ELE3202 CONTROL ENGINEERING

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	60	40	4

Rationale

The course requires a good mathematical background especially in complex, matrix and Laplace algebra. It is an introductory course of control engineering that covers block diagram systems representation, stability and compensation techniques.

Course Objectives

- To understand operation and characteristics of control systems
- To analyze and design control systems using appropriate mathematical tools
- To apply control techniques to advanced engineering situations

Detailed Course Content:

Basic control theory: **[10 Hours]**

The feedback control concept; stability and instability; stability criteria for control systems - Routh's, root –locus, Nyquist, Bode Plots.

Compensation techniques: **[6 Hours]**

Cascade frequency compensation: Lag and lead compensators, bridge-T compensators: cascade root-locus compensation; comparison of techniques. Feedback compensation: time response considerations, transformation of control elements, use of root-locus and polar plots.

State-space Methods: **[8 Hours]**

Linear algebra: matrix theory; linear vector; spaces, dimension, minor products, Euclidean space, orthonormalisation, change of bases, eigenvalues, eigenvectors, polynomial matrices transfer function matrices, system stability by lyapunov's state-space representation, boundedness of solution, asymptotic stability domain of attraction, linearisation, limit cyles; Poincare-Pendixson theorem, Lienards criteria, point-transformation method.

Discrete Data System: **[8 Hours]**

The sampling process Shannon sampling theorem, impulse sampling; the z-transform; inverse transform, theorems, pulse transfer function, limitations, modified z-transform; inverse; system representation: block diagrams, signal flow graphs; time and frequency response: time response, frequency response, bilinear transform, relative stability, root-locus.

Non-Linear Systems: **[6 Hours]**
General non-linear system description: State and output equations linearization, stability analysis; Liapunov methods; Stability regions; Application of artificial neural networks to non-linear systems; Subharmonic resonance.

Optimal Control and Filtering Theory: **[7 Hours]**
Concept of optimality; Kuhn-Tucker conditions; Dynamic programming; Discrete-time optimal control; Quadratic linear regulator (QLR); Matrix Riccati equation; Stability properties Stochastic systems and their control; Kalman filtering; Noise and its control; Adaptive Control and System Identification: Time series models; Parameter estimation; Prediction-error identification; Method of least squares; Autoregressive Moving-Average (ARMA) Models; Model determination; Self tuning. Special Techniques.

Learning Outcomes

The student will:

- Be able to comfortably check for stability of any system using any criteria.
- Understand the concept of control system engineering, why it is carried out and will appreciate its application in digital control.
- Acquire concepts on sensors and their use in design of automated systems.

Method of Teaching /Delivery

The course will be taught by using lectures, tutorials and assignments.

Mode of Assessment

Assignments, tests and final examination. Their relative contributions to the final grade are :

Requirement	**Percentage contribution**
Course work (Assignments, tests)	40
% Final examination	60
% **Total**	**100%**

Recommended Books and References

[1] William L. Brogan, *Modern Control Theory,* 2nd ed., Prentice-Hall, 1985
[2] Nise, N. S, *Control Systems Engineering,* 3rd ed., New York, NY: Wiley, 2000.
[3] *K. Ogata, Discrete- Time Control Systems*

Possible Lecturers:
Dr. M. K. Musaazi
Dr. P. DaSilva
Dr. A. Sendegeya
Mr. G. Bakkabulindi
Mr. C Wasswa Sebuwufu
Mr. A. Muguwa