
	SEE Sustainable Energy Engineering Program	Cairo University Faculty of Engineering Credit Hours System	
Course Specifications			
Program on which this course is given:	B. Sc. of Sustainable Energy Engineering (SEE)		
Department offering the program:	Credit Hours System, Faculty of Engineering, Cairo University		
Department offering the course:	Mechanical Power Engineering Dept - ACC Control Lab		
Academic Level:	400 Compulsory Course (Junior or Senior-1 or Senior-2)		
Semester (based on final exam timing)	1st Semester √ Fall 2023/2024		

A- Basic Information

1. Title:	Applied Control Technologies for Energy Systems			Code: MEPS 305
2. Credits: 3 (2+1+1)	Lectures=2 hours/wk	Tutorial=1 hr/wk	Practical=1 hr/wk	Total CHs =3
Prerequisites: MTHN003, MEPN224				

B- Professional Information

1. Course description:	<p>Part-1 (Control Theory): ملاحظة: يمكن تدريس هذا الجزء بعد الجزء 2- أو بالتبادل مع الجزء 2- حسب خطة الدراسة Power systems: Basic principles, system, modeling, design, simulation, analysis. Control systems- transfer function- closed loop- reduction, response, classical methods- transitional and steady state- stability- Bode diagram- frequency response.</p> <p>Overall Aims of Part-1: Part-1 is designed to show basic concepts & essentials of classical automatic control theory as it is applied on mech. power energy systems & heat and mass transfer processes. This part includes large numbers of practical examples and problems on various types of control systems to enhance student's professional skills in the field of modeling & analyzing real automatic control of energy systems. Overall aims are to define automatic control theory and associated terminology- introduce and study various types of control of energy Systems- mechanical components, pneumatic, hydraulic, electric systems- Mathematical Modeling of control systems- Laplace and inverse Laplace transformations- Element and System Transfer functions - Close and open loop systems - Instantaneous system response- system stability & equilibrium tests - Design of control systems - Bode Plots & Analysis of Frequency Response of Control systems- Practical applications of automatic control theory in different mechanical power and heat transfer and mass transfer processes and equipments.</p> <p>Part-2 (Hydraulic Control Circuits): Applications of Automatic control: Hydraulic control, Hydraulic pumps and motors- Control valves- Transmission components of power control- Pressure and flow valves- Applied ON/OFF Circuits.</p> <p>Overall Aims of Part-2: Part-2 is designed to show the basic concepts and essentials of Hydraulic Circuits as it is applied in automatic control of mechanical power and energy systems. This part uses the Virtual Lab method by a practical on-line interactive PC program. This control Virtual Lab is an E-self-learning type software. The software includes large number of examples for hydraulic parts and circuits, 3-D animations, e-learning labs, quizzes..etc. This Virtual Lab program along with the course notes & sheets provide a typical example for modern self-learning education techniques for studying and analyzing various aspects related to applications of ON/OFF Hydraulic Circuits in automatic control of mechanical power and energy systems. Part-2 overall aims are to introduce and study basic definitions of Hydrostatics (i.e., Pressure, work, transportation and magnification of force and moment). Hydraulic Power Transportation- Basic Components of Hydraulic Systems- Types of Positive Displacement Pumps (Gear, Vane, and piston pumps)- Types of Hydraulic Actuators (Cylinders, Engines, Semi-rotating Engines)- Pressure control Valves - Directional Control Valves- Flow Control Valves- Non-return Valves- Conditioning of Hydraulic Oils (filters, Heat Exchangers, Tanks)- Oil Piping - Auxiliaries (Accumulators, Manifolds, Flow Meters, Pressure Gauges, Switches)- Hydraulic Symbols - Reading Hydraulic Schematics- Applications for Basic Hydraulic Circuits (Direction & Speed Control, 2 cylinders Control, Pumps Curves, Step-displacement diagram, Numbering of Hydraulic Elements).</p>
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2. Learning Outcomes of Course (LOs):	Part-1 LO's: 1. Recognize and identify different types of automatic control systems and control loops. Also to understand basic concepts and definitions of classical control theory. 2. Apply mathematical modeling analysis of control systems & use block diagram presentation. Also use Laplace transforms technique to solve the Transfer Function of Control System. 3. Find instantaneous time-response of control systems & examine its graphical presentation. Also understand frequency response of control systems and investigate the Bode Diagram Plots.
	Part-2 LO's: 4. Recognize various applications of Virtual Lab Techniques to study control systems. Also apply educational Virtual Lab to understand basics & essentials of Hydraulic control systems. 5. Investigate various components, parts and accessories of Hydraulic Circuits. Also understand hydraulic symbols and schematics used for drawing hydraulic circuits. 6. Practice reading symbol-schematics of hydraulic circuits. Also perform function analysis to select proper parts for circuits with optimum performance.

