

Course MEP 480: Design Project, offered during academic year 2010/2011
(equivalent to 3 cr.hrs for each term, total grades =150 pts.)

The course is for the 4th year of undergraduate students at Mech. Power Eng. Department

Project title: Investigation and Verification of Automatic Control Virtual Labs

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Introduction:

What are Virtual Control Labs for Mechanical Power Systems?

Modern Applications for PCs and ITs have produced new types of Virtual Lab Programs work on PCs and simulate to a great extent real Automatic control Systems. These Virtual Labs consist of and display many essential control-boards and instrumentation-panels which are identical and also do the same functions as many industrial automatic control systems existing in practical mechanical power systems. These interactive Virtual Labs include also flow visualization of various fluids moving in the system under investigation. These labs are specially designed to give the user a broad based understanding of the most important concepts of practical automatic control and real thermo-fluid processes existing in industrial mechanical power systems such as the operation and control of electric power generation Steam-plant or operation and control of refrigeration and freezing plant or solar heating system...etc.

The objective of Virtual control labs is to show the engineer all types of input and output signals and the control procedures used in many complicated automatic control systems. For this reason, the simulations include many critical control alarms, temperature and pressure read-out meters, flow control valves, operation and instrumentation parameter-boards, diagnostic tools, error-report filling, and help/trouble-shooting menus. Further more the Virtual Labs perform many types of Thermal or Heat Balance Calculations and Plotting charts to get some required/important output values such as the thermal efficiency of the plant or the H-Q curve for a pump or the C.O.P of a refrigeration system.

Objectives of this design project:

- 1- Identifying the main concepts of industrial automatic control systems in many mechanical power applications by modern computer-based programs which simulate those practical control systems.
- 2- Investigation of many Applications Automatic Control Virtual Labs to understand their functions, how they work and what are their input & output signals ...etc (there are more than 16 virtual labs in ACC).
- 3- Verification of the accuracy and validity of the results obtained by those virtual labs through performing engineering and scientific calibrations for those virtual labs. The calibration is done by comparing internal calculations done by those virtual labs with external engineering calculations using thermo-dynamic, conservation equations, and thermo-fluid relations to get the same output results.
- 4- Training students and engineers on Technical Report Writing and Presentation Skills for each Lab.
- 5- Enhancing the skills of Searching for information and adopting self learning capabilities related to Automatic systems and modern computer technologies.

Names of **Automatic Control Processes** for Virtual Lab Experiments:

- VirtLab-1: Interactive Automatic Control System for an Industrial Water-tube Steam Boiler.
- VirtLab-2: Interactive Automatic Control System for an Industrial Steam-Turbine and Rankine Cycle Power Generation Plant.
- VirtLab-3: Interactive Automatic Control System for an Industrial Refrigeration & Freezing Plant.
- VirtLab-4: Interactive Automatic Control System for an Industrial Air-conditioning plant
- VirtLab-5: Interactive Automatic Control System for an Industrial thermal plant with heat pump.

- VirtLab-6: Interactive Virtual Simulation of 4 or 2 stroke Spark Ignition Otto Cycle engines.
- VirtLab-7: Interactive Virtual Simulation of 4/2 stroke Compression Ignition Diesel cycle engines.
- VirtLab-8: Interactive Automatic Control System for an Industrial 6-cylinder, turbo-charger, 4-stroke Diesel engine drive with thermal balance calculations.
- VirtLab-9: Interactive Automatic Control System for an Industrial 6-cylinder, turbo-charger, Diesel engine with a hydraulic brake unit.
- VirtLab-10A: Interactive Automatic Control System for an Industrial pumping plant with two Parallel or Series Centrifugal Pumps.
- VirtLab-10B: Interactive Automatic Control System for filling different vertical tanks with liquids.
- VirtLab-11: Interactive Virtual Simulation and Animated sections for 16-different components of Industrial Hydraulic control Circuits.
- VirtLab-12: Interactive Virtual Simulation for an Industrial Hydraulic automatic control Circuit with 16-different components.
- VirtLab-13: Interactive Virtual Simulation of 4-different Industrial Pneumatic automatic control circuits.
- VirtLab-14: Interactive Automatic Control System for an Industrial Solar Heating Plant with 2-Flat Plate collectors and auxiliary boiler.
- VirtLab-15: Interactive Automatic Control System for a civil heating plant for hot water distribution.