Course Specifications

Program on which this course is given:	**Diploma of Applications of Automatic Control of Mech. Power Systems**
Department offering the program:	**Mechanical Power Engineering Department - ACC control Lab**
Department offering the course:	**Mechanical Power Engineering Department - ACC control Lab**
Academic Level:	**Mandatory Course–2nd Term of the Diploma of Graduate Studies**
Date	**2nd Term 2014/2015**
Semester (based on final exam timing)	☐ Fall √ Spring

A- Basic Information

1. Title:	**Using Virtual Labs for Analysis of Automatic Control Systems**						**Code:**	**MEP 563**	
2. Units/Credit hrs per week:	**Lectures**	**3 Credit hours per week**	**Tutorial**	**--**	**Practical**	**--**	**Total**	**3**	

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 studyand 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 components and 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 automatic 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.
-Applytheconceptof softwaresimulation of diagnostics&operation of Water-Tube Boiler system.
-Comparebetweenpractical 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.
-Study, describe, and compare between different practical methods for measurement of pressure, temperature, flow rate, water-level,...etc 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 performanceofdifferent parts and components Water-Tube Boiler system.
- Formulate and analyze heat transfer and flow problems related to Water-Tube Boiler system.
-Performanalyseof manytypes of heat exchangers,thermal energy systems of Water-Tube Boiler.

d) General and Transferable Skills:

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

-Transfer knowledge, Work in group, and 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 Water-Tube Boiler.
-Organise & manage time & resources effectively; for short-term and longer-term commitments.

3. Contents

Topics:	Total hrs	Lectures hours	Tutorial/ Practical hrs
- 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 & System thermal Results- Evaluation and Calibration of V.L. Program- Case Study: Management and Operation of Automatic Control System of	**42 hrs**	**3hrs/week for 14 weeks before the final term exam**	**---**

Industrial Water Tube Boiler type- 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.			

4. Teaching and Learning Methods

Lectures (√)	Practical/ Training ( )	Seminar/ Workshop (√)	Class Activity (√)	Case Study (√)	Projects ( )	Laboratory ( )	E-learning (√)	Assignments /Homework (√)	Other: Submitting reports

5. Student Assessment Methods

Assessment Schedule	Week
-Assessment 1; Sheet # 1	Week # 2
-Assessment 2; Sheet # 2	Week # 4
-Assessment 3; Sheet # 3	Week # 6
-Assessment 4; Sheet # 4	Week # 8
-Assessment 5; Sheet # 5	Week # 10
-Assessment 6; Sheet # 6	Week # 12
-Assessment 7; Sheet # 7	Week # 13
-Assessment 8; Report # 8– General course Report	Week # 14

- **Weighting of Assessments**

-All in-term works, sheets and reports	30%
-Final-term formal, written Examination	70%
-Project	--
-Class Test	--
-Presentation	--
-Total	100%

6. List of References:

1- Several Class Notes and Special Reports prepared by Associate Professor Dr. Mohsen S. Soliman.

2- Virtual Lab program by "Interactive Industrial Training, Inc.", ***fluidpowerzone.com, a Newport vertical community 1987 north 1120 west Provo, UT 84604***

7. Facilities Required for Teaching and Learning: Data Show & Laptop Computer to run the Virtual Lab.

Course Coordinator:	**Associate Professor Dr. Mohsen S. Soliman**
Head of Department:	**Professor Ashraf S. Sabery**