**Techno India NJR Institute of Technology**



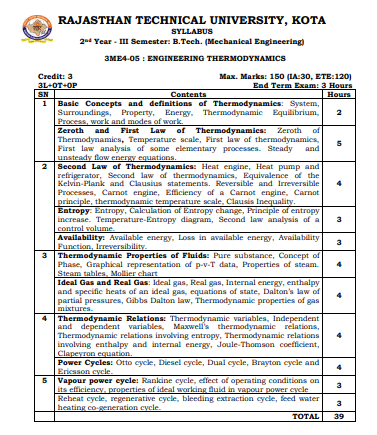
**Course File**

**Engineering Thermodynamics (3ME4- 05)**

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**Course Overview:**

Student will learn basics of Engineering thermodynamicsfrom this 40 hours course. They will be able to kinow about the laws of thermodynamics, such as first, second & third law and also about their applications. Linear data structures covered under this course are array, stack, queue, double ended queue and linked list. This course provides an introduction to the most powerful engineering principles you will ever learn - Thermodynamics: the science of transferring energy from one place or form to another place or form. We will introduce the tools you need to analyze energy systems from solar panels, to engines, to insulated coffee mugs.

More specifically, we will cover the topics of mass and energy conservation principles; first law analysis of control mass and control volume systems; properties and behavior of pure substances; and applications to thermodynamic systems operating at steady state conditions.

**Course Outcomes:**

|  |  |  |
| --- | --- | --- |
| **CO. NO.** | **Cognitive Level** | **Course Outcome** |
| 1 | Synthesis | Explain the basic principles and applications of the thermodynamics to the various real life systems. |
| 2 | Synthesis | Describe fundamental laws of thermodynamics. |
| 3 | Design | Apply the concepts such as Entropy, Energy Balance also the calculations of heat, work and other important thermodynamic properties for various ideal gas processes. |
| 4 | Design | Estimate performance of various thermodynamic gas power cycles and gas refrigeration cycle and availability in each case. |

**Course Outcome Mapping with Program Outcome:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcomes (PO’s)** | |
| **CO. NO.** | **Domain Specific (PSO)** | **Domain Independent (PO)** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| CO1 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| CO2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| C04 | 3 | 2 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| **Average** | 2.75 | 1.75 | 2.25 | 1.50 | 1.50 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.50 |

**Course Coverage Module Wise:**

|  |  |  |
| --- | --- | --- |
| Lecture No. | Unit | Topic |
| 1 | **1** | Basic Concepts and definitions of Thermodynamics: System, Surroundings, Property, Energy, |
| 2 | **1** | Thermodynamic Equilibrium, Process, work and modes of work. |
| 3 | **1** | Zeroth of Thermodynamics, Temperature scale |
| 4 | **1** | First law of thermodynamics, First law analysis of some elementary processes. |
| 5 | **1** | Steady and unsteady flow energy equations. |
| 6 | **1** | Numericals |
| 7 | **1** | Numericals |
| 8 | **1** | Numericals |
| 9 | **1** | Numericals |
| 10 | **2** | Heat engine, Heat pump and refrigerator, Second law of thermodynamics, |
| 11 | **2** | Equivalence of the Kelvin-Plank and Clausius statements |
| 12 | **2** | Reversible and Irreversible Processes, Carnot engine |
| 13 | **2** | Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality |
| 14 | **2** | Entropy, Calculation of Entropy change, Principle of entropy increase. T |
| 15 | **2** | Temperature-Entropy diagram, Second law analysis of a control volume. |
| 16 | **2** | Available energy, Loss in available energy, |
| 17 | **2** | Availability Function, Irreversibility |
| 18 | **2** | Numericals |
| 19 | **2** | Numericals |
| 20 | **2** | Numericals |
| 21 | **2** | Numericals |
| 22 | 3 | Pure substance, Concept of Phase, Graphical representation of p-v-T data |
| 23 | 3 | Properties of steam. Steam tables, Mollier chart |
| 24 | 3 | Ideal gas, Real gas |
| 25 | 3 | Internal energy, enthalpy and specific heats of an ideal gas, |
| 26 | 3 | equations of state, Dalton’s law of partial pressures, |
| 27 | 3 | Gibbs Dalton law, Thermodynamic properties of gas mixtures. |
| 28 | 3 | Numericals |
| 29 | 3 | Numericals |
| 30 | 3 | Numericals |
| 31 | 4 | Thermodynamic variables, Independent and dependent variables, |
| 32 | 4 | Maxwell’s thermodynamic relations, Thermodynamic relations involving entropy, |
| 33 | 4 | Thermodynamic relations involving enthalpy and internal energy, |
| 34 | 4 | Joule-Thomson coefficient, Clapeyron equation |
| 35 | 4 | : Otto cycle, Diesel cycle, Dual cycle |
| 36 | 4 | Brayton cycle and Ericsson cycle. |
| 37 | 4 | Numerical |
| 38 | 4 | Numerical |
| 39 | 5 | Rankine cycle, effect of operating conditions on its efficiency |
| 40 | 5 | properties of ideal working fluid in vapour power cycle |
| 41 | 5 | Reheat cycle, regenerative cycle, bleeding extraction cycle,, feed water heating co-generation cycle. |
| 42 | 5 | Numerical |
| 43 | 5 | Numerical |
| 44 | 5 | Numerical |
| 45 | 5 | Numerical |

