Cairo University
Faculty of Engineering
Mech. Power Department

ACC Virtual Labs
Automatic Control Circuits & Virtual Labs for Mechanical Power Systems

دبلوم تطبيقات التحكم الأوتوماتيكى فى نظم القوى الميكانيكية

MEP 563 Using Virtual Lab Applications in Automatic Control Systems

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مكق 563 إستخدام المعامل الإفتراضية فى دراسة وتحليل نظم التحكم الأوتوماتيكى لهندسة القوى الميكانيكية:

محتوى وأهداف المقررILOs: تعريف ماهية المعامل الإفتراضية وعلاقتها مع تطبيقات الحاسب الآلى وتكنولوجيا المعلومات- تحديد وظيفة وعلاقة المعامل الإفتراضية مع نظم التحكم الأوتوماتيكى فى هندسة القوى الميكانيكية- تحديد متطلبات التحكم التفاعلى المباشر-on line interactive control– تعريف المكونات الرئيسية النمطية والشكل العام لمعامل التحكم الإفتراضى- توضيح قوائم الإختيارات الرئيسية للبرنامج- وضع عناصرالتحكم الأساسية وإظهار مسارات التدفق على المخطط والرسم الوصفى لنظام القوى الميكانيكية (Synoptic diagram)- تحديدعناصرلوحات التحكم الرئيسية ولوحات الأجهزة والحساسات- توضيح مفاتيح التشغيل والتحكم ولمبات الإنذار- بيان كيفية تغيير شروط وعوامل التشغيل – تحديد طرق تحليل الأعطال ومشاكل النظام – توضيح طرق تسجيل البيانات وحفظ الملفات وطباعة تقاريرالتشخيص وقائمة أخطاء المشغل- توضيح الحسابات التفصيلية لقوانين الديناميكا الحرارية وميكانيكا الموائع وانتقال الحرارة – إظهارنتائج وخرائط الإتزان الحرارى والقدرة والكفاءة للنظام- تقييم ومعايرة برامج المعامل الإفتراضية. دراسة حالة وتطبيق عملى على تشغيل وإدارة نظم التحكم الأوتوماتيكى لغلاية صناعية لإنتاج البخار مع قياس وتحديد كفاءة التشغيل وخريطة الإتزان الحرارى للغلاية عند ظروف التشغيل المختلفة.

Contents: **Definition of Virtual Labs(V.L.), Relation with PC and IT applications – Function of V. L. in Automatic Control Systems of Mechanical Power Engineering- Requirements of on line interactive Control- Systematic Basic Components and general format for Automatic Control V.L.- Main Menus of V.L. program-Setting Basic Control Elements- Showing Flow directions on Synoptic diagram- Elements of Main Control Board- Sensors and Gauges Board- Operation, Control and Alarms Board- Changing Operation Parameters- Diagnostics and Trouble Shooting- Data Recording-File Saving-Operator Reports- Charts of Heat Balance and System thermal Results- Evaluation and Calibration of V.L. Program- Case Study: Management and Operation of Automatic Control System of Industrial Steam Boiler- The simulation includes many critical control alarms, input/output signals, operation and instrumentation parameter-boards, diagnostic tools, error-report filling, help/trouble-shooting menus and Thermal Balance Calculations and Plotting tools.**

Software:

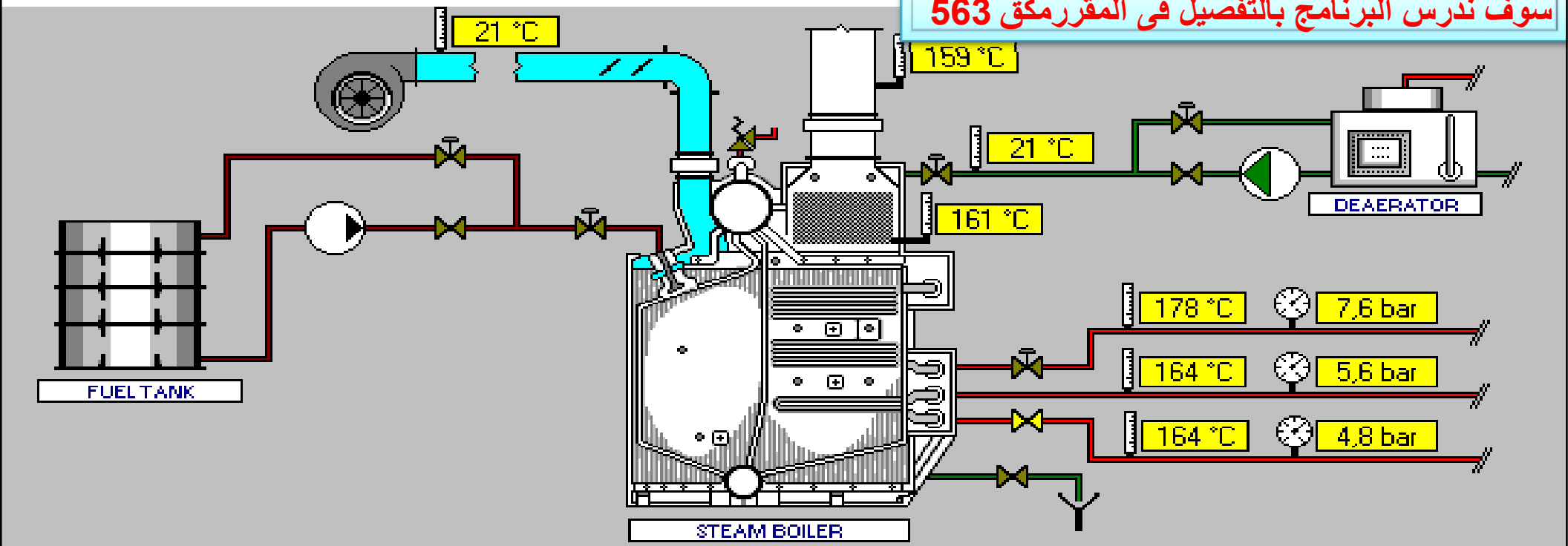
Modeling/Programming, Ladder diagram in PLC, data acquisition/process. MATlab, Fuzzy logic, Virtual lab Simulations

