University/Academy: Arab Academy for Science and Technology & Maritime Transport
Faculty/Institute: College of Engineering & Technology
Program: Electrical and Control Engineering

Form no. (12)
Course Specification

1- Course Data

Course Code:	Course Title:	Academic Year/Level:
EE 419	**Modern Control Engineering**	4
Specialization: Mechanical & Electronics Engineering	**No. of Instructional Units:** 3 **Lecture** 2 **Practical** 2	

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	**Analyzing and design of control systems with performance evaluation.** • Distinguish between time domain and frequency domain specifications • Demonstrate effect of lead compensator in time domain • Identify aspects of lag compensation in time domain • Show the differences between lag and lead compensators versus lead-lag compensators • Demonstrate effect of lead compensator in frequency domain • Demonstrate effect of lag compensator in frequency domain • Explain the role of matrix manipulation and linear differential equations for control systems representation • Defining control system representation techniques (phase variable form, diagonal form, …etc.) • Show how to solve the state equation

	• Define state transition matrix • Define controllability problem • Define observability problem • Distinguish the role of controllability / uncontrollability criterion for pole placement • Showing the basic structure of a digital control system • Definition and properties of z-transform • Knowing open and closed loop transfer functions • Distinguish between open loop and closed loop responses in presence of sampler • Associate the choice of pole location with digital control systems stability criterion

b- Intellectual Skills	**Analyze, interpret, and explain data and design experiments to obtain new data.** • Apply Root locus and Bode plot in determining system requirements • Modifying system response using lead-lag compensators • Apply Bode plot in determining system requirements • Apply Bode plot in determining system requirements • Demonstrate the role of matrix manipulation and linear differential equations in practical physical systems • Apply system representation techniques in classical transfer functions • Solve system equations to obtain system response with and without initial condition state vector • Detect controllable / uncontrollable systems • Detect observable / unobservable systems • Apply the state feedback gain controller law to assign the closed loop eigenvalues in desired locations • Demonstrate the differences between analog versus digital control systems • Apply difference equation using inverse z-transform • Calculate the overall open loop / closed loop transfer function in presence of sampler • Solve first and second order transient responses • Apply Jurry's test to check digital system stability
c- Professional Skills	**Realize control theory and measurement systems for industrial variables, signal conversion, conditioning and processing.** • Design lead compensators using Root locus technique • Design lag compensators using Root locus technique • Compare between system response via lead, lag and lead-lag compensators • Design lead compensators using Bode plot • Design lag compensators using Bode plot • Differentiate between state variables in phase variable form, diagonal form, …etc. • Explain system response with and without initial conditions • Analyze the role of controllability and observability in

	practical physical systems • Design state feedback gain controller matrix • Analyze the effect of sampling in control system process • Analyze digital transfer functions using partial fraction • Compare the effect of changing sampler locations applied on first and second order systems • Differentiate between range of sampling time (T) and range of gain (K) in determining system stability
d- General Skills	**Communicate effectively.** • Sketch the root locus for the compensated and uncompensated system using lead compensators • Sketch the root locus for the compensated and uncompensated system using lag compensators • Sketch the root locus for the compensated and uncompensated system using lead- lag compensators • Sketch the Bode plot for the compensated and uncompensated system using lead compensators • Sketch the Bode plot for the compensated and uncompensated system using lag compensators • Verify the role of digital control systems in A/D and D/A converters

4- Course Content	*Week Number 1:* Lead compensation design. *Week Number 2:* Lag compensation design. *Week Number 3:* Lag-Lead compensation design. *Week Number 4:* Lead compensation by frequency response. *Week Number 5:* Lag compensation by frequency response. *Week Number 6:* Introduction to state-space. *Week Number 7:* 7th week exam+ Methods of state space representation. *Week Number 8:* Solution of state equation. *Week Number 9:* Controllability – observability. *Week Number 10:* State variable feedback. *Week Number 11:* 12th week exam + Introduction to digital control systems. *Week Number 12:* The z- transform.

	Week Number 13: Block diagram of digital systems. *Week Number 14:* Time response of digital systems. *Week Number 15:* Stability analysis for digital systems. *Week Number 16:* Final Exam.
5- Teaching and Learning Methods	- Lectures - Tutorials - Discussion papers - Designing codes
6- Teaching and Learning Methods for Students with Special Needs	- Lectures - Tutorials - Discussion papers - Designing codes

7- Student Assessment:	
a- Procedures used:	**Quiz to asses part of the 7th week evaluation** **Report to asses the 7th week practical evaluation** **Written exam to asses the mid term exam** **Written exam to asses part of the 12th week**

	evaluation **Matlab code to asses class activities**
b- Schedule:	**Assesssment 1** 5th Week **Assesssment 2** 5th Week **Assesssment 3** 7th Week **Assesssment 4** 12th Week **Assesssment 5** 14th 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:	Ogata " Modern control Engineering " Orintice Hall
a- Course Notes	
b- Required Books (Textbooks)	G.F. Franklin & J.D. Powell & A.E. Naeinin, "Feedback Control of Dynamic Systems", Addison Wesley Publisher
c- Recommended Books	

d- Periodicals, Web Sites, …, etc.	

Course Instructor:

Head of Department:

Program Manager: