Arab Academy for Science, Technology & Maritime Transport
College of Engineering & Technology
Electrical & Control Engineering Department

University/Academy: Arab Academy for Science, Technology & Maritime Transport
Faculty/Institute: College of Engineering & Technology
Program: B.Sc. Mechanical Engineering

Form no. (12)
Course Specification

1- Course Data

Course Code: **EE 419**	Course Title: **Modern Control Engineering**		Academic Year/Level: **4th** year / **8th** semester
Specialization: **Computer/Electronics Engineering**	No. of Instructional Units	Lecture	Practical
	3 Credits	**2 Hrs.**	**2 Hrs.**

2- Course Aim

To enable students of other departments to design control systems using classical approach and state-space approach.

3- Intended Learning Outcome

a- Knowledge and Understanding	• K1. Distinguish between time domain and frequency domain specifications • K1. Definition and properties of z-transform • K1. Show how to solve the state equation • K1. Explain the role of matrix manipulation and linear differential equations for control systems representation • K1. Knowing open and closed loop transfer functions • K4. Associate the choice of pole location with digital control systems stability criterion • K5. Demonstrate effect of lead compensator in time domain and in frequency domain. • K5. Identify aspects of lag compensation in time domain • K5. Show the differences between lag and lead compensators versus lead-lag compensators • K5. Defining control system representation techniques (phase variable form, diagonal form …etc.), state transition matrix, controllability problem, and observability problem. • K5. Distinguish the role of controllability / uncontrollability criterion for pole placement • K5. Distinguish between open loop and closed loop responses in presence of sampler • K10. Showing the basic structure of a digital control system

b- Intellectual Skills	• I2. Apply Root locus and Bode plot in determining system requirements • I3. Modifying system response using lead-lag compensators • I2. Apply Bode plot in determining system requirements • I2. Apply Bode plot in determining system requirements • I1. Demonstrate the role of matrix manipulation and linear differential equations in practical physical systems • I2. Apply system representation techniques in classical transfer functions • I1. Solve system equations to obtain system response with and without initial condition state vector • I1. Detect controllable / uncontrollable systems • I1. Detect observable / unobservable systems • I3. Apply the state feedback gain controller law to assign the closed loop eigenvalues in desired locations • I5. Demonstrate the differences between analog versus digital control systems • I1. Apply difference equation using inverse z-transform • I2. Calculate the overall open loop / closed loop transfer function in presence of sampler • I1.Solve first and second order transient responses • I11. Apply Jurry's test to check digital system stability
c- Professional Skills	• P2. Design lead compensators using Root locus technique • P2. Design lag compensators using Root locus technique • P2. Compare between system response via lead, lag and lead-lag compensators • P2. Design lead compensators using Bode plot • P2. Design lag compensators using Bode plot • P1.Differentiate between state variables in phase variable form, diagonal form, …etc. • P12.Explain system response with and without initial conditions • P4. Analyze the role of controllability and observability in practical physical systems • P6. Design state feedback gain controller matrix • P7. Analyze the effect of sampling in control system process • P5. Analyze digital transfer functions using partial fraction • P3. Compare the effect of changing sampler locations applied on first and second order systems • P1. Differentiate between range of sampling time (T) and range of gain (K) in determining system stability
d- General Skills	• G6. Sketch the root locus for the compensated and uncompensated system using lead and lag compensators • G6. Sketch the root locus for the compensated and uncompensated system using lead- lag compensators • G1. Sketch the Bode plot for the compensated and uncompensated system using lead and lag compensators • G2. Verify the role of digital control systems in A/D and D/A converters

4- Course Content

Week Number 1:	Introduction to control system
Week Number 2:	Differential equation of physical systems.
Week Number 3:	Block diagram models using MATLAB.
Week Number 4:	Signal flow graph models using MATLAB.
Week Number 5:	Test input signals.
Week Number 6:	Performance of 1st and 2nd order system
Week Number 7:	7th week exam + Effect of 3rd pole and a zero on the 2nd order system.
Week Number 8:	Stability concept Routh- Hurwitz stability criterion
Week Number 9:	Root locus techniques
Week Number 10:	Bode plots
Week Number 11:	Nyquist plots.
Week Number 12:	12thweek + Approaches to system design, advantage of feedback.
Week Number 13:	Approaches to system design, advantage of feedback.
Week Number 14:	Analog controllers.
Week Number 15:	Analog controllers (2).
Week Number 16:	Final exam

5- Teaching and Learning Methods

- Lectures
-Tutorials

6- **Teaching and Learning Methods for Students with Special Needs**

- Lectures
- Tutorials
- Reports & sheets
- Laboratories
- Seminars

Academic Support:

- The general academic advisor appoints an academic supervisor for handicapped students.

Continuous follow ups are made for handicapped students after each assessment to evaluate their academic level of achievement

7- Student Assessment:

Quiz (to asses part of the 7th and 12th week evaluation) and Report (to asses part of practical evaluation)	
a- Procedures used:	Written Examinations to asses The Intended Learning Outcomes Class Activities (Reports, Discussions, ------) to asses The Intellectual Skills
b- Schedule:	**Assesssment 1** **3rd Week** **Assesssment 2** **4th Week** **Assesssment 3** **5th Week** **Assesssment 4** **7th Week** **Assesssment 5** **10th Week** **Assesssment 6** **11th Week** **Assesssment 7** **12th Week**

c- Weighing of Assessment:	**7th Week Examination**	**30%**
	12th Week Examination	**20%**
	Final-term Examination	**40%**
	Oral Examination	**0%**
	Practical Examination	**5%**
	Semester Work	**5%**
	Total	**100%**

8- List of References:

a- Course Notes	Subjected in documentation
b- Required Books (Textbooks)	G.F. Franklin & J.D. Powell & A.E. Naeinin, "Feedback Control of Dynamic Systems", Addison Wesley Publisher
c- Recommended Books	Ogata " Modern control Engineering " Prentice Hall
d- Periodicals, Web Sites, ..., etc.	www.ieee.org

Course coordinator: **Program Manager:**