YEAR IV

MEC 4102: Applied Thermodynamics

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	60	40	4

Rationale

This course introduces the basic concepts of combustion, heat transfer, steam and gas power plants and the relevant analysis of the various system components. Engineers are interested in studying systems and how they interact with their surroundings. To facilitate this, the subject of thermodynamics is extended to the study of systems through which matter flows. This course therefore prepares them for working on technologies in industries that involve

energy conversations and transfers. **Pre-requisites**

MEC1203, MEC3204

Objectives

- To develop their skills and knowledge in the following areas; thermodynamic systems (properties and processes); calculations of changes in a thermodynamic system and evaluation of applied thermodynamic systems

- Develop the skills of students to identify, formulate and solve the thermodynamic problems applied to industrial engineering in a logical and systematic way

Course Content

8. Combustion (8 Hours)

Ideal gas mixtures Reactant and product mixtures Chemical kinetics Flames

Burning of liquids Burning of solids Pollutant emissions

Steam plants (8 Hours)

Rankine Cycles

The Rankine Cycle with Superheat The enthalpy-entropy chart (h-s chart) The reheat cycle The regenerative cycle Plant Efficiency

Positive displacement machines (5 Hours)

Reciprocating Machines Reciprocating compressors including clearance Volumetric Efficiency Multi-stage compression The ideal intermediate pressure Two-stage machine with intercooler Rotary Machines

Gas turbines (6 Hours)

The practical gas turbine Modifications to the basic cycle Centrifugal and axial flow compressors

Internal combustion engines (5 Hours)

Four stroke cycle Two stroke cycle Criteria of performance Engine output and efficiency

- Performance characteristics
- Air-fuel ratio and volumetric efficiency
- Supercharging
- Engine emissions and legal requirements

13. Refrigeration (8 Hours)

- Vapor-compression refrigeration cycles
- Refrigerating Load
- The pressure-enthalpy diagram
- Multi-pressure systems
- Absorption refrigeration
- Properties of refrigerants

14. Pyschrometry (5 Hours)

- Psychrometric mixtures
- Specific humidity, percentage saturation, relative humidity
- Specific heat, specific enthalpy, and specific volume of moist air
- Air-conditioning

Learning Outcomes

At the end of the course, students should demonstrate the ability to;

- Perform power cycle analysis using various working fluids.
- Perform analysis of refrigeration and heat pump cycles using various working fluids.
- Apply psychrometrics to analyze heating, cooling and other air conditioning processes.
- Apply the laws to combustion to combustion processes.

- Solve problems related to internal combustion engines and positive displacement machines
- Formulate and solve problems involving systems having various forms of energy exchange and energy conversion.

Recommended Reference Books

- Eastop T.D, McConkey A, 1993. *Applied Thermodynamics for Engineering Technologies.* Longman Group UK Limited, 5 Editions, ISBN 0-582-09193-4.
- Nag P.K, 2002, *Basic and Applied Thermodynamics,* Tata McGraw-Hill, 1 Edition, ISBN: 0070473382
- Dossat R.J, Horan T.J, 2001, *Principles of Refrigeration,* Prentice Hall, 5 Editions, ISBN: 0130272701