19ME3302 - ENGINEERING THERMODYNAMICS

Offering Branches	ME		
Course category:	Program Core	**Credits**	4
Course Type:	Theory	**Lecture-Tutorial-Practical:**	3-1-0
Prerequisites	Nil	**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Learn the terminology and basic concepts of thermodynamics and capable of analyzing zeroth and first law of thermodynamics	L1
CO2	Analyze Second law of thermodynamics and working of various devices with heat and work transactions.	L4
CO3	Assess quality and quantity of energy and analyze Exergy	L5
CO4	Recognize and understand different phases of pure substances and familiarize with saturated and superheated steam property tables and charts	L2
CO5	Learn power producing thermodynamic cycles capable of making their analysis and evaluate the relative performance	L1

Course Content

UNIT-1	**INTRODUCTION:** Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics. **FIRST LAW OF THERMODYNAMICS:** Joule's experiment - first law of thermodynamics, corollaries- perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics.	**CO1**
UNIT-2	**SECOND LAW OF THERMODYNAMICS**: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.	**CO2**
UNIT-3	**ENTROPY:**	**CO3**

	Clausius inequality - Concept of Entropy- entropy equation for different processes and systems, Maxwell relations, TdS equations **AVAILABILITY AND IRREVERSIBILITY**: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes, irreversibility.	
UNIT-4	**PROPERTIES OF STEAM AND USE OF STEAM TABLES**: Pure Substances, P-V-T surfaces, dryness fraction, property tables, T-s and h-s diagram (Mollier chart),analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.	**CO4**
UNIT-5	**THERMODYNAMIC CYCLES**: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Brayton Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.	**CO5**
Learning Resources		
Text books:	1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013. 2. Van Wylen, Fundamentals of Classical Thermodynamics, G.J.John Wylie./ S chand Publications.	
Reference books	1. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011. 2. P.L.Dhar, Engineering Thermodynamics a generalized approach..., Elsevier 3. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons,2012. 4. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015 5. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009 6. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010.	
e- Resources & other digital material	1. https://nptel.ac.in/courses/112/105/112105266/ 2. https://nptel.ac.in/courses/112/105/112105220/ 3. https://nptel.ac.in/courses/101/104/101104067/ 4. https://nptel.ac.in/courses/101/104/101104063/ 5. https://nptel.ac.in/courses/103/104/103104151/	

Course coordinator **HOD**

Code No: **19ME3302**

PVP19

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
II.B.Tech – I Semester Model Paper
ENGINEERING THERMODYNAMICS

(ME)

Duration:3 Hours **Max Marks:70**

Note: 1. This question paper contains two papers Part A and B.
2.Part A is compulsory which carries 10 marks. Answer all questions in part A.
3.Part B consists of 5 units. Answer any one full question from each unit. Each question carries 12 marks and may have a, b, c as sub questions.
4.All parts of question paper must be answered in one place.

PART-A

5×2=10 Marks

		Blooms Level	CO
1.a)	Determine the pressure at a point in the flow system if the flow energy is 100 kJ and specific volume 2.5 m3 /kg.	3	**CO1**
1.b)	State Clausius statement of second law of thermodynamics.	2	**CO2**
1.c)	Define Carnot's theorem.	2	**CO3**
1.d)	Define latent heat of evaporation.	2	**CO4**
1.e)	Name thermodynamic processes occurred in Lenoir cycle.	1	**CO5**

PART-B

5×12=60 Marks

			Blooms Level	CO	Max. Marks
		UNIT-I			
2	a	Explain thermodynamic equilibrium.	2	**CO1**	6
	b	A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the Page 3 of 4 following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?	3	**CO1**	6
		OR			
3	a	A gas undergoes a thermodynamic cycle consisting of three processes beginning at an initial state where p1 = 1 bar, V1 = 1.5 m3 and U1 = 512 kJ. The processes are as follows: (i) Process 1–2: Compression with pV = constant. p2 = 2 bar, U2 = 690 kJ (ii) Process 2–3: W23 = 0, Q23 = –150 kJ, and (iii) Process 3–1: W31 = +50 kJ. Neglecting KE and PE changes,	3	CO1	6

		determine the heat interactions Q12 and Q31.			
	b	Derive S.F.E.E stating the assumptions first?	2	CO1	6
		UNIT-II			
4	a	Why Carnot cycle cannot be realized in practice?	2	**CO2**	6
	b	A household refrigerator is maintained at a temperature of 2°C. Every time the door is opened, warm material is placed inside, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs. 2.50 per kWh. What is the monthly bill for this refrigerator? The atmosphere is at 30°C.	3	**CO2**	6
		OR			
5	a	Prove the equivalence of Kelvin Planck and Clausius Statements of second law of thermodynamics.	2	**CO2**	6
	b	A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17 kJ/s from the 5°C reservoir, determine i) The rate of heat supply from the 840°C source ii) The rate of heat rejection to the 60°C sink.	3	**CO2**	6
		UNIT-III			
6	a	Calculate the available energy in 40 kg of water at 750 C with respect to the surroundings at 50 C, the pressure of water being 1 atm.	3	**CO3**	6
	b	Distinguish between reversibility and irreversibility.	2	**CO3**	6
		OR			
7	a	Explain entropy and disorder. Prove that entropy is a property of a system.	2	**CO3**	6
	b	Calculate the entropy change of the universe as a result of the following processes: 8 M (i) A copper block of 600 g mass and with heat capacity of 150 J/K at 1000C is placed in a pond at 80C. (ii) The sane block at 80C is dropped from a height of 100 m into the pond. (iii) Two such blocks at 1000C and 00C are joined.	3	**CO3**	6
		UNIT-IV			
8	a	Draw the phase equilibrium diagram for a pure substance on p-T coordinates. Explain, in brief.	2	**CO4**	6
	b	A steam holding capacity of 4 m3 contains a mixture of saturated water and saturated steam at 2500C. The mass of the liquid present is 1 ton. Determine: (i)Quality; (ii) Specific Volume; (iii) Specific Enthalpy; (iv) Specific Entropy and (v) Specific Internal Energy of steam.	3	**CO4**	6
		OR			
9	a	Explain the formation of steam and its properties.	2	**CO4**	6

	b	Find the enthalpy and entropy of steam when the pressure is 2 MPa and the specific volume is 0.09 m3 /kg.	3	**CO4**	6
		UNIT-V			
10	a	Compare Otto, Diesel and Dual combustion cycles.	2	**CO5**	6
	b	An air standard Otto cycle has a compression ratio of 7. At the start of the compression, pressure and temperature are 1 bar and 27 0C. If the maximum temperature of the cycle is 727 0C, calculate: i) Heat supplied Page 4 of 4 ii) Net work iii)Thermal efficiency.	3	**CO5**	6
		OR			
11	a	Derive the expression for thermal efficiency of Ericson cycle on regeneration.	2	**CO5**	6
	b	An engine working on diesel cycle has a compression ratio of 15 and cut-off takes place at 5% of the stroke. Find the air standard efficiency.	3	**CO5**	6

Course coordinator **HOD**