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Mech. Power Department



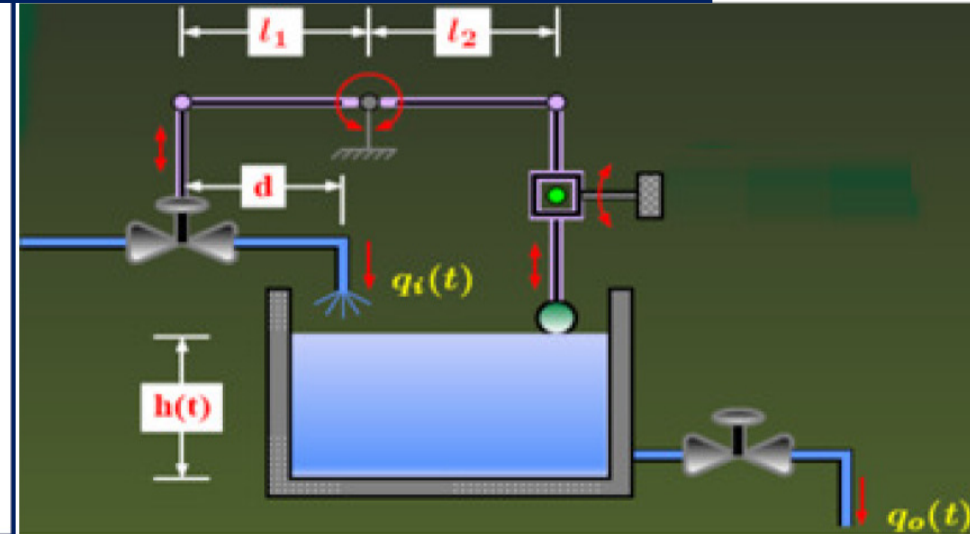
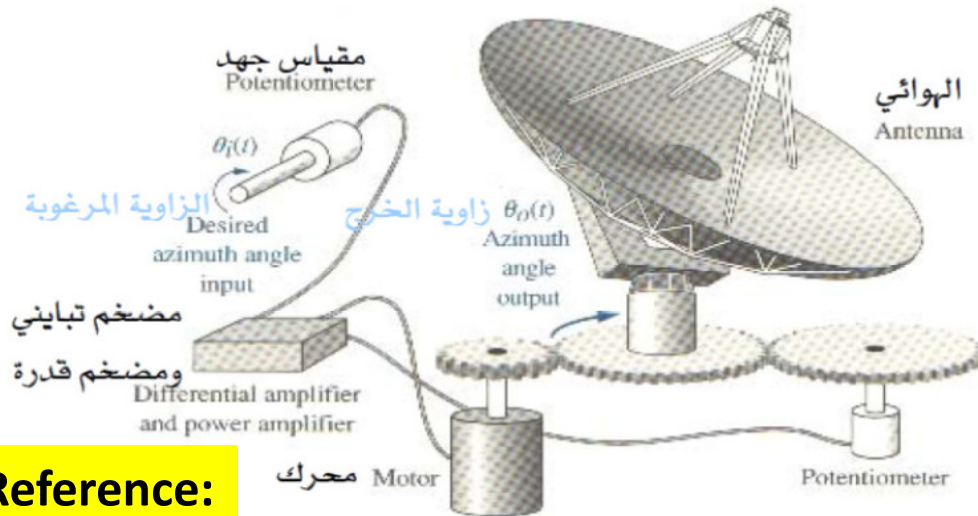
# دبلوم تطبيقات التحكم الأوتوماتيكي فى نظم القوى الميكانيكية

**MEP 561 Control Theory**

**Dr. Mohsen Soliman, ACC Manager**



أنظمة التحكم الأوتوماتيكي  
- النظرية والتطبيق -



**Reference:**

**MODERN  
CONTROL  
ENGINEERING**

Katsuhiko Ogata

FIFTH EDITION

Prentice Hall

Boston Columbus Indianapolis New York San Francisco Upper Saddle River  
Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montreal Toronto  
Delhi Mexico City Sao Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo  
10 9 8 7 6 5 4 3 2 1

Prentice Hall  
is an imprint of

PEARSON

www.pearsonhighered.com

ISBN 10: 0-13-615673-8

ISBN 13: 978-0-13-615673-4

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Library of Congress Cataloging-in-Publication Data on File

# MEP 561- Basics of Control Theory (and Examples of Process Control Applications)

اسم المقرر - مكق 561 التحكم الأوتوماتيكي - النظرية والتطبيق في نظم القوى الميكانيكية:

**محتوى وأهداف الجزء الأول:** وصف وتعريف أنواع نظم التحكم، تحديد المكونات الميكانيكية والهوائية والهيدروليكية والكهربائية، تحديد طرق النمذجة ودالة التحويل، وصف النظام ذو الحلقة المغلقة، تحديد الاستجابة الوقتية، وصف اختبار الاتزان والاستقرار.

**Contents of Part one:** Types of Control Systems – Mechanical components, pneumatic, hydraulic, electric systems – Modeling – Transfer function – Closed loop system – Instantaneous response – Stability and equilibrium tests – Design of control systems – Applications of control systems in turbo-machines, heat transfer equipments and in combustion systems.

