Course Code: **TIF208**	*Course Name:* **Digital Signal Processing**		
Study Program: **Informatics**	*Faculty*: **Engineering and Computer Science**		
Course Pre-requisite: **Calculus 1–2, Linear Algebra**	*Credit:* **3**		
Revision Date: **March 12, 2020**	*Lecture:* **3**	*Tutorial*: –	*Practicum:* –
Revision Status: **2.5**	*Semester:* **Genap/Even** *Academic Year:* **2019/2020**		
Lecturer's Name: Irwan Prasetya Gunawan			
Prepared by: Name : Irwan Prasetya Gunawan Position : Lecturer Date : March 12, 2020 ( )	**Certified by**: Name : Hoga Saragih Position : Head of Department Date : ( )		

COURSE DESCRIPTION

This course provides a fundamental understanding of signal processing in a discrete-time system (digital) domain that can be done in the time (by performing various operations on the signal including convolution and correlation) or in the frequency domain, as well as providing knowledge of discrete-time systems analysis, synthesis and implementation including digital filter design through various methods.

COURSE OBJECTIVES

Upon completion of this course, the student should be able to:

- Understand the concepts of discrete-time signals and systems
- Apply transform method and their inverse to signals
- Have knowledge on digital filters and their realisation
- Understand and recognize issues in sampling and reconstruction
- Know about DFT and its fast computation
- Apply frequency domain analysis using DFT
- Understand the fundamental algorithms and structures used in DSP computation
- Design and code DSP applications in a high-level language
- Review state-of-the-art DSP R&D

The above mentioned objectives should be aligned into the following competences:

A. Knowledge (Information plus Understanding)

A.1. Representation of continuous-time signals and systems in time domain
A.2. Representation of continuous-time signals and systems in frequency domain
A.3. Representation of discrete-time signals and systems in time domain
A.4. Representation of discrete-time signals and systems in frequency domain
A.5. Transformation method for signals/systems analysis: Discrete-time Fourier Transform (DFT)
A.6. Transformation method for signals/systems analysis: Z-transforms
A.7. Introductory knowledge on other transforms method; e.g., wavelet and other joint time-frequency transforms, and their applications
A.8. How to convert between continuous-time and discrete-time domains
A.9. Using digital signal processing for filtering applications

B. Skills (Application of Knowledge)

B.1. Be able to calculate responses (in various different ways) of discrete-time systems to given signals
B.2. Classify discrete-time systems according to their properties
B.3. Convert between different but equivalent representations of linear time-invariant systems
B.4. Design and implement digital filters for specific applications

C. Values and Attitudes

C.1. Appreciate the value of fundamental mathematical sciences to the procedural design of complex digital signal processing
C.2. Develop an understanding and application of the design/synthesis procedure
C.3. See advanced applications of digital signal processing and transform theory

METHODS OF INSTRUCTIONS

Classroom instruction consists of lectures and practical problem solving, supplemented by visual aids designed to assist the student to successfully meet the courses learning objectives.

It is imperative that students take an active interest in the course. To succeed in this course, students must read, think, and write in a critical and analytical manner and this takes time and practice. Such practice can only be achieved by working exercises. When troubles arise, and they will, the student must ask questions which may be directed to the instructor or other students in a variety of ways.

Students are also encouraged to work together on problem sets as part of their exercises. However, individual must ultimately demonstrate the understanding of the material by writing up his/her own solutions without the help of other students or their written work.

On average students need to spend roughly, at least, 9 hours of study and preparation per week for this course.

ATTENDANCE REQUIREMENT

Comply with academic rules. Punctuality and regular attendance in classes is of prime importance for successful completion of this course. Students will be expected to arrive for class on time and to remain in class until the end of the class session.

Absence from lectures shall not exceed 22%. Students who exceed the 22% limit without a medical or emergency excuse acceptable to and approved by the Dean of the Faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course.

ASSESSMENT

Coursework evaluation will be weighted as follows:

- Mid Semester Test: 25%
- Final Semester Test: 35%
- Assignment: 30%
- Others (class participation, quiz/pretest): 10%
- Total: 100%

MATERIAL REFERENCES AND REQUIRED SUPPLIES

Textbooks:

[1] Jonathan Stein, Digital Signal Processing: A Computer Science Perspective, John Wiley & Sons, 2000
[2] Steven Smith, The Scientist and Engineers Guide to Digital Signal Processing, California Technical Publishing. Downloadable at http://www.dspguide.com/pdfbook.htm

Supporting reading materials:

- Emmanuel C. Ifeachor and Barrie W. Jervis, Digital Signal Processing: A Practical Approach, Prentice-Hall, 2002
- Sanjit K. Mitra and James F. Kaiser, Handbook for Digital Signal Processing, John Wiley & Sons, 1993
- PA Lynn and W Fuerst, Introductory Digital Signal Processing with Computer Applications, Revised Edition, John Wiley & Sons, 1994

- MIT OpenCourseWare[1], 2005.

