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:	**Elective Course- 1st or 2nd Term of the Diploma of Graduate Studies**
Date	**1st Term 2014/2015**
Semester (based on final exam timing)	√ Fall ☐ Spring

A- Basic Information

1. Title:	**Applications of Virtual Labs for Control of HVAC-Central Air-Conditioning Systems**							**Code:**	**MEP 571**
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 an elective course as one of the 4 elective courses requirements of the Diploma. It is designed to review the essentials of HVAC processes as important applications of mechanical power systems. It is designed also to enhance the skills and give the participant a broad based understanding of the most important concepts of practical automatic control and real thermo-fluid processes of industrial HVAC plant used to air-condition a building to some pre-specified dry-bulb temperature and relative humidity. The course uses the Virtual Lab method by a practical on-line interactive PC program. This automatic control Virtual Lab is E-self-learning type software. The course includes a large number of practical examples and problems for HVAC systems and processes. This Virtual Lab program along with the course notes & sheets provide a typical example for modern self-e-learning education techniques for studying and analyzing various aspects related to applications of automatic control of HVAC systems.

Course overall aims is to review various definitions, basics, & conservation equations of different types of HVAC processes. To introduce, investigate, & verify/calibrate an interactive automatic control system for industrial HVAC plant. To provide interactive virtual lab practical training that includes simulation, flow visualization, flow control valves, temperature read-out gauges, control alarms, input/output signals, On/Off & operation instrumentation parameter-boards, diagnostic tools, error-report filling, help/trouble-shooting, thermal balance calculations and Plotting tools. To provide on-line, real psychometric diagram plotting to show all performed HVAC processes.

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 HVAC processes & control systems.
-Requirements of general interactive virtual lab program to study & analyze HVAC control systems.
-Basics of on-line interactive virtual lab to study and analyze HVAC control circuits/systems.
-Essential components of HVAC circuits as important application of mechanical power systems.
-Basics and main concepts of HVAC processes, functions and how to perform them, and what their inputs and outputs signals are?
-Governing conservation equations of the HVAC automatic control processes.
-Analysis of industrial HVAC automatic control systems by using modern PC-based Virtual lab program to simulate actual processes performed in real HVAC automatic control systems.
-Main requirements of on-line chart plotting module for real psychometric diagram plotting to show all performed HVAC processes.
-Structure, main components, various menus & submenus of HVAC automatic control Virtual lab.
-Control parameters, Synoptic diagram, flow paths, instrumentation & control boards of HVAC Virtual Lab.

	- Verification and engineering calibration of the outputs of a HVAC automatic control virtual lab program.
	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 HVAC systems.** **-Apply the concept of software simulation of diagnostics & operation of various types of practical HVAC systems.** **-Compare between various types of HVAC processes, components, and complete systems.** **-Select and apply appropriate HVAC processes, components to design, model, analyze, and solve automatic HVAC control problems.** **-Apply scientific and engineering analysis for HVAC circuits/systems.**
	c) Professional and Practical Skills: **Having successfully completed this course, the student should have the ability to do:** **-Identify several types of automatic HVAC control problems which are essential for design and operation of mechanical power systems and energy transfer processes.** **-Perform professional design and modelling for different automatic HVAC control systems.** **-Suggest possible alternative solutions for various types of HVAC components and parts.** **-Diagnose efficiency and performance of different types of HVAC control circuits/systems.** **- Analyze different types of HVAC processes on real psychometric diagram/plotting schematics.**
	d) General and Transferable Skills: **Having successfully completed this course, the student should have the ability to do:** **-Perform eng. assembly of different HVAC processes & components in one control system.** **-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 HVAC systems.** **-Organise & manage time & resources effectively; for short-term and longer-term commitments.**

3. Contents

Topics:	Total hrs	Lectures hours	Tutorial/ Practical hrs
-Introduction: Review of various definitions, basics, and conservation equations of different types of HVAC processes. **-HVAC case study: Investigation of interactive virtual lab & computer-based practical training that includes simulation and flow visualization. It provides the participants a broad-based understanding of the most important concepts of practical automatic control & real thermo-fluid processes existing in an industrial HVAC plant used to air-condition a building to some pre-specified dry-bulb temperature and relative humidity. Air-locks are used to have different adjustable ratios of recycled air brought back to the building mixed with some renewal air. The plant includes 4 centrifugal pumps for the 4 battery cells for heating, cooling, humidification, and after-heating. Each pump has its on/off control board. Each battery cell has a control board that includes a pump flow rate-meter and both inlet and outlet cell temperature (except the humidification cell). The plant has an on/off air fans or ventilators control board and air locks control board. On-line, real**	**42 hrs**	**3hrs/week for 14 weeks before the final term exam**	---

psychometric diagram is plotted showing all performed processes. The diagram shows a point for Renewal air, point for Recycled air taken from inside the environment, a point for the mixture of Renewal and Recycled air, points for the air outlet from the various A/C plant batteries, and last point for the air going to the environment-building. The simulation includes many flow control valves and temperature read-out gauges. , many critical control alarms, input/output signals, operation and instrumentation parameter-boards, diagnostic tools, error-report filling tool, help and trouble-shooting 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; Report # A –Review of Physhcometry	Week # 1
-Assessment 2; Report # B –Thermal Loads Calculation	Week # 2
-Assessment 3; Report # C –Selection of HVAC	Week # 4
-Assessment 4; Report # 1 –Case Study: Types of HVAC	Week # 6
-Assessment 5; Report # 2 –Case Study: Central AHUs	Week # 8
-Assessment 6; Report # 3 – Case Study: HVAC-Virtual Lab	Week # 10
-Assessment 7; Report # 4 – Case Study: AHU equipments & devices	Week # 12
-Assessment 8; Report # 5 – Case Study: AHU Instrumentation & sensors	Week # 13
-Assessment 9; – 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, presentations, &Special Reports prepared by Assoc. Professor Dr. Mohsen S. Soliman.
2-Virtual Lab program by "NEW-TRONIC S.r.l.–Via Thures", 36– 10142 TORINO (ITALY)- Tel.: 0039-4.68 – Fax: 411.09.39
3-Guy W. Gupton, Jr.,"HVAC Controls-Operation&Maintenance" 3rd ed., The Fairmont Press, Inc., 2002.

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

Course Coordinator:	**Associate Professor Dr. Mohsen S. Soliman & Assistance Professor Dr. Amro Abdel-Raouf**
Head of Department:	**Professor Ashraf S. Sabery**