1**	**R**	**3**
(i) The total energy contained within a system. **(ii)** The heat rejected to the surroundings. **(iii)** The maximum theoretical useful work obtainable as a system comes to equilibrium with a dead state. **(iv)** The energy that is lost forever during a process.			
(c) When a system reaches a "Dead State," its availability is	**1**	**R**	**3**
(i) Maximum. **(ii)** Equal to its internal energy. **(iii)** Infinite. **(iv)** Zero.			
(d) In a Diesel cycle, the 'cut-off ratio' (ρ) specifically refers to the ratio of volumes	**1**	**R**	**4**
(i) At the beginning and end of the compression stroke **(ii)** Of the clearance volume to the total volume **(iii)** At the maximum and minimum temperatures of the cycle **(iv)** At the maximum and minimum temperatures of the cycle			
(e) The Bell-Coleman cycle, also known as the Reversed Brayton Cycle, is primarily used for which specialized refrigeration application?	**1**	**R**	**4**
(i) Aircraft refrigeration **(ii)** Industrial ice plants **(iii)** Domestic deep freezers **(iv)** Thermoelectric cooling			
Q.6 Attempt Any Two	**[10]**		
(a) Explain Entropy change in isothermal and adiabatic processes using T-S diagrams.	**5**	**U**	**3**
(b) Derive an expression for Exergy (availability) of a closed system.	**5**	**U**	**3**

(c)	Explain Clausius inequality in detail and its significance for reversible and irreversible processes.	**5**	**U**	**3**

Q.7 Attempt Any Two **[10]**

(a)	Explain Carnot cycle and derive expression for the efficiency of the Carnot cycle.	**5**	**U**	**4**
(b)	Explain Bell-Coleman air refrigeration cycle with neat diagram.	**5**	**U**	**4**
(c)	Derive an expression for Air standard efficiency of an Otto cycle.	**5**	**U**	**4**

Q.8 Attempt Any Two **[10]**

(a)	Compare Rankine cycle with Carnot cycle.	**5**	**U**	**4**
(b)	Explain Vapor Compression Refrigeration system with neat sketch. Also draw p-h and T-S diagram for the same.	**5**	**U**	**4**
(c)	Draw air standard Diesel cycle on p-V and T-s diagrams. Derive its efficiency equation with usual notations.	**5**	**U**	**4**

****