

## APPLY THERMODYNAMICS PRINCIPLES

**UNIT CODE: ENG/OS/MC/CC/06/6/A**

### Unit description

This unit describes the competencies required by a mechatronic technician in order to apply thermodynamics principles in their work. It includes understanding fundamentals of thermodynamics, performing steady flow processes, performing non steady flow processes, understanding perfect gases, generating steam, performing thermodynamics reversibility and entropy, understanding idea gas cycle, demonstrating fuel and combustion, perform heat transfer, understanding heat exchangers, understanding air compressors, understanding gas turbines and understanding of impulse steam turbines

### ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function.	These are assessable statements which specify the required level of performance for each of the elements. <b><i>Bold and italicized terms are elaborated in the Range.</i></b>
1. Understand fundamentals of thermodynamics	1.1 Terms used in thermodynamics are described according to prescribed guidelines 1.2 Thermodynamics processes and cycles are described according to prescribed guidelines 1.3 First law of thermodynamics is applied in accordance to prescribed guidelines
2. Perform compressed air cycles	2.1 Operation principles of air compressors are studied according to manufacture specification 2.2 <b><i>Types of air compressors</i></b> are identified according to manufacturer's specifications 2.3 Work inputs, compressor clearances and varying outputs are calculated according to compressor types 2.4 Multi-staging and intercooling of air compressors is performed according to manufacturer's specifications 2.5 compressed air engines are studied according to manufacturer specifications
3. Understand steam cycles	3.1 Rankine cycle is studied according to thermodynamics principles 3.2 Reheat cycle is studied according to thermodynamics principles 3.3 Steam generation is performed according to user specification 3.4 Steam cycle efficiencies are determined according to

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	thermodynamic principles
4. Understand steam engines	4.1 Reciprocating engine principles are studied according to manufacturer specifications 4.2 Valves and timing methods are studied according to user specifications 4.3 Power calculations are performed according to thermodynamic principles 4.4 Ideal thermal and mechanical efficiency are calculated according to thermodynamic principles 4.5 Indicated and brake power are determined according to thermodynamic principles
5. Understand steam turbines	5.1 Reaction, impulse and staging is performed according to manufacture specifications 5.2 Velocity calculations are performed according to manufacturer specifications 5.3 Turbine design considerations are determined according to user specification 5.4 Ideal, thermal and mechanical efficiencies are calculated according to thermodynamic principles 5.5 Condensing arrangements are performed according to user specifications
6. Perform refrigeration	6.1 Reversed Carnot cycle is studied according to thermodynamics principles 6.2 Cycle analysis is performed according to thermodynamic principles 6.3 Heat pumps are studied according to manufacturer specifications 6.4 Absorption refrigeration systems are studied according to manufacturers specifications 6.5 Steam jet refrigeration systems are studied according manufacturer specifications

## RANGE

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

Variable	Range
Types of air compressors may include but is not limited to:	<ul style="list-style-type: none"><li>• Reciprocating</li><li>• Rotary</li><li>• Piston</li></ul>

## REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

### Required Skills

The individual needs to demonstrate the following skills:

- Apply basic mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools

### Required knowledge

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations
- Gas laws
- SI units of mechanical energy.
- Power transmission systems
- Parameters of fluid system

- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

### EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

<p>1 Critical aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Identified Principles of mechanical science  1.2 Performed mechanical calculations of a system  1.3 Identified types of forces on a system  1.4 Calculated resultant forces on plane framework  1.5 Identified application of forces on the production flow  1.6 Tested mechanical properties of a materials  1.7 Identified tools and equipment for measuring system parameters  1.8 Recorded and interpreted measured parameters.  1.9 Operated Power transmission systems</p>
<p>6. Resource Implications</p>	<p>The following resources should be provided:</p> <p>6.1 Access to relevant workplace or appropriately simulated environment where assessment can take place  6.2 Measuring tools and equipment  6.3 Sample materials to be tested</p>
<p>7. Methods of Assessment</p>	<p>Competency in this unit may be assessed through:</p> <p>7.1 Direct Observation  7.2 Demonstration with Oral Questioning  7.3 Case studies  7.4 Written tests</p>
<p>Context of Assessment</p>	<p>Competency may be assessed individually in the actual workplace or through accredited institution</p>
<p>Guidance information for assessment</p>	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>