Introduction to Control Systems

Lecture_ 00

Module Name – Code	Control Engineering – **MME4027**
Module Language:	English
Responsible:	Dr. Chalang H. R. Mohammed
Lecture:	Dr. Chalang H. R. Mohammed
College:	College of Engineering – Salahaddin University
Duration:	15 week – 1 semester (hrs 4/23**)**
Course outcomes:	This semester course is intended to present the basic principles and techniques for the design of feedback control systems. At this point in this study the students have mastered the prerequisite topics such as dynamics and the basic mathematical tools that are needed for analysis. Moreover, they will be familiars with the controller (PID) to maintain the output(s) variable within a desired range. This can be obtained by understanding the concepts of performance and stability. Control system design relies on student's knowledge in these fields but also requires additional skills in system interfacing.

Course Content:	Reviewing relative mathematical continuous dynamics. Later, the SISO Modelling of some processes; such as mechanical, electrical, liquid. Also, modelling of some actuators; which are electric motor, pneumatic and hydraulic. Later, the PID; namely pneumatic controller will be introduced and studied with main versions. The block diagram and signal flow graph to obtain a final behavior of some sub-systems will be analyzed. Then, the main criteria of performance and stability will be learned. In addition, the design and maintenance due to applied inputs discuss to obtain an acceptable overall system. Finally, the state space representations and transformations to MIMO will be explained.
Literature:	Katsuhiko Ogata . “Modern Control Engineering ”. 2002 Franci H.Raven . “Automatic Control Engineering”. 2017 Nise.”Control System Engineering”. 2011
Type of Teaching:	Face to Face learning 4 hrs in lectures
Pre-requisites:	Background in physical behavior, electrical machines, advanced analysis (ode, Laplace, matrices trance formations) are recommended

Frequency:	Yearly in fall semester
Requirements for credit points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: Written (Written 90 min for med & 120 min final] Written exam – Med term : 20% quizzes : 10 % Poster: 5% HW & assignments: 5% Written exam- Final exam: 60% Student's attendance is required in all classes. Students with more than 10% absence and/or less than 15% effort in continuous exams are NOT allowed to attend the final exam.
Credit point:	unit theory **4/19**
Grade Distribution:	The Grade is generated from the examination result(s) with the following weights (w): Theoretical Part "w": 100% [20% midterm exam + 60% final Exam + 20% HW, report, quizzes and assignments]

The Academic Season Program

1.	**Introduction to Control Systems and Measurements**
2.	Introduction to Signals, System dynamics, and Laplace transform definition
3.	Introduction to modelling and Modelling linear mechanical components.
4	Modelling rotational mechanical components. [quiz]
5.	Linear electric elements and examples (Examples)
6.	Modelling of liquid level system [quiz]
7.	Modelling of thermal system (Example)
8.	Modelling pneumatic system and P controller [quiz]
9.	Modelling pneumatic system and I, and PI controllers
10.	Modelling pneumatic PID controller & actuator (Example)
11.	Modelling hydraulic actuator & controller (I) [quiz]
12	Block diagram method of solution
13.	Examples on Block diagram method of solution
14	Signal flow graphs method of solution (Examples)
15.	Time domain Performance of control systems [quiz]
16	Performance criteria (step input) (Examples)
17	Performance criteria (step input) (Examples) [quiz]
18	Steady state errors e_{stst} & error constants (position, velocity and acceleration transfer functions)
19	Design systems based on e_{stst} (Examples)
20	Generalized error series (Examples) [quiz]
21.	Med Term Exam
22.	s-plane and 2nd Order System Performance Parameters
23.	Introduction to Stability analysis: Absolute stability & Relative stability
24	Stability s-domain: Routh-Hurwitz criterion & design (Examples) [quiz]
25	Stability frequency response: Bode plot criterion & design (Examples)
26.	Examples on Bode plot criterion
27.	State space representation [quiz]
28	Analysing and solution of state space representations (Examples)
29.	Review
30	Final Exam

Due to a number of unforeseen reasons that may lead to shifting of the academic year program, it may be subjected to modifications. Also extra curriculum hours may be needed to cover all the topics. The students shall be notified of the changes if and when they may occur.