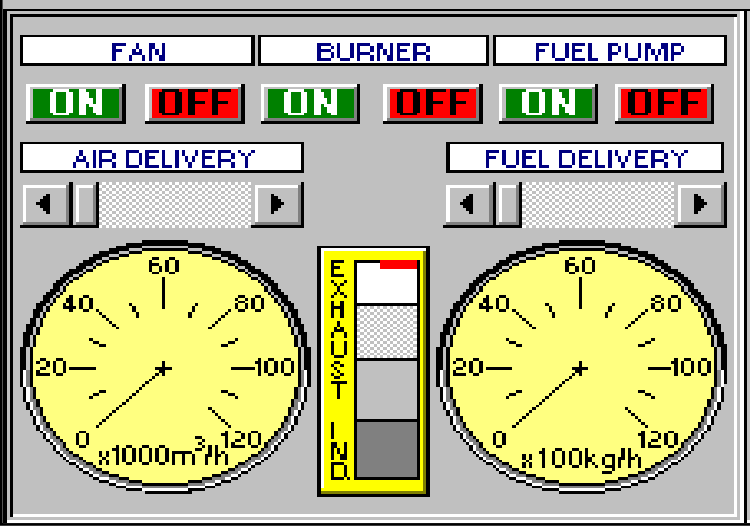
computer applications related to aut.control

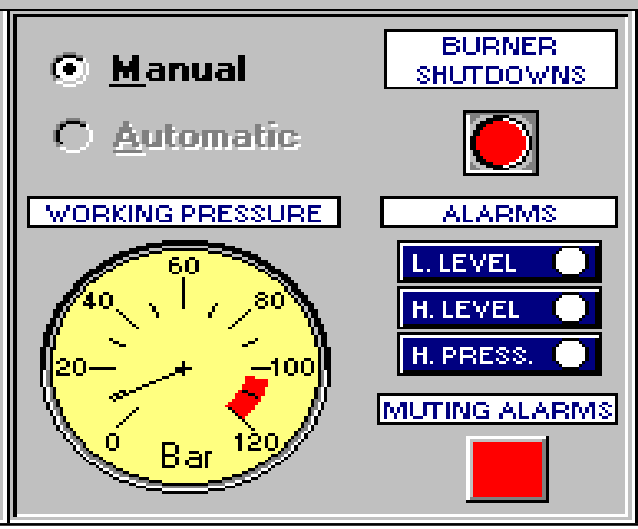
Hardware/instruments

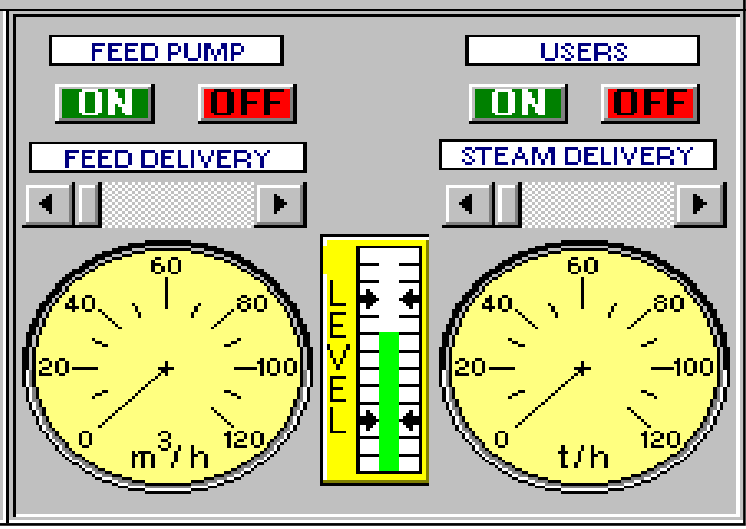
دراسةحالةوتطبيق عملى لتشغيل وإدارةنظم التحكم الأوتوماتيكى لغلايةصناعية لإنتاج البخار مع قياس وتحديدكفاءةالتشغيل وخريطةالإتزان الحرارى للغلاية عند ظروف التشغيل المختلفة

