310 CPE Course Syllabus

Course Code	310 CPE
Course Name	Automatic Control Systems
Credit Hours	3
Contact Hours	2
Instructor Name	Dr. Mohammed Shiblee

Text Book (title, author, and year)
• Ogata, K., "*Modern Control Engineering*", Pearson Prentice Hall, Fourth edition, 2008. • D. C. Jagan, "Control System", B S publications. Second edition, 2008.

Specific Course Information	
Catalog Description	To introduce modeling, stability analysis, and frequency response calculation methods, Ethics and automatic control, Societal impact of wide spread use of automatic control and Contemporary issues.
Prerequisites	NIL
Co-requisites	NIL
Required/Elective	required

Course Learning Outcomes	
1	Define transfer function and recall different Block diagram reduction techniques and find the stability of a system.
2	Explain different compensation mechanisms.
3	Analyze the stability of control systems
4	Describe the techniques, and MATLAB programming tools and skills necessary for Automatic control systems.
5	Demonstrate life-long learning by synthesizing information from several sources.
6	Demonstrate skills of documentation and communication ideas of the Control System.

Mapping course LOs to the SLO.

Course LOs #	**Student Learning Outcomes**											
	a1	**a2**	**b1**	**b2**	**b3**	**b4**	**b5**	**c1**	**c2**	**c3**	**d1**	**d2**
1	√											
2			√									
3				√								
4			√									
5										√		
6											√	

List of Theory Topics
Introduction: Terminology and basic structure, Mathematical modeling of mechanical, electrical, thermal, hydraulic and pneumatic systems. Industrial control devices: Potentiometers, DC and AC servo-motors, Open and closed loop systems: their merits and demerits. • **Transfer Function & Block Diagram:** Transfer Functions of linear systems, Block Diagram representation, Block Diagram reduction techniques, and Signal Flow graph method.

• **Time Domain Analysis:** Time Response analysis of second order systems, Performance specifications in time domain. Stability concept. Steady state errors and error constants, static error coefficients. Root locus plots, examples, general rules for constructing root loci, analysis of control system by root loci.
• **Frequency Domain Analysis:** Routh-Hurwitz's stability criterion, Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins.
• **Industrial controllers and controller design:** Proportional (P), Proportional-Differential (PD), Proportional-Integral (PI) and Proportional-Integral-Differential (PID) controllers. Controller design considerations, lead compensation, lag compensation, leadlag compensation.

List of Lab Experiments

• Finding zeros and poles of a transfer function using MATLAB control system toolbox.
• Block Diagram simplification and transfer function extraction using MATLAB control system toolbox.
• Time Domain Analysis: Obtaining the unit-step response of a second order transfer function system using MATLAB control system toolbox.
• Time Domain Analysis: Obtaining the rise time, peak time, maximum overshoot and settling time of unit-step
response of a second order transfer function system using MATLAB control system toolbox.
• Time Domain Analysis: Obtaining the unit-impulse response of a second order transfer function system using MATLAB control system toolbox
• Time Domain Analysis: Obtain the time response of a system with given transfer function when the input is
r(t)= e^(-0.5t)using MATLAB control system toolbox.
• Finding various responses Using SIMULINK
• Stability of the systems using Routh – Hurwitz criteria
• Root locus plot
• Bode Plot
• Transfer function modeling and Speed Control of the DC Motor (Labview and Elvis II board)
• Position Control of the Stepper Motor (Labview and c-RIO)
• Position Control and Step Size variation of the Servo motor (Labview and c-RIO)
• Flight Control of the VTOL helicopter (Labview and Elvis II board)