Control Systems

Code	Credit Hours
AE- 339	2-1

COURSE DESCRIPTION:

The course is designed to provide basic understanding of the feedback control systems with which everyone comes across in daily life. The course also includes the study of instrumentation needed to measure and analyze levels of vibrations. It is expected that after this course students will attain a level of understanding of the subject that will help them in their practical life..

TEXT AND MATERIAL

Text Book:

1. Control Systems Engineering, Latest Available Edition, Kindle Edition by Norman S. Nise (Author)
2. Electronic Fundamentals by Aviation Maintenance Technician Certification Series, Latest Available Edition

Reference Books:

1. Modern Control Engineering, Kathuhiko Ogata, 5th Edition, Prentice-Hall, 2009.
2. R.T Stefani, et al., Feedback Control systems, Feedback and Control Systems, Schaum's Series, Feedback Control systems by Norman Nise, Modern

PREREQUISITE:

EE-103 : Electrical Engineering

ASSESSMENT SYSTEM:

Quizzes	10%
Assignments	10%
Mid Terms	30%
ESE	50%

ASSESSMENT SYSTEM FOR LAB:

Quizzes	10%-15%
Assignments	5% - 10%
Lab Work and Report	70-80%
Lab ESE/Viva	20-30%

Teaching Plan

Week No	Topics	Learning Outcomes	Delivery Method
1	Introduction	Course Outline, objectives, teaching plan, assessment method	Lecture
2	Introduction to control system	Basic terminology and examples	Lecture and discussion
3	Introduction to control system	Concept of open loop system	Lecture and discussion
4	Introduction to control system	Concept of close loop system	Lecture and discussion
5	Introduction to control system	Introduction to various test signals	Lecture and discussion
6	Introduction to control system	Design of control system	Lecture and discussion
7	Modelling of system	Introduction to graphical mathematical modelling	Lecture and discussion
8	Modelling of system	Mathematical modelling of engineering system, translational and rotational systems	Lecture and discussion
9	MID TERM EXAM		
10	Modelling of system	Electrical and electro mechanical system Servomechanism defects, reversal of synchro leads, hunting.	
11	Modelling of system	Concept of Laplace and inverse Laplace in control system, Non linearity and linearization concept	Lecture and discussion
12	Time response	First and second order system time response, transient response analysis, Routh's stability and steady state error	Lecture and discussion
13-14	Root locus analysis	General rules for constructing root locus analysis and plots, Root locus analysis of control system	Lecture and discussion
15	PID design	, Lead and Lag compensation (PD. PI. PID)	Lecture and discussion
16	Aircraft Transfer Functions	Transfer function of aircraft	Lecture and discussion
17	Aircraft pitch and altitude	Pitch and altitude of aircraft	Lecture and discussion
18	**End semester exam (ESE)**		

Lab No.	Description
Lab No.	**Description**
1	(Simulation) General introduction to MATLAB programmingenvironment (a) General introduction to MATLAB and guidelines to install (b) Basic functions of MATLAB (math operations, etc) (c) Basic graph plotting (d) How to write, debug, and execute .m filesMATLAB and its workspace
2	(Practical) Step response modeling of 1st order system (DCmotor/Servo System)
3	(Practical) Determination of model (transfer function) of a 1st order system using experimental tests (parameter estimation)
4	(Practical) Open-loop control of DC motor (a) Open-loop system simulation in code (b) Open-loop system simulation in Simulink (c) Analysis of stable, unstable, and marginally stable system (d) Practical open-loop position and speed response of a servomotor
5	(Practical) Open-loop control of DC motor using analog circuits (a) Practical open-loop speed control of DC motor with no-loadconditions (b) Practical open-loop speed control of DC motor with load
6	(Practical) Routh-Hurwitz stability analysis on DC motor (a) Matlab simulations (b) Routh-Hurwitz stability test of DC motor
7	(Practical) Second-order closed-loop system analysis (a) MATLAB simulations (b) 2nd order system analysis: under-damped system, dampingratio & natural frequency, peak-time and percent overshoot.
8	(Simulation) Closed-loop position and speed control of DC motor (a) Closed-loop system simulation in MATLAB using coding Closed-loop system simulation in MATLAB using Simulink
9	(Practical) Closed-loop position and speed control of DC motor (a) Servo position control (b) Servo speed control (c) Steady-state error Proportional compensator
10	(Practical) Frequency response modeling of 1st order system (DC motor)

11	(Practical) Frequency response modeling of 1st order system (DC motor)
12	(Practical) Determination of stability margins using Nyquist stability criteria for DC motor
13	(Practical) PD control design for DC motor position control
14	(Practical) Inverted pendulum system control: • Derivation of dynamic equations • Design of its controller
15	(Practical) Inverted pendulum system control: • Simulation of system on Simulink • Implementation of controller on the system Comparison with Simulation Results
16	(Simulation) Aircraft Pitch, bank angle control
17	(Simulation) Aircraft heading control
18	**LAB END SEMESTER EXAM**