سوف ندرس البرنامج بالتفصيل فى المقررمكق 563









Course Specifications & Basic Information

1. Title:	Using Virtual Lab Applications in Automatic Control Systems			Code:MEP563
2.Credit hrs per week	Lectures= 3 hours per week	Tutorial= 0.0	Practical= 0.0	Total=3 Cr.Hrs

B- Professional Information

1. Course description: Overall Aims:

This is a mandatory course as one of the 6 mandatory core courses of the Diploma. It is designed to show the basic concepts and essentials of using Virtual Labs for study and analysis of automatic control systems. The course uses the Virtual Lab method by a practical on-line interactive PC program. This control Virtual Lab is not an E-self-learning type software but it is an advanced and applied control virtual lab. It represents a practical case-study for the operation and control of "An Industrial Water Tube Boiler". This Virtual Lab program along with the distributed course notes, sheets and reports provide a typical example for modern application for E-learning education techniques for studying and analyzing various aspects related to applications of automatic control of mechanical power systems.

Course overall aims is to introduce and study various types of mass, heat and energy transfer processes involved in operation and control of an industrial water tube boiler. Those aims are achieved by using advanced & applied control virtual lab method. One of the course objectives is to train students on how to search on the net for specific technical information about various sensors & subsystems used in boiler control. Another objective is to learn how to do "calibration" for an engineering virtual lab program. Last objective is to teach students the skills of technical report writing and presentation of scientific and engineering data.

2. Intended Learning Outcomes of Course (ILOs):

a) Knowledge and Understanding:

Having successfully completed this course, the post-graduate student should have knowledge and understanding of:

-Basics & various definitions & terminologies associated with Virtual Lab teaching techniques.

-Requirements of a general interactive virtual lab program to study and analyze control systems.

-Basics of on-line interactive virtual lab to study and analyze various types of mass, heat and energy transfer equipments and energy efficiency processes involved in safe-operation and accurate and stable control of an industrial water tube boiler.

-Basics and essential/various components and physical parts of various types of Fire-Tube Boilers and Water-Tube Boilers.

-Various types of automatic control subsystems & sensors required for safe-operation of boilers.

-Management methods of Water-tube Boiler control parameters, synoptic diagram, flow paths, instrumentation, control Boards, operation buttons, alarm signals, system diagnostics, and diagnostic page of various output data.

-Analysis of heat balance diagram/chart for various heat transfer processes in water tube boiler components.

Presentation of the different heat transfer processes in water tube boiler on H-S chart of steam.

-Concepts of verification and calibration of automatic control virtual lab programs.

-b) Intellectual Skills:

Having successfully completed this course, the student should have the ability to do:

-Select and apply appropriate technical and optimum method in doing engineering design and analysis of auto. control problems.

-Searching for scientific information and adopting automatic control self-E-learning capabilities.

-Analyze and compare the component effects, performance, and efficiency of different types of automatic control subsystems in an industrial practical virtual lab.

-Verify accuracy & validity of a virtual lab program by doing parallel engineering calculations.

-Apply mass, thermodynamic & energy balance analysis for case study of Water-Tube Boiler.

-Apply the concept of software simulation of diagnostics & operation of Water-Tube Boiler system.

-Compare between practical measurement devices, transducers & methods for signal conditioning, data acquisition and different output displaying/processing systems of Water-Tube Boiler.

- Solve numerical examples on mass, heat balance and efficiency for Water-Tube Boiler system.

c) Professional and Practical Skills:

Having successfully completed this course, the student should have the ability to do

-Identify several types of sensors and automatic control subsystems which are essential for the safe and stable operation of various energy transfer processes of Water-Tube Boiler system.

-Suggest possible alternative sensors and automatic control subsystems of Water-Tube Boiler.

-Diagnose all possible operation modes, thermodynamic properties/conditions, heat balance and thermal efficiency of various parts and components of Water-Tube Boiler system.

- Use, apply & calibrate an on-line interactive automatic control Virt.Lab for Water-Tube Boiler.

- Diagnose failure and automatic control problems of industrial Water-Tube Boiler.

- Monitor & evaluate performance of different parts and components Water-Tube Boiler system. - Formulate and analyze heat transfer and flow problems related to Water-Tube Boiler system.

d) General and Transferable Skills:

Having successfully completed this course, the student should have the ability to do:

-Perform engineering calculations, draw feed-back control circuits, block diagrams, graphical presentation of experimental data, and perform data-regression analysis.

-Transfer knowledge, Work in group, & Communicate in written & oral forms, in English.

- Use IT& evolutionary technological tools& PC applications (Excel, Mat lab, Virtual labs, .etc).

- Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.

- Identify practical problems, compare between different technologies for measurement systems.

-Organise & manage time & resources effectively; for short-term and longer-term commitments.