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Thermal Engineering-I — Complete Syllabus

BTEUP Diploma in Mechanical Engineering • 3rd Semester • Session 2026–27
Subject 3.1 (Theory) • Total 100 Marks • 3 Credits

About this document — Thermal Engineering-I is subject 3.1 of the 3rd semester of the Diploma in Mechanical Engineering. The 3rd-semester subject list is the same across Mechanical Engineering (Automobile), Mechanical Engineering (Production) and Mechanical Engineering (Refrigeration & Air Conditioning). This document gives the complete unit-wise syllabus, the examination scheme and the reference books from the official curriculum.

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Examination Scheme

Code	Paper	Type	L – P	Credits	Internal	External	Total
3.1	Thermal Engineering-I	Theory	4 – 0	3	Theory 40	Theory 60 (3 hrs)	100
Thermal Engineering-I Total				**3**	**40**	**60**	**100**

What This Subject Aims To Do

To give diploma students the essential knowledge of thermodynamics, heat transfer and energy systems that every mechanical engineer works with — so that they can analyse, operate and maintain thermal systems such as boilers, turbines, steam generators and sources of energy, and understand energy efficiency and sustainable technologies.

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Unit-Wise Complete Topic List

Unit	Topic	Periods	Marks
1	Fundamental Concepts	10	12
2	Thermodynamic Processes on Gases and Laws of Thermodynamics	10	12
3	Properties of Steam	12	12
4	Steam Generators	12	12
5	Steam Turbines and Steam Nozzles	12	12

Total: 56 periods, 60 marks (external theory). Each unit carries 12 marks in the external theory paper, as per the suggested distribution of marks in the official syllabus.

Unit 1 — Fundamental Concepts (10 Periods, 12 Marks)

Topics: Role of Thermodynamics in Engineering. Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, properties of system, thermodynamic equilibrium, quasi-static process, reversible and irreversible processes, Zeroth law of thermodynamics.

In simple words: The basic vocabulary of the subject — what a system is, what kinds of systems exist, what equilibrium means, and the law that makes temperature measurement possible.

Unit 2 — Thermodynamic Processes on Gases and Laws of Thermodynamics (10 Periods, 12 Marks)

Topics: Explanation of perfect gas laws – Boyle's law, Charle's law, Gay-Lussac's law, Universal gas constant, Characteristic gas constants, simple problems on gas equation, Laws of conservation of energy, first law of thermodynamics (Joule's experiment), Application of first law of thermodynamics, Steady flow energy equation, Application of steady flow energy equation, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, Perpetual motion Machine of first kind, second kind, Carnot cycle, Carnot engine, Introduction of third law of thermodynamics.

In simple words: How gases behave (the gas laws and pV = mRT), the three laws of thermodynamics, and the energy equation used for boilers, turbines and nozzles — plus the ideal Carnot engine that no real engine can beat.

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Unit 3 — Properties of Steam (12 Periods, 12 Marks)

Topics: Formation and Industrial uses of Steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, internal energy, latent heat, of wet, dry and superheated steam at a given pressure using steam tables and simple direct problems on the above using table.

In simple words: How steam is formed, what wet, dry and superheated steam mean, and how to read steam tables to find enthalpy and internal energy — the numbers every turbine and boiler calculation needs.

Unit 4 — Steam Generators (12 Periods, 12 Marks)

Topics: Introduction and classification of boilers with example, Boiler mountings and accessories, Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers, Locomotive boiler; Brief explanation with line sketches of High Pressure Boiler, Draught systems (Natural, forced & induced).

In simple words: How boilers are classified, which fittings keep a boiler safe (mountings) and which make it efficient (accessories), how the Cochran, Babcock & Wilcox and Locomotive boilers work, and how air is moved through the furnace (draught).

Unit 5 — Steam Turbines and Steam Nozzles (12 Periods, 12 Marks)

Topics: Classification of steam turbines with examples. Difference between Impulse & Reaction turbines. Working Principle of a simple De Laval turbine & Parson's Reaction turbine with line diagrams – Velocity diagrams; Basic concept used for calculation of work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency. Governing of steam turbines: Throttle, Bypass & Nozzle control governing. Flow of steam through nozzle; Discharge of steam through nozzles; Critical pressure ratio; Effect of friction in nozzles and Super saturated flow in nozzles.

In simple words: How steam turbines turn steam into shaft work — impulse vs reaction, the De Laval and Parson turbines, velocity diagrams, governing (speed control) — and how nozzles accelerate steam, including the critical pressure ratio.

Learning Outcomes

- Understand the Fundamentals of Thermodynamics.
- Apply Thermodynamic Principles to Practical Systems.
- Understand and Apply Heat Transfer Principles.

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- Understand Steam Properties and Steam Boilers.
- Analyze Steam Turbines and Steam Nozzles.

Reference Books (as listed in the syllabus)

- Engineering Thermodynamics by P. K. Nag; Tata McGraw Hill, Delhi.
- Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.
- Engineering Thermodynamics by C. P. Arora; Tata McGraw Hill, Delhi.
- R. K. Rajput, Thermal Engineering, Laxmi Publications Pvt Ltd, New Delhi.
- R. S. Khurmi, J. K. Gupta, A Textbook of Thermal Engineering, S. Chand Publications.
- Ebooks/e-tools/relevant software to be used as recommended by AICTE/BTE, Lucknow.

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Source: IRDT Kanpur NEP-2020 curriculum for the Diploma in Mechanical Engineering (Automobile), effective session 2025-26 (urise.up.gov.in). Topic lists follow the official syllabus; short explanations are the author's own plain-English summaries, not syllabus text. Please confirm with your own polytechnic for any local changes.