SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE, MARIE, ONTARIO

COURSE OUTLINE

Course Title: APPLIED THERMODYNAMICS

Code No -: MCH 206

Program: MECHANICAL TECHNOLOGY

Semester

Date: JUNE 1987

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New X Revision:

APPROVED: £7\ / LJCtJt^^^^ r ? • OB -/>

Chairperson /) Date

CALENDAR DESCRIPTION

APPLIED THERMODYNAMICS	MCH 206
Course Name	Course Number

PHILOSOPHY/GOALS:

This is the basic course in Thermodynamics necessary for the next two thermodynamics courses. It gives the student a grounding in all the laws, steam compressors and engine heats.

METHOD OF ASSESSMENT (GRADING METHOD);

See attached sheet.

TEXTBOOK(S):

Basic Engineering Thermodynamics in S.I. Units - Joel (Longmans)

Thermodynamics Tables in S.I. Units - Haywood - Cambridge University

REFERENCE TEXTS:

Engineering Thermodynamics

Work and Heat Transfer - Rogers and Mayhew - Longmans S.I. Units

Thermodynamic Cycles and Processes - Hoyle & Clarke - Longmans

MTY 4 - MCH 206

The_co_urse will cover chapters 1, 2, 3, 10, 13, 14 in Basic Thermodynamics bjfJoelT^N

You will be tested on chapters 1 and 3 two weeks after completion of these chapters.

You will be tested on chapters 14 and 2 two weeks after completion of these chapters.

You will be tested on chapters 13 and 10 at the end of the course.

The marking system will be A, B, C and I and tests will be graded on logical solutions, layout, sketches and tidiness.

It is expected that the student will be a regular, diligent and puctual attender in class.

APPLIED THERMODYNAMICS

MCH 206-5

TOPIC NUMBER	TOPIC DESCRIPTION
	INTRODUCTORY Concepts Work, Heat, Energy, Temperature Pressure Joules , EQUIVALENT Zeroth & First Laws
	Essential of heat engine, cycle, efficiency
	Work in cylinders, reversibility, indicators, measurement of shaft power, efficiency, engine testing
	Generation and properties of steam, use of steam tables, steam calorimetry
	Gas Laws Involving Thermodynamic processes Non-flow processes Steady flow open system
	Reciprocating air compressors and air motors
	Carnot eyele, reverslbi1ity, SECOND LAW & INTRODUCTION TO THE CONCEPT OF ENTROPY
	Combustion; air required for effective combustion

THERMODYNAMICS MCH - 206

Unit #1 - Introductory Concepts

GENERAL OBJECTIVE:

The student will acquire a sound fundamental knowledge of Work, Heat, Energy, Temperature, Pressure and the Thermodynamic Laws.

SPECIFIC OBJECTIVES:

1. To be able to define the term closed system.
2. To be able to define the term open system.
3. To be able to define the term boundary.
4. To be able to differentiate between positive and negative work
5. To be able to define the term internal energy.
6. To be able to state Zero's Law of Thermodynamics.
7. To be able to convert from degrees Centigrade to degrees Kelvin.
8. To be able to convert from degree Fahrenheit to degrees Rankine.
9. To be able to define the term conduction.
10. To be able to define the term convection.
11. To be able to define the term radiation.
12. To be able to state Joule's Equivalent.
13. To be able to define the term British Thermal Unit.
14. To be able to define the principle of Conservation of Energy.
15. To be able to state the First Law of Thermodynamics.
16. To be able to define the term Calorific Value.
17. To be able to define Power.
18. To be able to define Horsepower, kilowatt.
19. With the s to define Horsepower Hour, kilowatt hour.
20. 1, NO. 's 3 to tudent 4, 5 to will solve correctly the following problems: Chapt 6.

Unit #2 - Heat Engine, Cycles and Efficiency

GENERAL OBJECTIVE:

The student will have a fundamental knowledge of Heat engines, engine cycles and efficiencies.

SPECIFIC OBJECTIVES:

1. To be able to define the term Heat Engine.
2. To be able to define the term source.
3. To be able to define the term sink.
4. To be able to recall the Law of Conservation of Energy.
5. To be able to recall the First Law of Thermodynamics.

SPECIFIC OBJECTIVES (Cont'd):

6. To be able to construct a basic flow diagram of a heat engine.
7. To be able to define the term working agent.
8. To be able to construct a basic flow diagram for a heat pump and vapour compression refrigerator.
9. To be able to explain the operation of a reciprocating steam engine.
10. To be able to explain the operation of a steam turbine.
11. To be able to explain the operation of a four stroke cycle.
12. To be able to explain the oepration of a two stroke cycle.
13. To be able to explain the operation of a four stroke compression Greater eyele.
14. To be able to explain the operation of a turbo jet engine,
15. To be able to explain the operation of a ram jet engine.

Unit #3 - The Gas Laws

GENERAL OBJECTIVE:

The student will be able to solve varied problems dealing with the Laws of Compressible Gases.

