ALTERNATIVE APPROACH TO TEACH GAS TURBINE BASED POWER CYCLES[1]

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This essay presents the new approach in teaching Thermodynamics in general and gas turbine cycles in particular to undergraduate and graduate mechanical engineering students through the integration of a simulation and modeling software.

When the author started to teach Thermodynamics, he realized that the teaching methods for thermodynamics have not changed much since he took the course himself about 25 years ago. So he started to look for other resources and teaching methods. He reviewed and evaluated 25 thermodynamics textbooks covering 1963 - 2018 [1-25]. Great majority of them are using the same teaching approach. Only two of them are taking advantages of computational tools [9, 11].

Three relatively new techniques in teaching engineering courses are as follows:

CONCEPTUAL-BASED LEARNING VS. CALCULATION-BASED LEARNING

The responsibilities of engineers are usually designing systems. In majority of cases, the design process involves some sort of calculations. That is why traditionally engineering education heavily emphasized the calculation techniques. Until 90s this approach was reasonable and perfectly fitted the requirements of industry. But in the past couple of decades, the applications of computational tools have made a major shift in the expectations from professional engineers. Engineers no longer do complicated calculation manually. They just need to design configuration of systems, identify and input data to software, and more importantly analysis and validate the results. This process requires conceptual understanding of topics, skills in using the software, and analysing the results.

For example, when teaching steam cycles, students do not need to be taught how to do the calculation for open and closed feed-water heater, reheater, superheater, economizer, etc. They only need to learn simple steam cycle calculation and how each of these components affects the performance of the cycle. Then, they need to know how to develop the models to simulate these cycles and evaluate the effects of various parameters.

SYSTEM LEVEL VS. PROCESS LEVEL LEARNING

Traditionally teaching thermodynamics starts with the definition of terminology followed by how to find thermodynamics properties e.g. property tables, ideal gas property calculations, and property relation for fluid and solid. Then, the concept of heat and work are introduced followed by conservation laws, including the conservation of mass and the first and second laws of thermodynamics. These laws are all presented for processes rather than systems. When the foundation of thermodynamics laid out, these fundamentals are applied in the system level to teach thermodynamics cycles. In the system level learning, these concepts are presented in the reverse order.

TRADITIONAL TEACHING VS. PROBLEM/PROJECT-BASED TEACHING

In traditional teaching, first a concept is presented and then examples, problems, and projects based on the presented topics are discussed. In the problem/project-based teaching, first a problem/project is introduced and then the skills needed to solve the problem are developed.

INTEGRATION OF PROCESS MODELING SOFTWARE TO APPLIED THERMODYNAMICS

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The combination of three aforementioned methods, namely conceptual learning, system level learning, and problem/project-based teaching has led the teaching approach presented in the teaching activities document. A commercial process modeling software is utilized to deepen student understanding of the gas turbine-based cycles and evaluation of effects of various parameters on the cycle performance.

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