TEL4111 DIGITAL SIGNAL PROCESSING

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
This course discusses the concepts of dicrete signal processing and their applications in communications, control and instrumentation.

Course Objectives
To give students an understanding of the analysis of discrete signals and systems, and their application in the design of filters and signal processors used in control, communications and instrumentation.

Detailed Course Content:
Discrete-Time Signals, Systems, & Transforms: **[11 Hours]**
Basic Sampling Theory and D/A Conversion; Discrete-Time Linear Systems; Autocorrelation; Cross-Correlation (VIP); Z Transform; Discrete-Time Fourier Transform; Frequency Selective Linear Filtering; Sampling and Reconstruction; Multirate DSP: Efficient Up-sampling/Down-sampling, Multi-Stage Interpolation, Digital Subbanding; Applications: CD Players, Cell Phones, wireless networks.

Digital Filter Design: **[8 Hours]**
FIR Filters – Equiripple Designs; IIR Filters: Common analog filters, Bilinear transformation, Frequency transformations.

Discrete Fourier Transform: **[8 Hours]**
Definition and Properties; Fast Fourier Transform Algorithms: Divide and Conquer Approach, Radix-2 FFT; Sectioned Convolution

Nonparametric methods of power spectrum estimation: **[6 Hours]**
Discrete random processes; Estimation of autocorrelation sequence; Periodogram; Smoothed periodograms.

Model-Based Spectrum Estimation: **[6 Hours]**
Autoregressive (AR) Modelling; Forward/Backward Linear Prediction; Levinson-Durbin Algorithm; Minimum Variance Method; Eigenstructure Methods I: MUSIC; Eigenstructure Methods II: ESPRIT; Applications in Speech Processing, Communications, and Acoustics.

Adaptive Signal Processing: **[6 Hours]**
Applications: Equalization, etc ; Adaptive Direct-Form FIR Filters – LMS; Adaptive Direct-Form FIR Filters – RLS

Learning Outcomes
- Identify some contributors to digital signal processing and multimedia and relate their achievements to the knowledge area.
- Know the difference between analog and discrete signals.
- Describe how computer engineering uses or benefits from digital signal processing and multimedia.
- Explain the purpose of a Fourier transform in signal processing.

- Describe the advantage of the FFT.
- Contrast how group size affects signal spectra.
- Understand the concept, properties and uses of the z–transform.
- Understand the relationship between z–transform and the conformal map
- Understand the Discrete Fourier transform and its significance.
- Understand frequency selective filters in the z–transform domain.
- Understand the definition of a window function.
- Understand the discrete-time representation of signals.
- Use the convolution technique to analyze circuits.

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 and Reference Books

[1] Emmanuel C. Ifeachor, Barrie W. Jervis, *Digital Signal Processing; A practical Approach*, 2nd Edition, Prentice Hall, 2002.

[2] Richard G. Lyons, *Understanding Digital Signal Processing,* 2nd Edition, Pearson Education, 2004.

[3] John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing; Principles, Algorithms and Applications,* 4th ed., Prentice Hall, 2006.

[4] S. Salivahanan, A. Vallararaj, C. Gnanapriya, *Digital Signal Processing,* Tata McGraw-Hill Publishing Company Limited, 2006.

[5] A.V. Oppenheim and R.W. Schafer, *Digital Signal Processing,* Prentice Hall, Englewood Cliffs NJ, 1975.

[6] Sanjit K. Mitra, *Digital Signal Processing,* 3rd ed., 2006

[7] Boaz Porat, *A course in digital signal processing,* John Wiley & Sons Inc., 1997.

[8] Alan V. Oppenheim, Ronald W. Schafer, *Discrete-time Signal Processing,* Prentice-Hall, International ed., 1989.

[9] Lawrence R. Rabiner, Bernard Gold, *Theory and application of digital signal processing,* Prentice-Hall Inc., 1975.

Possible Lecturers:

Dr. J. Butime
Dr. D. Okello
Dr. Ing. L. L.
Kaluuba Mr. D.
Nsubuga Mubiru
Mr. S. Mwanje
Mr. A Wasswa Matovu

Mr. D. Sebbaale
Mr. I. Kitone