UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

School of Electrical and Information Engineering

ELEN 3013A Signals and Systems IIB

Course Brief and Outline—2019

Academic Staff:

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1. Course Background and Purpose

The content of Signals and Systems (Signals and Systems I, IIA and IIB) is considered basic electrical engineering science. Signals and Systems provide the student with the theoretical and mathematical foundations underpinning more specialized courses in Control, Signal Processing and Measurements. The emphasis of Signals and Systems IIB is on the analysis of discrete time linear systems in the time and frequency domains.

2. Course Objectives

This course continues from Signals and System IIA (ELEN 3012) and it provides the student with the theoretical and mathematical foundations underpinning more specialized courses in Control, Signal Processing and Measurements.

3. Course Outcomes

On successful completion of this course, the student is capable of:

1. Defining, explaining and using linear systems and signals terms, concepts and principles.
2. Analyzing discrete signals and LTI systems in the time and frequency domains.
3. Selecting the most appropriate analysis technique to analyze a given system or signal and justify the selection of the technique.
4. Verifying that the solution obtained to a particular LTI system or signal problem is correct.
5. Conveying a logical linear system and signal analysis solution to another person in a clearly comprehensible fashion.

4. Course Content

i. Discrete Time Signals: Discrete Signal Representations; Discrete Signal Classifications ; Discrete Signal Models; Its Basic Operations; Discrete time systems and its properties

ii. Analysis of Discrete Time Systems (Linear Time Invariant (LTI) Systems): Linear Time Invariant (LTI) Systems, System Analysis (Difference Equation); Block diagram representation of LTI systems

iii. Discrete-Time System Analysis: Z-Transform Definition; Properties of Z-Transform; Inverse Z-Transform; Transfer function and system realization

iv. Digital Filters: Discrete IIR Filters; Discrete FIR Filters

v. Fourier Transforms (Analysis) of Discrete Time Signals: Discrete-Time Fourier Transform (DTFT)- Definition and Properties; Discrete-Fourier Transform (DFT); Applications of Discrete Fourier Transform

5. Prior Knowledge Assumed

The following prior knowledge is assumed on the part of students starting this course: sampling of continuous time signals, Fourier transforms, continuous filter design and bode plots. The student will also be expected to be familiar with Matlab. The prerequisites and co-requisites to register for this course are defined in the current Rules & Syllabuses: Faculty of Engineering and the Built Environment.

6. Assessment

All submissions must be in strict accordance with the guidelines contained in the *School's Blue Book* and the rules contained in the *School's Red Book*. No exceptions will be considered.

6.1 Formative Assessments Elements

There will be in-class problem solving slots during lectures.

6.2 Summative Assessment

Table 1: Summative assessment contributions

Summative Assessment Contributor	Duration h	Component Yes/No	Method & Weight %	Calculator Type 0/1/2/3	Permitted Supporting Material
Test	1	No	Assignment of Marks/ 20%	2	One double-sided handwritten A4 formula sheet
Laboratory	3	No	Assignment of Marks/ 20%	2	
Examination	3	No	Assignment of Marks/ 60%	2	One double-sided handwritten A4 formula sheet

6.3 Assessment Methods

The student's understanding of the fundamental concepts of the course will be assessed through the examination of the application of the concepts. All material covered in lectures, tutorials, prescribed reading and laboratory exercises are examinable. Note that the onus is upon the student to convey this understanding in an examination. A terse, correct answer may not necessarily attract marks!

7. Satisfactory Performance (SP) Requirements

For the purpose of Rule G.13 *satisfactory performance in the work of the class* means attendance and completion of prescribed laboratory activities, attendance at tutorials designated as compulsory in this CB&O, writing of scheduled tests unless excused in terms of due procedure.

8. Teaching and Learning Process

8.1 Teaching and Learning Approach

Signals and systems is a conceptual subject which requires a significant effort on the part of the student to get to a level where fundamental principles are appreciated and readily applied. Ultimately, as in any subject, the student has to learn by himself/ herself. The lecturing approach which comprises, lectures and tutorials, can only serve as a guide. The lectures aim to put the course material in context. Self-study and external reading is expected and forms an integral part of the course. Tutorial exercises are designed to complement and probe material currently being taught. They are not necessarily designed as examination questions, doing these exercises only just before the exams will not help. They are to be done concurrently with the material being explored. Complete solutions to problems set will not be provided except for selected problems. Students are required to verify their solutions through alternative approaches i.e. the use of a simulation package and peer learning.

8.2 Information to Support the Course

8.2.1 Prescribed Text/Reading

- Lathi B.P. "Signal Processing and Linear Systems", International edition, Oxford University Press, 2010.

8.2.2 Other References

- Phillips C.I. and Parr J.M. "Signals and Systems" 2nd or higher ed. Prentice Hall Publishers.
- Oppenheim A.V., Shafer R.W. and Buck J.R. "Discrete Time Signal Processing" any edition, Prentice Hall.
- Oppenheim A.V., Wilskey A.S. and Young I.T. "Signals and Systems" any edition, Prentice Hall.

8.3 Learning Activities and Arrangements

The learning and teaching strategy will be a combination of traditional Lecture and problem-based (problem solving) learning. Note that lectures are not compulsory but students are expected to attend and it will be taken that announcements made during lectures have been received by all students

Lectures:

There will be two lectures per week. Students are expected to attend all lectures and to make their own notes.

Tutorials:

There will be one tutorial per week as scheduled in the school's lecture timetable.

Project:

No project.

Laboratory:

There will be laboratory exercises which will be demonstrated by the student in the D lab. The booking form will be made available at the school's reception.

Consultation:

Consultations are preferably to be held during the Tutorial periods. If there is not sufficient time due to student numbers and the students have attended the Tutorials consistently, then additional time arrangements may be considered. To schedule a consultation, send an e-mail to course coordinator, with subject line ELEN3013 consultation.

9. Course Home Page

Further information and announcements regarding the course are posted on the course home page: https://cle.wits.ac.za/portal/site/ELEN3013A_2019/tool/d8f22953-39d8-4d8b-8d24-60e6bd17ded1

10. Other Information

Although the University Senate has ruled that attendance at lectures is not compulsory, lectures will be used to *supplement* course texts, and this supplementary information *will* be examinable. Further information and announcements regarding the course will be announced verbally, or otherwise, during lectures. Likewise, additional tutorial questions may be handed out or dictated during any of the lectures. The onus lies solely with the student to acquaint himself/herself fully with all such changed and/or additional material that may be given from time to time, should he or she miss any of the lectures of the course.

10.1 Queries:

Queries or problems related to the course should be directed through the class rep. Emails from other individuals registered for the course should not be sent to the course coordinator directly, unless there is an emergency. This will speed up the process of addressing problems, which will be raised by a single email from the class rep (as opposed to 20 emails from individual students) since problems are often common to many students.

10.2 Deferred and supplementary examinations:

Students that have a valid reason for missing a test or a laboratory submission date must complete an application form that can be obtained from the School of Electrical & Information Engineering's reception. The form must be submitted, together with

substantiating documentation, for example a medical certificate in the case of illness. Approval is at the discretion of the Head of School.

Students that miss the November examination must apply for a deferred examination at the Faculty office. In terms of Faculty policy, students who for whatever circumstance, fail to write the normal examination paper and are granted the opportunity to write a deferred examination by the Faculty Office, will write the supplementary exam paper as their deferred exam paper and waive the right to a supplementary exam.

A student failing the course with a final mark permitting him/her to write a supplementary examination will get a maximum mark of 50% since the supplementary examination is to ascertain whether the student passes or fails the course. All course material will be assessed in the supplementary exam.