



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

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JECRC Campus, Shri Ram Ki Nangal, Via-Vatika, Tonk Road, Jaipur

Department of Mechanical Engineering

Name of Subject: Engineering Thermodynamics

Subject Code: 3ME4-05

Year: 2nd Year, 3rd Semester



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Department of Mechanical Engineering

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

Mission:

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



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PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



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Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigation of Complex Problems:** Conduct investigation of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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Department of Mechanical Engineering

SYLLABUS



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME4-05 : ENGINEERING THERMODYNAMICS

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Basic Concepts and definitions of Thermodynamics: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	2
	Zeroth and First Law of Thermodynamics: Zeroth of Thermodynamics, Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	5
2	Second Law of Thermodynamics: Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Planck and Clausius statements. Reversible and Irreversible Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausius Inequality.	4
	Entropy: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	3
	Availability: Available energy, Loss in available energy, Availability Function, Irreversibility.	3
3	Thermodynamic Properties of Fluids: Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	4
	Ideal Gas and Real Gas: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures.	4
4	Thermodynamic Relations: Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	4
	Power Cycles: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle.	4
5	Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	3
	Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	3
TOTAL		39



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Course Plan

Name of the Course: Engineering Thermodynamics

Code of the course: 3ME4-05

Name of Faculty: Abhishek Kumar

Course Outcomes

CO-1: Explain the fundamental laws of thermodynamics and their applications in engineering systems.

CO-2: Apply thermodynamic relations to analyze cycles, processes, and systems.

CO-3: Analyze the performance of engines, refrigerators, and heat pumps.

CO-4: Determine properties of pure substances, mixtures, and gases under different conditions.

CO-5: Evaluate the efficiency and irreversibility of thermodynamic processes.

CO-6: Develop innovative energy systems or cycles using thermodynamic principles

Course Plan

Unit	Topic	Lec	CO	Specific Objectives	Expected Outcomes	Primary Reference (R.S Khurmi)
Intro	Basic concepts & definitions	1	CO1	Explain basics	Understand concepts	Ch 1 (1–10)
1	Thermodynamic properties	2	CO1	Define properties	Apply definitions	Ch 1 (10–20)
	Work and heat transfer	3	CO1	Explain modes	Solve problems	Ch 1 (20–28)
	Zeroth law & temperature	4	CO1	Explain equilibrium	Use temperature scales	Ch 1 (28–35)
	First law	5	CO1	Apply first law	Solve systems	Ch 1 (35–45)
	SFEE & processes	6	CO2	Apply SFEE	Analyze systems	Ch 1 (45–55)
2	Second law statements	7	CO1	Explain laws	Interpret systems	Ch 3 (65–75)
	Carnot cycle	8	CO2	Analyze cycle	Evaluate efficiency	Ch 3 (75–85)
	Reversible/irreversible	9	CO5	Differentiate	Apply concepts	Ch 3 (85–95)
	Entropy	10	CO2	Define entropy	Solve entropy problems	Ch 4 (100–110)
	Entropy applications	11	CO5	Apply laws	Evaluate systems	Ch 4 (110–120)
	Availability	12	CO5	Explain availability	Analyze irreversibility	Ch 4 (120–130)
3	Pure substances	13	CO4	Explain phases	Use tables	Ch 5 (140–150)



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	Steam tables & Mollier	14	CO4	Use charts	Solve problems	Ch 5 (150–160)
	Properties of steam	15	CO4	Analyze properties	Apply concepts	Ch 5 (160–170)
	Ideal gas	16	CO4	Apply gas laws	Solve numericals	Ch 2 (30–40)
	Real gas	17	CO4	Explain deviations	Apply EOS	Ch 2 (40–50)
	Gas mixtures	18	CO4	Apply Dalton law	Solve problems	Ch 2 (50–60)
4	Thermodynamic relations	19	CO2	Apply relations	Solve equations	Ch 6 (180–190)
	Maxwell relations	20	CO2	Use relations	Simplify problems	Ch 6 (190–200)
	Clapeyron equation	21	CO2	Apply equation	Analyze phase change	Ch 6 (200–210)
	Joule-Thomson effect	22	CO5	Explain effect	Apply cooling	Ch 6 (210–220)
	Otto cycle	23	CO3	Analyze engine	Evaluate performance	Ch 7 (230–240)
	Diesel cycle	24	CO3	Compare cycles	Solve problems	Ch 7 (240–250)
	Brayton cycle	25	CO3	Analyze cycle	Evaluate efficiency	Ch 7 (250–260)
5	Rankine cycle	26	CO3	Analyze cycle	Evaluate performance	Ch 8 (280–290)
	Reheat cycle	27	CO3	Explain improvement	Compare efficiency	Ch 8 (290–300)
	Regenerative cycle	28	CO6	Apply concept	Design systems	Ch 8 (300–310)
	Feedwater heating	29	CO6	Explain system	Improve efficiency	Ch 8 (310–320)
	Cogeneration	30	CO6	Explain system	Apply concepts	Ch 8 (320–330)
	Cycle performance	31	CO3	Evaluate systems	Interpret results	Ch 8 (332)
	Numerical/problem solving session	32	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	33	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	34	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	35	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	36	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	37	CO2	Practice problems	Strengthen concepts	



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	Numerical/problem solving session	38	CO2	Practice problems	Strengthen concepts	
	Numerical/problem solving session	39	CO2	Practice problems	Strengthen concepts	