SPECIFIC OBJECTIVES:

1 To be able to state Boyle's Law.
2 To be able to state Charles Law.
3 To be able to state the combined Boyle's.
4 To be able to state the characteristic Gas Equation.
5 To be able to state Gay-Lussac's Law.
6 To be able to state Dalton's Law of Partial Pressures
7 To be able to define the term mole of a gas.
8 To be able to calculate the molecular weight of a gas mixture,
9 To ng the above specific objectives the student will solve the
To lowing problems from the textbook: 12-4, 5, 6, 8, 9, 11, 12, 15.
10 Usibe able to recall the gas Laws from unit No. 3.
11 folbe able to derive the formula for the work done during the expansion
a gas according to the Law $PV = C$.
12 To be ale to develop the relationship between pressures, temperatures
To volume of a gas obeying the Law $PV^n = C$.
of
To
and

SPECIFIC OBJECTIVES (Cont'd);

13. To be able to define the term reversible process.
14. To be able to define the term irreversible process.
15. To be able to define the term Isothermal Expansion.
16. To be able to derive an expression for the work done during an Isothermal Expansion.
17. To be able to define the term Adiabatic Expansion.
18. To be able to derive an expression for the work done during an adiabatic expansion.
19. To be able to define the term Internal Energy.
20. To be able to state Joule's Law. - J.
21. To be able to define the Specific Heat (Cp) of a gas at constant pressure.
22. To be able to define the Specific Heat (Cv) of a gas at a constant volume.
23. To be able to develop the relationship Cp - Cv = R., where R is the gas constant.
24. With the aid of the above specific objectives the student will solve the following problems from the textbook: 3-1 to 3-29 inclusive.

Unit #6 - Measurement of Work, Power, Consumption and Efficiency

GENERAL OBJECTIVE:

The student will be able to solve problems dealing with work, power, consumption and efficiency.

SPECIFIC OBJECTIVES;

1. To be able to recall SO.4 Unit #1.
2. To be able to define mechanical work done by a fluid expanding in a cylinder.
3. To be able to construct (hypothetically) indicator diagrams.
4. To be able to explain the operation of engine indicators.
5. To be able to evaluate recorder indicator diagrams.
6. To be able to define swept volume.
7. To be able to define clearance volume.
8. To be able to define indicated horsepower.
9. To be able to calculate indicated horsepower for multi-cylinder engines of various cycles.
10. To be able to define brake power.
11. To be able to calculate brake power.
12. To be able to calculate friction power.
13. To be able to define indicated power hour (kwhr)
14. To be able to calculate fuel consumption per kwhr.
15. To be able to define thermal efficiency.
16. To be able to define mechanical efficiency.
17. With the aid of the above specific objectives the student will solve the following problems from the textbook: 13-1 to 13-18 inclusive.

Unit #5 - Properties of Steam

GENERAL OBJECTIVE:

The student will be able to deal correctly with various problems dealing with the properties and generation of steam.

SPECIFIC OBJECTIVES:

1. To be able to define the term vapour.
2. To be able to define the term saturation termperature.
3. To be able to define the term absolute pressure.
4. To be able to construct the pressure - temperature curve for steam.
5. To be able to define the term sensible heat.
6. To be able to define the term latent heat.
7. To be able to define the term evaporation.
8. To be able to define the term wet steam.
9. To be able to define the term dry steam.
10. To be ale to define the term super heated steam.
11. To be able to define the term enthalpy.
12. To be able to define the term flow work.
13. To be able to recall the term internal energy.
14. To be able to define the term dryness fraction.
15. To be able to recall the term specific heat.
16. To be able to obtain the dryness factor from the steam tables.
17. To be able to explain the operation of a combined separating and throttling calormeter.
18. To be able to obtain the dryness fraction using the combined separating and throttling calormeter.
19. With the above specific objectives the student will solve the following problems from the textbook: 2-1 to 2-18 inclusive.

Unit #7 - Air Compressors and Air Motors

GENERAL OBJECTIVE:

The student will be able to solve varied problems dealing with air compressors and motors.

SPECIFIC OBJECTIVES:

1. To be able to recall what indicator diagrams are.
2. To be able to construct a hypothetical compressor diagram.
3. To be able to derive an expression for the work done during a compression cycle.
4. To be able to define air horsepower.
5. To be able to calculate air horsepower.
6. To be able to define isothermal efficiency.
7. To be able to recall mechanical efficiency.
8. To be able to define overall isothermal efficiency.
9. To be able to recall swept volume.

SPECIFIC OBJECTIVES (Cont'd);

10. To be able to recall clearance volume.
11. To be able to define volumetric efficiency.
12. To be able to define compression ratio.
13. To be able to define multi-stage compression.
14. To be able to construct a hypothetical indicator diagram for a multi-stage compressor.
15. To be able to obtain an expression for the condition for minimum work during multi-stage compression.
16. To be able to obtain an expression for the work done per cycle for an air motor.
17. With the aid of the above specific objectives the student will solve the following problems from the textbook: 10-1 to 10-7 inclusive.

UNIT #4 - COMBUSTION

General Objective:

The student will solve varied problems dealing with the combustion of solid/ liquid and gaseous fuels.

Specific Objectives:

1. To be able to differentiate between element, compounds and mixtures.
2. To be able to define atomic weight and molecular weight.
3. To be able to write the combustion equations for C, H-r S, CO_f and the various hydrocarbons associated with Canadian natural gas.
4. To be able to state the gravimetric and volumetric composition of air.
5. To be able to define complete and incomplete combustion.
6. To be able to calculate the amount of air required for complete combustion with or without entrapped oxygen.
7. To be able to calculate the amount of constituent gases in boiler or furnace exhaust.
8. Using the above specific objectives, the student will solve the following problems from the textbook: 14-1 to 14-16 inclusive.