**محتوى وأهداف الجزء الثاني (مكق 581 - إختياري - موضوعات مختارة وتطبيقات عملية في نظم التحكم):** وصف تصميم نظم التحكم، وصف ودراسة وتحليل عناصر التحكم في بعض التطبيقات في خطوط الأنابيب والآلات التوربينية ومعدات إنتقال الحرارة ونظم الإحتراق.... إلخ

**محتويات الجزء الأول – الوحدة الثانية تدخل في مقرر مكق 560: أجهزة القياسات والاختبارات Part (1) -**

## الوحدة الثالثة: تحويل لابلاس ودالة التحويل

- 1- العلاقة بين الدخل والخرج
- 2- تحويل لابلاس
- 3- دالة التحويل
- تمارين 3

## الوحدة الرابعة: الاستجابة الزمنية لنظام المرتبة الأولى والثانية

- 1- دراسة نظام المرتبة الأولى
- 2- دراسة نظام المرتبة الثانية
- تمارين 4

## الوحدة الخامسة: تحليل الخطأ في أنظمة التحكم الآلي

- 1- المنظومات الآتية والإستاتية
- 2- الخطأ الآتية للمنظومة
- 3- معاملات الخطأ الآتية ودرجة الإستاتية
- 4- تحليل إشارة الخطأ عند استعمال المنظومات
- 5- تأثيرات المنظومات على أداء المنظومة
- تمارين 5

## الوحدة السادسة: تحليل استقرار أنظمة التحكم الآلي

- 1- أداء منظومات التحكم الآلي
- 2- دراسة استقرار العمليات في المنظومات
- 3- الطريقة الجبرية
- 4- أمثلة محلولة
- 5- شروط استقرار بعض المنظومات
- تمارين 6
- المصطلحات
- المراجع

## المحتويات

### الوحدة الأولى: علم الاتصال والتحكم الآلي

- 1- مقدمة
- 2- منظومات التحكم الآلي الهندسية
- 3- المصطلحات الفنية المستخدمة في منظومات التحكم الآلي
- خلاصة الباب الأول
- تمارين 1

### الوحدة الثانية: عناصر القياس ومحولات الإشارة

- 1- عنصر الحس
- 2- عناصر قياس الكميات الطبيعية
- 1- 2- عناصر قياس درجة الحرارة
- 2- 2- عناصر قياس الضغط
- 3- 2- عناصر قياس مستوى سائل
- 4- 2- عناصر قياس معدل التدفق
- 5- 2- عناصر قياس الوضع السرعة والقوة
- 3- محول الإشارة
- 1- 3- وظيفية محول الإشارة
- 2- 3- التوصيلات الكهربائية
- 3- 3- المحول الذكي
- 4- 3- كيفية اختيار المحول
- 5- 3- بعض محولات الإشارة
- خلاصة الباب الثاني
- تمارين 2



## Course Specifications & Basic Information

<b>1. Title:</b>	<b>Basics of Control Theory</b>			<b>Code:MEP561</b>
<b>2.Credit hrs per week</b>	<b>Lectures= 3 hours per week</b>	<b>Tutorial= 0.0</b>	<b>Practical= 0.0</b>	<b>Total=3 Cr.Hrs</b>

### **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 automatic control theory as it is applied on mechanical power systems and heat and mass transfer processes. The course include large numbers of practical examples and problems on various types of control systems to enhance students professional skills in the field of modeling & analyzing real automatic control systems. Course overall aims is to define automatic control theory and the associated terminology- introduce and study various types of Control Systems– Mechanical components, pneumatic, hydraulic, electric systems–Mathematical Modeling of control systems–Laplace and the inverse Laplace transformations-Element and System Transfer functions – Close and open loop systems –Instantaneous system response–system stability & equilibrium tests –Design of control systems – Practical applications of automatic control theory in different mechanical power and heat transfer and mass transfer processes and equipments.

#### **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 and various definitions and terminologies associated with automatic control theory.
- Various types of automatic control loops in mechanical power and energy transfer systems.
- Essential requirements of accuracy, efficiency, safety, and stability of automatic control systems
- Concepts of mathematical modelling of various mech. power systems & energy transfer processes
- The element and the whole system transfer functions, and Block diagram analysis method.
- Laplace Transform & inverse Laplace technique to solve 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<sup>st</sup> and 2<sup>nd</sup> order automatic control systems.
- The analogy between various types of mechanical control systems and electric control systems.
- Practical applications of automatic control theory in different mechanical power and heat transfer and mass transfer processes and equipments.

### **-b) Intellectual Skills:**

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

- Select and apply appropriate mathematical and technical methods to model, analyze, and solve automatic control problems.
- Search for scientific and technical information and adopt control self-learning capabilities.
- Analyze& compare performance and time response of different types of ordinary time-dependent differential equations of control systems.
- Solve numerical and practical examples on automatic control systems.
- Apply scientific and engineering analysis for different mechanical power control systems.
- Apply and use Laplace Transform and inverse Laplace tables for mathematical modeling, block diagram reduction and for solving the system's ordinary time-dependent differential equations.

### **c) Professional and Practical Skills:**

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

- Identify several types of automatic 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 control systems.
- Suggest possible alternative solutions for various types of automatic control systems.
- Use & apply different tables and equations for Laplace and inverse Laplace Transformations.
- Diagnose stability and dynamic response problems of automatic control of mechanical power systems and energy transfer equipments.
- Formulate and analyze heat transfer and fluid flow practical problem related to control fields.

### **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.