3-a. Contents of Part-1: ملاحظة: يمكن تدريس الجزء-1 بعد نهاية الجزء-2 أو بالتبادل مع الجزء-2 حسب خطة الدراسة المعتمدة

ملاحظة هامة: يتم تدريس كافة محاضرات وتمارين الجزء الأول On-campus داخل مقر الكلية بالجيزة وذلك خلال أول ثمانية أسابيع من الترم (كل أسبوع محاضرة+سكشن حتى موعد إمتحان الميـد ترم الذى سيقـتصر على الجزء الأول فقط)

Topics of Part-1: أنظر ملف خطة الدراسة التفصيلية على موقع معمل التحكم + على جوجل كلاس روم	Total hrs	Lectures hours	Tutorial/ Practical hr
-Introduction to Basics, definitions & terminologies associated with automatic control theory. -Various types of automatic control loops in mech. power & energy transfer systems. -Essential requirements of accuracy, efficiency, safety, and stability of control systems -Concepts of mathematical modelling of various mechanical power systems and energy transfer processes -The element & whole system transfer functions & Block diagram analysis method. -Laplace Transform & inverse Laplace technique to solve the system's ordinary time-dependent differential equations. -Instantaneous dynamic response of control system and its graphical presentation on an output-time scale for various types of different input testing functions. -Main definitions and control characteristics of dynamic response of 1 st and 2 nd order automatic control systems. - The analogy between various types of mechanical control systems and electric control systems. Bode Plots & Analysis of Frequency Response of Control systems. -Practical applications of automatic control theory in different mechanical power and heat and mass transfer equipments.	28 hrs	2hrs/week for 7 weeks before The Mid-Term Exam	2hrs/week for 7 weeks before The Final Term Exam

3-b. Contents of Part-2 (Note that this is a Self-Study Virtual Lab Course)

ملاحظة: يمكن تدريس الجزء-2 بعد نهاية الجزء-1 أو بالتبادل مع الجزء-1 أسبوعياً حسب خطة الدراسة المعتمدة للطلاب

ملاحظة هامة: يتم تدريس محاضرات وتمارين الجزء الثاني داخل الكلية بواسطة النت (حسب الإعلان بذلك) وذلك من الأسبوع 9 حتى أسبوع 15 بعد إمتحان الترم (كل أسبوع محاضرة+سكشن حتى موعد إمتحان نهاية الترم الذى سيشمل كل من الجزء الأول +الجزء الثاني)

Topics of Part-2: أنظر ملف خطة الدراسة التفصيلية على موقع معمل التحكم + على جوجل كلاس روم	Total hrs	Lectures hours	Tutorial/ Practical hr
-Introduction, Basics and definitions of Hydrostatics (i.e., work, Pressure, transportation and magnification of force and moment)- -Hydrodynamics (Continuity, Bernoulli's eqn., Energy, types of fluid flow) -Methods of Power transportation -Basic components of Hydraulic Systems-Types of Positive Displacement Pumps (Gear, Vane, and piston pumps)- Types of Hydraulic Actuators (Cylinders, Engines, Semi-rotating Engines)-Pressure Valves-Directional Valves-Flow Valves-Non-return Valves - Conditioning of Hydraulic Oils (filters, Heat Exchangers, Tanks)- Oil Piping-Auxiliaries (Accumulators, Manifolds, Flow Meters, Pressure Gauges, Switches). -Hydraulic Symbols- Reading Hydraulic Schematics - Basic Hydraulic Circuits (Direction Control, Speed Control, 2-cylinders Control, Pumps Curves, Step-displacement diagram, Numbering of Hydraulic Elements). -Practical applications of automatic control Hydraulic systems/systems in different mechanical power and heat and mass transfer equipments.	28 hrs	2hrs/week for 7 weeks before The Final Term Exam	2hrs/week for 7 weeks before The Final Term Exam

