2021-2022	Mechanical Engineering	Year 3 - Sem. 5
PHYS311	**Applied Thermodynamics in ME**	Mandatory
ECTS: **4**	*Coordinator:* Dr Elias SARRAF	*Language:* English/French
Total hours: **54 h**	*Lectures:* Dr Elias Sarraf, Dr Hanna Nakhoul, Dr Majed Morkos	

Description:

Throughout this course, the student is made aware of some fundamental aspects of thermodynamics. Properties of gas mixtures, air-vapor mixtures, and applications are considered. Vapor and gas power plant, and refrigeration systems are covered. Furthermore, thermodynamics of combustion processes and equilibrium are also studied. After completing this course, a student should be able to: Analyze vapor power cycles (Rankine cycle) in which the working fluid is vaporized and condensed (i.e., a steam power plant). Determine the efficiency of gas power cycles such as Otto, Diesel, and Brayton cycles (i.e., Spark-Ignition Engines, Diesel Engines, Gas Turbines). Evaluate the performance of refrigeration and heat pump cycles. Determining the properties of ideal gas mixture and vapor-gas mixtures which applied in psychrometric application. Estimate the heat release from reactant mixtures such as in combustion processes.

Learning outcomes:

- Apply modifications to ideal vapor cycles to improve efficiency various devices operations,
- Apply modifications to ideal gas cycles to improve efficiency of various devices operations,
- Apply modifications to ideal heat pump and refrigeration cycles to improve their performance,
- Calculate p-v-T data using equations of state and compare to those obtained from thermodynamic tables,
- Apply mass, energy, and entropy balances to systems involving non-reacting ideal gases,
- Apply psychrometry to water-air mixtures,
- Calculate the heat of combustion and equilibrium constants.

Content:

- Properties of the thermodynamics systems
- First and second law analysis
- Thermodynamics cycle of vapor power systems: Rankine cycle, sketching schematic and accompanying *T–s* diagrams, evaluating property data at principal states in the cycle, applying mass, energy, and entropy balances for the basic processes, determining power cycle performance, thermal efficiency, net power output, and mass flow rates, describe the effects of varying key parameters on Rankine cycle performance.
- Thermodynamics cycle of gas power systems: Internal combustion engine (Otto cycle, Diesel cycle, Dual cycle), Brayton cycle (Evaluating principal work and heat transfer, Regenerative gas turbine with reheat and intercooling, combined gas turbine-vapor power cycle)
- Thermodynamics cycle of refrigeration and heat Pump systems: Carnot refrigeration cycle, Analyzing vapor compression refrigeration systems, cascade cycle, absorption refrigeration.
- Ideal gas mixtures and psychometrics applications: Describing mixture composition, relating p,V and T for ideal gas mixture, evaluation U, H, S and specific heats, Moist air, Humidity ratio, relative humidity, mixture enthalpy, and entropy, wet and dry bulb temperatures, psychrometric charts.
- Reacting mixtures and combustion.

References:

- M.J. Moran, H.N. Shapiro, D.D. Boettner, and M.B. Bailey, *Moran's Principles of Engineering Thermodynamics,* SI Global Edition 9e, J. Wiley & Sons, 2018. ISBN 978-1-119-45406-9.
- Thermodynamics: An Engineering Approach, Yunus Çengel, Micheal Boles.
- Fundamentals of Thermal-Fluid Sciences, Yunus Çengel, Robert Turner.

Evaluation Method:

Assessment in the following areas will be converted to points, to compute your final grade in this course:

- Mid-Term

- Final Exam

Description :

Tout au long de ce cours, l'étudiant est sensibilisé à certains aspects fondamentaux de la thermodynamique. Les propriétés des mélanges gazeux, des mélanges air-vapeur et les applications sont prises en compte. Les centrales électriques à vapeur et à gaz et les systèmes de réfrigération sont couverts. En outre, la thermodynamique des processus de combustion et l'équilibre sont également étudiées. A l'issue de ce cours, l'étudiant doit être capable : d'analyser les cycles de vapeur (cycle de Rankine) dans lesquels le fluide est vaporisé et condensé (c'est-à-dire une centrale à vapeur). De déterminer l'efficacité des cycles d'alimentation à gaz tels que les cycles Otto, Diesel et Brayton (c'est-à-dire les moteurs à allumage commandé, les moteurs diesel, les turbines à gaz). D'évaluer les performances des cycles de réfrigération et de pompe à chaleur. De déterminer les propriétés du mélange des gaz parfait et des mélanges vapeur-gaz qui s'appliquaient à l'application psychrométrique. D'estimer la chaleur dégagée par les mélanges de réactifs, par exemple dans les processus de combustion.