Additional tools:

- Octave: http://www.gnu.org/software/octave/
- Matlab: http://www.mathworks.com/matlab/
- Audacity: http://www.audacityteam.org
- Python: http://www.python.org

COURSE OUTLINE

This section should show the targeted competencies, topics, sub-topics, specific method of instruction/ delivery, material references, and assessment indicators for each session. The targeted competencies refer to the list of competencies given in the Course Objectives section.

Session	Targeted Competencies	Topics & Sub-Topics	Methods	References	Assignment
1	C.1., B.2.	Introduction to DSP (a) Course manifest (b) Syllabus explanation (c) Overview to DSP (d) Review: complex numbers (e) General Introduction to Signals & systems	Lecture, Discussion, Assignment	[1] Chapter 1	[1] Problems: 1.2.4, 1.3.4, 1.4.2, 1.4.4, 1.4.6
2	A.1., A.3., C.1.	Signal representations (a) Signal plotting (b) Signal functions (c) Odd and even functions (d) Operations on signals	Lecture, Discussion	[1] Chapter 2.1-2.5	[1] Probs: 2.1.2, 2.2.3, 2.2.5, 2.2.7 (for sinc function only), 2.3.3
3	A.1., A.3., A.8.	Discrete Time Signals Introduction (a) Review: continuous time signals (b) Discrete time signals	Lecture, Discussion, Quiz	Continued	[1] Probs: 3.3.2, 3.4.1
4	A.1., A.3., A.8., B.1.	Basic signals (a) Impulse signals (b) Unit step (c) Exponential signals (d) Complex sinusoidal (e) Discrete periodic signals	Lecture, Discussion	[1] Chapter 2.6, 2.7, 2.8	[1] Probs: 2.4.6, 2.5.3, 2.5.4, 2.6.4, 2.9.2
5	B.2.	Systems (a) Systems Classifications (b) Static v Dynamic (c) Causal v Non-Causal (d) Linear v Non-Linear (e) Time Invariance v Time Varying	Lecture, Discussion	[1] Ch. 6.1, 6.2, 6.4	[1] Problems 6.1.1, 6.4.1, 6.4.3, 6.4.6
6	B.3.	System (cont'd): (a) block diagram (b) graph theory (c) LTI system	Lecture, Discussion	[1] Ch. 6.3	[1] Problems: 6.3.1, 6.3.7
7	B.1.	Convolution sum (a) Basic concept (b) Array algorithm (c) Polynomial multiplication method (d) Use of convolution in LTI system	Review, Discussion, Quiz	[1] Chapter 1, 2, 6	–
MID SEMESTER TEST					
8	A.2., A.4., A.5.	Fourier Transform	Review, Discussion	[1] Ch. 4.1-4.3, 3.6	[1] Probs: 4.1.2, 4.1.3, 4.2.2, 4.3.3, 3.6.1

[1] http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-341Fall-2005/

9	A.2., A.4., A.5.	DFT, FFT Algorithm	Lecture, Discussion	[1] Ch. 4.7, 4.17, 14.1-14.2	[1] Probs: 4.7.1, 4.7.5, 4.17.1, 4.17.3, 14.1.1, 14.2.2, 14.2.3
10	A.2., A.4., A.6.	Z Transform	Lecture, Discussion	[1] Ch. 4.10-4.11	[1] Probs: 4.10.1, 4.10.3, 4.11.2, 4.11.5
11	A.6., A.7.	Transfer function, pole-zero plot	Lecture, Discussion, Quiz	[1] Ch. 6.14, 7.6	[1] Probs: 6.14.3, 6.14.5, 7.6.5, 7.6.7, 7.6.9
12	B.4., C.2.	Filters: (a) MA filters (b) ARMA filters (c) Filters specification (d) Design	Lecture, Discussion	[1] Ch. 6.7, 6.9-6.10, 7.1	[1] Probs: 6.7.1, 6.7.5, 6.9.2, 6.9.3, 6.10.5, 7.1.3
13	C.2., C.3.	Systems identification	Lecture, Discussion	[1] Ch. 6.12, 6.13	[1] Probs: 6.12.2, 6.12.3, 6.13.4, 6.14.5
14	A.9., B.4., C.3.	Applications (a) Digital communications (b) Speech applications (c) Compression	Lecture, Review, Discussion, Quiz	[1] Ch. 11.3, 11.4, 17, 18 , 19.1, 19.6, 19.8	See chapter problems
FINAL SEMESTER TEST					