4. Teaching and Learning Methods									
Lectures (√)	Practical/ Training (√)	Seminar/ Workshop ()	Class Activity (√)	Case Study (√)	Projects ()	Laboratory ()	E-learning Part-2 (√)	Assignments /Homework (√)	Other: Submitting reports
5. Student Assessment Methods									
Assessment Schedule for Part-1									Week
-Assessment 1; Part-1 Sheet-1– Introduction to control theory									Week # 1
-Assessment 2; Part-1 Sheet-2 – Mathematical modeling									Week # 2
-Assessment 3; Part-1 Sheet-3 –Block Diagram									Week # 3
-Assessment 4; Part-1 Sheet-4 – Laplace Transformations									Week # 4
-Assessment 5; Part-1 Sheet-5 – System Transfer Function									Week # 5
-Assessment 6; Part-1 Sheet-6 – System Analysis & Dynamic Response									Week # 6
-Assessment 7; Part-1 Sheet-7 – General Problems on Part-1									Week # 7
Assessment Schedule for Part-2									Week
-Assessment 1; Part-2 Sheet-1 Fluid Power Physics									Week # 9
-Assessment 2; Part-2 Sheet-2 – Pumps & Part-2 Sheet-3 Actuators									Week # 10
-Assessment 3; Part-2 Sheet-4–Pressure Control Valves& Part-2 Sheet-5 Directional Control Valves									Week # 11
-Assessment 4; Part-2 Sheet-6 Flow Control Valves & Part-2 Sheet-7 Fluid Conditioning									Week # 12
-Assessment 5; Part-2 Sheet-8 Check Valves & Part-2 Sheet-9 Accessory Components									Week # 13
-Assessment 6; Part-2 Sheet-10 Fluid Conductors & Part-2 Sheet-11 Understanding Schematics									Week # 14
-Assessment 7; Part-2 Sheet-12 Basic system Design & Part-2 Sheet-13 Review General Report for Part-2									Week # 15
<ul style="list-style-type: none"> Weighting of Assessments 									
-Mid-Term Exam (written & Open Book) on Part-1					20%				
-All in-term works, sheets and reports					40 %				
-Final-term formal written Examination(written & Open Book) on both Part-1 & Part-2					40 % (Open Book Exam Type)				
-Project					--				
-Class Test					--				
-Presentation					--				
-Total					100%				
6-a. List of References for Part-1:									
1- Several Class Notes, Self-Study Files, Reports and Materials prepared by Course Instructor.									
2- Katsuhiko Ogata, “Modern Control Engineering”, Prentice Hall & PEARSON, 2010.									
3-“Instrumentation and Control- Process Control Fundamentals”, www.pacontrol.com									
ملاحظة: يوجد عدد كبير من المادة العلمية والأفلام والمراجع للمقرر موجودة على موقع معمل التحكم acc-vlab.cu.edu.eg									
6-b. List of References for Part-2(Note that this is a Self-Study Virtual Lab Course):									
1- Several Class Notes, Reports, and Self-study Materials prepared by Course Instructor.									
2- E-Learning Software and Virtual Lab program by “Interactive Industrial Training, Inc.”, fluidpowerzone.com , a Newport vertical community 1987 north 1120 west Provo, UT 84604									
ملاحظة: يوجد عدد كبير من المادة العلمية والأفلام والمراجع للمقرر على جوجل كلاس روم وعلى موقع معمل التحكم acc-vlab.cu.edu.eg									
7. Facilities Required for Teaching and Learning: Data Show and Laptop Computer									
Course Coordinator:					Associate Professor Dr. Mohsen S. Soliman				
SEE Program Coordinators:					Professor Dr. Mohamed Ahmed Ali Yehia & Assistance Professor Dr. Ahmed Mahmoud Abouzid				