**TEXT/REFERENCE BOOKS**

1. Engineering Thermodynamics, P.k.nag
2. Engineering Thermodynamics By D.S.kumar
3. Thermal Engineering by R.S.Khurmi
4. Thermal Engineering by F.S.Mehta

**Course Level Problems (Test Items):**

|  |  |
| --- | --- |
| **CO.NO.** | **Problem description** |
| **1** | 1. Relate zeroth law with practical everyday life. 2. Relate stady flow process with everyday life 3. Relate first law with everyday life. |
| **2** | 1. Relate second law with everyday life 2. Attempt numericals on second law of thermodynamicss 3. Relate entropy concept with second law. |
| **3** | 1. Write different phase change properties of water at different pressure. 2. Attempt numerical on steam table 3. Attempt numeical on moiller chart. |
| **4** | 1. Derive thermodynamic relation. 2. Derive efficency of otto , diesel, dual cycle. 3. Attempt numerical on otto,diesel , dual cycle. |
| **5** | 1. Derive rankine and ideal rankine cycle. 2. Derive reheat, regenerative , binary vapor cycle. 3. Attempt numerical on reheat, regenerative & binary vapor cycle. |

**Assessment Methodology:**

1. Practical exam in lab where they have to prepare practical model related to thermodynamic laws .(Once in a week)
2. Assignments one from each unit.
3. Midterm subjective paper where they have to attempt numericals.
4. Final paper at the end of the semester subjective.

**Teaching and Learning resources unit-wise:**

**Unit-1**

Basic Concept of thermodynamics

Video Tutorials: [https://www.youtube.com/watch?v=CWKMCXc1qWk](Course%20File%20Et.docx)

Theory conchttps:[https://www.edibon.com/en/thermodynamics-thermotechnics/fundamentals-and-basic-concepts-of-thermodynamics](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

**Unit-2**

1. Heat engine , Heat pump & refrigerator( Second law of thermodynamics)

Video Tutorials: [https://www.youtube.com/watch?v=Z1crLo7KyH8](Course%20File%20Et.docx)

Theory concepts: [https://www.livescience.com/50941-second-law-thermodynamics.html](Course%20File%20Et.docx)

Sample Quiz: https:[//www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

1. Clausius inequality & 3rd law of thermdynamics

Video Tutorials: <https://www.youtube.com/watch?v=c5v1b5pCL40>

Theory concept:- [https://itp.uni-frankfurt.de/~gros/Vorlesungen/TD/4\_Entropy\_second\_law.pdf](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

**Unit-3**

1. Pure substance, Concept of Phase, Graphical representation of p-v-T data

Video Tutorials: [https://www.youtube.com/watch?v=D28Mg5u3cW8](Course%20File%20Et.docx)

Theory concepts:[https://www.ohio.edu/mechanical/thermo/Intro/Chapt.1\_6/Chapter2a.html](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

B. Steam table & moiller chart

Video Tutorials[:https://www.youtube.com/watch?v=jtsLoBKc5hE](Course%20File%20Et.docx)

Theory concepts[:http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2410](Course%20File%20Et.docx)

Sample Quiz:https:[//www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

**Unit-4**

1. Thermodynamic relation, Thermodynamic variables, Independent and dependent variables,

Video Tutorials: [https://www.youtube.com/watch?v=wlzVbnCovO0](Course%20File%20Et.docx)

Theory concepts: [https://www.cpp.edu/~tknguyen/che302/Notes/chap8-1.pdf](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

1. Gas power cycles

Video Tutorials: <https://www.youtube.com/watch?v=U6sKICs5XtY&list=PLvGeDdLVzd1kqvbp0fdQjv8fMwB620S_O>

Theory concepts: [http://www.nitjsr.ac.in/course\_assignment/ME4255\_2.pdf](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

**Unit-5**

1. Vapour power cycle

Video Tutorials: [https://www.youtube.com/watch?v=lucNT3kGjKY&list=PLvGeDdLVzd1kVAEtLsL6sb0bQyUOH0PpC](Course%20File%20Et.docx)

Theory concepts: <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2430>

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

1. Binary vapor cycle & cogeneration power plant

Video Tutorials: <https://www.youtube.com/watch?v=PWqyKT8TOQA>

Theory concepts: [https://www.learnthermo.com/T1-tutorial/ch09/lesson-C/pg10.php](Course%20File%20Et.docx)

Sample Quiz: [https://www.mechanicaltutorial.com/thermodynamics-objective-type-questions-and-answers](Course%20File%20Et.docx)

Previous Year Question Papers:

