SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: INTRODUCTION TO THERMODYNAMICS

CODE NO.: MCH 130

PROGRAM: MECHANICAL TECHNOLOGY

SEMESTER: THREE

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APPROVED DATE QhC>^{C}i'0

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INTRO TO THERMO **MCH 130**

TOTAL CREDIT HOURS 3

Prerequisite None

I. PHILOSOPHY/GOALS

This course provides the student of MECHANICAL TECHNOLOGY the opportunity to examine and apply the fundamentals of THERMODYNAMICS to the solution of problems involving heat and heat transfer. The student will use and justify units in both systems and will become comfortable with the skill of dimensional analysis. Upon successful completion, the student will be prepared to move on to more advanced topics in thermodynamics.

II. STUDENT PERFORMANCE OBJECTIVES

Upon competion of this course the student will be able to :

1. Write and explain all the terms of the GENERAL ENERGY equation.
2. Use the three fundamantal units and the derived units.
3. Use dimensional analysis to verify the units of the solved quantities.
4. Understand the concepts and apply the principles of heat, temperature and Internal Energy to the solution of problems.
5. Understand the concepts and apply the principles involved in Energy Work and Power to the solution of problems.
6. Apply the principles of Calorimetry to the solution of heat balance problems.
7. Understand and apply the principles of changes of phase to the solution of heat balance problems.
8. Understand and apply the principles involved in Thermal Expansion of solids and liquids.
9. Understand and apply the principles involved in the expansion and compression of perfect gases.
10. Understand and apply the laws involved in the transfer of Heat by the three modes of heat transfer.
11. Understand the fundamental principles underlying HEAT ENGINES
12. Understand and be able to explain the workings of a basic refrigeration cycle

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III. TOPICS TO BE COVERED Approximate hours

1. Temperature and Heat	3
2. The Nature of Heat	5
3. Laws of Gases	7
4. Heat and Changes of State	12
5. Heat Transfer	10
6. Heat Engines	4
7. Refrigeration	4

IV. LEARNING ACTIVITIES

1.0 TEMPERATURE AND HEAT

Upon competion of this unit the student will be able to:

1.1 Write the terms of the General Energy EQuation in its steady flow form

1.2. Define Temperature, Internal Energy and Heat

1.3 Identify the different heat-related terms in the General Energy Equation

1.4 Compare the Fahrenheit and Celsius scales

1.5 Explain how liquid - glass thermometers are constructed

1.6 Differentiate between dial thermometers, Resistance thermometers, Thermocouples and Optical Pyrometers

REQUIRED RESOURCES - 1.0

Textbook Pages 314 to 321
Instructional film **on Heat** and **Temperature**

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Learning Activities con't

2.0 THE NATURE OF HEAT

Upon completion of this topic the student will be be able to:

2.1 Relate Temperature to Internal Energy and differentiate the meaning of heat from the previous

2.2 Explain Temperature in relation to the Kinetic Theory

2.3 Write the formulae for Linear, Area and Volume expansion of solids and liquids.

2.4 List some practical applications for the phenomenon of expansion,

2.5 Explain the peculiarities of the expansion of water

2.6 Solve problems Pages 339, 340 and 342
Group two 11, 12, 13, 15 17, 18, 19, 23, 26 ,27, 28,
Group three 33, 34, 35, 36, 37

REQUIRED RESOURCES 2.0

Textbook Pages 322 to 331

£ 4.0 HEAT AND THE CHANGE OF STATE

Upon the completion of this topic the student will be able to:

4.1 Define the quantities of heat known as the kilojoule, the kilocalorie and the Btu.

4.2 State the relationship between the various quantities of Heat

4.3 Define the term Heat of Combustion

4.4 Using the appropriate formula, perform calculations involving the heats of combustion.

4.5 Write the heat balance formula.

4.6 Define the term "specific heat"

4.7 Use the Heat balance formula to make calculations involving the specific heat of substances.

4.8 State the specific heat of water in S.I and Imperial systems.

^^ 4.9 Define the Heats of fusion and Vaporization for any substance

4.10 Draw the Temperature-Heat curve for water and label all sections

4.11 Perform calculations to solve mixing problems

4.12 Explain what happens to its volume as water freezes and thaws

4.13 Explain what happens when water boils.

4.14 Explain why Evaporation is a cooling process while Condensation is a warming process.

4.15 List factors which have an effect on the rate of evaporization

4.16 Draw and explain the TRIPLE POINT CURVE for water,.

4.17 Answer questions and solve problems on pages363 to 365
Questions 1 thru 17
Group one 1, 3, 5, 7, 9
Group **Two** 11, 13, 15, 17, 19, 21, **23, 25,** 27, 29.
Group Three 31, 33, 35, 37, 39

REQUIRED RESOURCES **4.0**

Textbook **Pages 342 to 365**

3.0 THE LAWS OF GASES

Upon completion of this topic the student will be able to:

3.1 Write and solve problems involving the laws of Boyle, Charles and Gay-Lussac .

3.2 Compare the Four temperature scales against each other using the temperatures of known common phenomenon.

3.3 Write and use the Ideal gas law in the solution of gas expansion problems.

3.4 Define a mole and relate it to Avogadro's number.

3.5 Write and use the equation of state for perfect gases.

3.6 Write and use the equation relating moles, molecular weight and mass.

3.7 Solve problems pages341, group three,32, 33, 34, 35, 36, and 37.

REQUIRED RESOURCES 3.0

Textbook Pages 331 to 338 with necessary review ofpages 291 to 305 which deals with properties of gases.

5.0 HEAT TRANSFER

Upon completion of this topic the student will be able to:

5.1 List and give examples of the three mechanisms of Heat Transfer

5.2 State the equation and list the units for Heat Transfer by Thermal Conductivity

5.3 State the difference between Q and **and** H -use units

5.4 Define "Thermal Resistance" in terms of material thickness and thermal Conductivity

5.5 Write the formula that relates the resistance of a composite to the resistances of the individual constituent materials.

5.6 State the relationship between the "overall heat transmission coefficient" and the " thermal resistance" of materials

5.7 Make a sketch of the Searles apparatus for measuring the heat conductivity of metals and other materials.

5.8 Differentiate between forced and natural convection

5.9 Write the formula for the rate of heat transferred by convection.

5.10 State the practical values for h and h for inside and outside common walls

5.11 State the Stephan-Boltzmann Radiation Law and define Emissivity

5.12 Answer questions and solve problems on pages 387 to 389
Questions 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16.
Group one 3, thru 10
Group two 11, 12, 13, 15, 18, 19, 20, 21, 23, 26 27.
Group three 30, 31, 32, 33, 35.

REQUIRED **RESOURCES 5.0**

Textbook pages 366 to 386
Experiment on Conductivity

6.0 THERMODYNAMICS - HEAT ENGINES

Upon completion of this topic the student will be able to:

6.1 State the meaning of Joule's constant

6.2 State that part of the General Energy equation that relates the conversion of work to heat

6.3 State the first law of the conservation of energy

6.4 State the first law of thermodynamics as it applies to heat engines

6.5 State the first law of thermodynamics as it includes changes in internal energy

6.6 State two expressions of the 2nd law of thermodynamics

6.7 Give an example of "entropy"

6.8 On a p-v diagram draw lines of
- a) constant volume
- b) constant pressure
- c) isothermal
- d) adiabatic

6.9 On a p-v diagram draw the processes that form the Carnot cycle and explain how the cycle works.

6.10 State the Ideal Carnot thermal efficiency in terms of temperatures of the reservoir and the sink.

6.11 Answer questions and solve problems on pages 417 to 419
Questions 6, 12, 16, 18,
Group one 1, 2, 3, 4, 7, 8, 9, 10, 11, 12.
Group two 15, 17, 23, 26, 29.

REQUIRED RESOURCES - 6.0

Textbook pages 390 to 416

7.0 REFRIGERATION

Upon completion of this topic the student will be able to:

7.1 Draw the thermodynamic symbol for both a Heat Engine and a Refrierator

7.2 Define "Refrigeration Ton "

7.3 Given a diagram representing the components of a mechanical refrigerator, explain how it works to remove heat from the hamburger in the freezer.

7.4 State the formula for the Coefficient of Performance (COP) of a Carnot Refrigerator

7.5 State the formula for the Energy Efficiency Ratio

7.6 Answer Questions and solve problems on pages 443 thru 445
Questions 1, 3, 5, 7, 9,
Group one 1,3,5.

REQUIRED RESOURCES 7.0

Textbook pages 420 to 430