College of Micronesia – FSM
P.O. Box 159
Kolonia, Pohnpei

Course Outline Cover Page

Heat and Heat Engines I — Course Title
ME 222 — Department and Number

Course Description: This course provides the student with the knowledge and skills required to explain elementary thermodynamic concepts, solve simple thermodynamic problems and identify the thermodynamic principles upon which a vessel's engine operates.

Prepared by: Brent Villiers **State:** FSM-FMI

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	3/6/12/24	16/8/4/2	48	3
Laboratory	3/6/12/24	16/8/4/2	48	1
		Total Semester Credits:		4

Purpose of Course

Degree Requirement	_____XX_____
Degree Elective	_____
Advanced Certificate	_____
Certificate	_____
Remedial	_____
Other (Workshop)	_____

Prerequisite Course(s): ME 179 Practical Mathematics

_____ _____
Signature, Chairman, Curriculum Committee **Date Approved by Committee**

_____ _____
Signature, President, COM-FSM **Date Approved by the President**

General Objective: By successfully completing this course, students will have been provided with the skills required to explain elementary thermodynamic concepts, solve simple thermodynamic problems and identify the thermodynamic principles upon which a vessel's engine operates.

Learning Outcomes: On successful completion of this course the student will be able to:

1. Identify basic units used in thermodynamics.
2. Define thermodynamic systems and processes, and identify their states and properties.
3. Solve perfect gas problems using standard equations.
4. Determine the effects of heat transfer.
5. Monitor the performance of internal combustion (IC) engines.
6. Manage and monitor the combustion process between fuel and air.
7. Monitor the performance of reciprocating air compressors.
8. Monitor the operation of refrigeration plants.

STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT ALL TIMES.

Outline of Content: This course contains:

1. Units
   - Standard units
   - Multiples and sub-multiples of units
2. Property and State
   - The thermodynamic system
   - Thermodynamic properties of a system
   - Pressure, volume, mass, and temperature
   - Internal energy
   - The state of a system
   - Heat, work, and internal energy
3. Gases
   - The perfect gas
   - Boyle's Law
   - Charles' Law
   - The equation of state for a perfect gas

4. Specific Heat
   - Specific heat capacity
   - Sensible and latent heat
   - Latent heat
   - Heat transfer
5. Internal Combustion Engines
   - Two and four stroke engine cycle
   - Compression and spark ignition
   - Performance measurement
   - Thermal efficiency and mechanical efficiency
   - Indicated and brake power
6. Combustion
   - Constituents of fuels and air
   - Products of combustion
   - Fuel and air ratio
   - Flash point of fuel
7. Air Compressors
   - Uses of compressed air
   - Compressed air cycle
8. Refrigeration
   - Principles of refrigeration
   - Simple refrigerant cycles

Learning Outcomes: On completion of this course the learner will be able to:

Learning Outcome 1 **Identify basic units used in thermodynamics.**

Assessment criteria

1.1 The importance and use of units are explained.
1.2 SI and basic units are identified
1.3 Multiples and sub-multiples of units are converted to and from basic units.

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:
- Written assessment
- Calculations
- Assignments
- Oral assessment

Learning Outcome 2 **Define thermodynamic systems and processes, and identify their states and properties.**

Assessment criteria

2.1 A thermodynamic system is identified.
2.2 Thermodynamic properties are explained

2.3 Absolute and gauge pressure, temperature, volume, mass, and their units are identified.

2.4 Internal energy and its units identified. The state of a system is identified.

2.5 The effect of work and heat on the internal energy of a system is explained.

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations
- Assignments
- Oral assessment

Learning Outcome 3 **Solve perfect gas problems using standard equations.**

Assessment criteria

3.1 The concept of a perfect gas is explained.

3.2 The relationships between the properties of a perfect gas, namely: Boyle's Law, Charles' law, and the equation of state are identified and simple problems solved

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations
- Assignments
- Oral assessment

Learning Outcome 4 **Determine the effects of heat transfer.**

Assessment criteria

4.1 The specific heat capacity is identified.

4.2 Sensible and latent heat, including its effect on water, are described.

4.3 The terms: conduction, radiation, and convection heat transfer are described.

4.4 The basic formula for heat transfer is identified.

4.5 Simple problems involving heat transfer are solved.

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations

- Assignments
- Oral assessment
- Practical assessment

Learning Outcome 5 **Monitor the performance of internal combustion (IC) engines.**

Assessment criteria

5.1 Using pressure/volume diagrams, the principles of operation of two and four stroke IC engines are explained.
5.2 The combustion process of compression ignition and spark ignition is identified, and related to practical engines.
5.3 Thermal efficiency is explained and simple calculations involving thermal efficiency for IC engines are solved.
5.4 The measurement and calculation of indicated power, brake power, and mechanical efficiency are explained.
5.5 Simple mechanical efficiency calculations for an IC engine are performed
5.6 Thermal and mechanical losses of an IC engine are identified.

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations
- Assignments
- Oral assessment
- Practical assessment

Learning Outcome 6 **Manage and monitor the combustion process between fuel and air.**

Assessment criteria

6.1 The constituents of fuel and air are identified.
6.2 The combustion process between fuel and air is outlined, the air/fuel ratio identified, and typical products of combustion for sufficient and insufficient air described.
6.3 Flashpoint and associated dangers are explained.

Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations

- Assignments
- Oral assessment
- Practical assessment

Learning Outcome 7	**Monitor the performance of reciprocating air compressors.**
Assessment criteria	7.1 The uses of compressed air on board ships are identified. 7.2 Using a pressure/volume diagram, the operating cycle of a single stage reciprocating air compressor is explained.
Conditions and Method of assessment	As specified in the Assessment Strategy listed at the end of this outline and by a combination of: • Written assessment • Calculations • Assignments • Oral assessment • Practical assessment
Learning Outcome 8	**Monitor the operation of refrigeration plants.**
Assessment criteria	8.1 The principles of refrigeration are explained. 8.2 The basic refrigeration cycle used in refrigeration systems is outlined.
Conditions and Method of assessment	As specified in the Assessment Strategy listed at the end of this outline and by a combination of: • Written assessment • Calculations • Assignments • Oral assessment • Practical assessment
Delivery strategy	The module provides for delivery by on and off-the-job training and assessment. Some areas of content may be common to more than one learning outcome, and therefore integration of training and assessment may be appropriate. Methods of instruction includes: 1. Classroom lectures with handouts, course notes, overhead transparencies (or equivalent),

slide presentations, video material, and whiteboard notes;
2. Tutorials;
3. Practical demonstrations;
4. Practical exercises; and
5. Laboratory work.

Resource requirements — Delivery of the training will require:

- Classroom
- Whiteboard
- Overhead projector (or equivalent)
- Video player
- Access to appropriate vessels or models.
- Appropriate models
- Appropriate testing equipment
- Appropriate tools and safety equipment

Assessment Strategy

Assessment Method — Knowledge based criteria will be satisfied through a combination of calculations, written and oral assessments.
Skill based criteria will be satisfied through practical exercises.

Condition of Assessment — This module may be assessed on and off the job. Competence may be assessed in the following situations: classroom; laboratories; and appropriate vessels.

Evaluation:

Final Grade for this course will be based on meeting the course requirements at the following percentage rates:

96% - 100%	A – Superior
90% - 95%	B – Above Average
80% - 89%	C – Average
69% - 79%	D – Below Average
0 % - 69%	F – Failure

Attendance:

The COM-FSM attendance policy will apply.