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 – SUMMER 2025

Subject Code: 1ME202 **Date: 26-05-2025**

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? **(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	**1**	**R**	**1**
(b)	Which of the following is an example of an intensive property? **(i)** Volume **(ii)** Mass **(iii)** Temperature **(iv)** Energy	**1**	**R**	**1**
(c)	If a system does 200 J of work and 500 J of heat is added to the system, what is the change in internal energy of the system? **(i)** 500 J **(ii)** 300 J **(iii)** 700 J **(iv)** 200 J	**1**	**R**	**2**
(d)	The efficiency of a Carnot heat engine operating between a hot reservoir at 600 K and a cold reservoir at 300 K is **(i)** 50% **(ii)** 75 % **(iii)** 33.3 % **(iv)** 100%	**1**	**R**	**2**

(e) A bomb calorimeter is used for finding the		**1**	**R**	**5**

(i) LCV of gaseous fuel **(ii)** HCV of gaseous fuel

(iii) LCV of solid fuel **(iv)** HCV of solid fuel

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

(a) Define the term "Thermodynamic system". Discuss the types of thermodynamic system by giving a suitable example of each.	**5**	**U**	**1**
(b) Explain the quasi-static process with a neat sketch.	**5**	**U**	**1**
(c) What do you mean Steady flow process? Write the Steady Flow Energy Equation (SFEE) for the open system and obtain the expression of, 1) Velocity of fluid at exit of "Nozzle" 2) Work done by the "Steam turbine".	**5**	**U**	**2**

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

(a) Derive the Steady Flow Energy Equation. Explain the significance of S.F.E.E. in engineering applications.	**5**	**U**	**2**
(b) Gas enters a nozzle at 15 bar and 1500 K with a velocity of 30 m/s. The pressure at the exit of the nozzle is 5 bar. If the nozzle efficiency is 90%, calculate the actual exit velocity. Neglect changes in P.E. and heat exchange between nozzle and surrounding. Take Cp = 1.005 KJ/kg K	**5**	**A**	**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 to the turbine, and (ii) The area of the inlet pipe given that the Specific volume of gases at inlet is 0.45 m^3/kg.	**5**	**A**	**2**

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

(a) Explain Bomb calorimeter with neat sketch.	**5**	**U**	**5**
(b) State Kelvin Plank and Clausius statements of second law of thermodynamics and prove the equivalency between both statements.	**5**	**U**	**2**
(c) Explain Carnot cycle for heat engine with neat sketch and also derive the equation of its efficiency.	**5**	**U**	**2**

SECTION B

		Marks	BL	CO
Q.5	**Multiple-Choice Questions**	**[05]**		
(a)	The entropy _____ in an irreversible cyclic process.	**1**	**R**	**3**
	(i) remains constant **(ii)** decreases **(iii)** increases **(iv)** all of these			
(b)	Clausius inequality is given by which of the following expressions for a cyclic process?	**1**	**R**	**3**
	(i) $\oint \delta Q/T=0$ **(ii)** $\oint \delta Q/T \geq 0$ **(iii)** $\oint \delta Q/T \leq 0$ **(iv)** $\oint \delta Q/T > 0$			
(c)	In a reversible process, the change in entropy is	**1**	**R**	**3**
	(i) Greater than zero **(ii)** Less than zero **(iii)** Zero **(iv)** Equal to the heat transfer divided by temperature			
(d)	Thermal power plant work on	**1**	**R**	**4**
	(i) Carnot cycle **(ii)** Joule cycle **(iii)** Rankine cycle **(iv)** Otto cycle			
(e)	The efficiency of Diesel cycle depends upon	**1**	**R**	**4**
	(i) temperature limits **(ii)** pressure ratio **(iii)** compression ratio **(iv)** cut-off ratio and compression ratio			
Q.6	**Attempt Any Two**	**[10]**		
(a)	Prove that entropy is the property of system.	**5**	**U**	**3**
(b)	Explain Clausius inequality.	**5**	**U**	**3**
(c)	Explain the concept of available and unavailable energy. When does the system become dead?	**5**	**U**	**4**
Q.7	**Attempt Any Two**	**[10]**		
(a)	Derive an expression for exergy of a closed system.	**5**	**R**	**3**
(b)	Explain Carnot cycle and derive an expression for efficiency of Carnot cycle.	**5**	**U**	**4**

(c)	Explain Rankine Cycle with P-V & T-S Diagram in detail.	**5**	**U**	**4**

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

(a)	Draw block diagram and p-h diagram of Vapour Compression Refrigeration system and explain in brief.	**5**	**U**	**4**
(b)	Explain Otto Cycle with P-V & T-S diagram in detail.	**5**	**U**	**4**
(c)	Explain Simple Brayton Cycle with P-V & T-S diagram in detail.	**5**	**U**	**4**

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