London South Bank University

Module Guide

DSP for Communications

ENG_6_522

School of Engineering

2015-16

Level 6

Table of Contents

1. MODULE DETAILS

Module Title:	DSP for Communications
Module Level:	6
Module Reference Number:	ENG_6_522
Credit Value:	20
Student Study Hours:	200
Contact Hours:	26 hours lectures, 12 hours workshop, 12 hours Tutorials (12 hours extra workshop and 12 hours extra tutorials when required)
Private Study Hours:	126
Pre-requisite Learning (If applicable):	*Mathematics, Circuits, Signals and Systems*
Co-requisite Modules (If applicable):	None
Course(s):	BEng and MEng TE
Year and Semester	Year 3 Semester 2
Module Coordinator:	Prof. Mohammad Ghavami
MC Contact Details (Tel, Email, Room)	020 7815 7196, ghavamim@lsbu.ac.uk, T704
Teaching Team & Contact Details (If applicable):	
Subject Area:	Telecommunications
Summary of Assessment Method:	Examination: 70% Coursework: 30%
External Examiner appointed for module:	Dr Jonathan Loo, School of Science and Technology, Middlesex University

2. SHORT DESCRIPTION

Today, Digital Signal Processing (DSP) is widely used in radio receivers, computers, and many other applications where signals need to be processed. DSP is based upon the fact that it is possible to build up a representation of the signal in a digital form.
This Module is a one-semester third year course for students who have had prior exposure to university mathematics, and signal and system theory. It introduces fundamental concepts, algorithms and applications of digital signal processing, starting from a description of how signals can be represented as digital waveforms and how systems may be modelled as digital filters. The Module investigates the processing and analysis of signals using the most common approaches and algorithms.

3. AIMS OF THE MODULE

The aim of this module is to provide final year undergraduate students with the fundamental knowledge of DSP, Intellectual skills in theory and design, practical skills in workshops and capability for problem analysis and solving. The students of this Module will study how to apply DSP techniques to design problems in the real world, exploring the trade-offs between software and hardware implementations of the methods discussed.

4. LEARNING OUTCOMES

4.1 Knowledge and Understanding

At the end of the semester students should understand the implications of the sampling theorem, the importance of the z-transform and its properties, and the impulse response and transfer function of a digital filter. They should also have familiarity with ideal filter approximation functions and be able to design digital filters to meet prescribed specifications. They should be proficient in the use of the discrete Fourier transform (DFT) and its fast form (FFT) to perform signal analysis.

4.2 Intellectual Skills

At the end of the semester students should understand the main mathematical methods for representation of digital signals. They should master the methods for signal sampling and aliasing phenomena and the Nyquist frequency. They should understand transform methods such as Fourier and Z-Transforms. They should know how to design and implement a digital filter and set up a DSP system.

4.3 Practical Skills

At the end of the semester, the students should be able to use DSP tools such as Matlab and Simulink to handle DSP problems. They should be able to design, analysis and simulate digital filters and be able to use the knowledge acquired in class to solve simple engineering problems.

4.4 Transferable Skills

- Analytical skills and laboratory experimentation skills.
- Teamwork in laboratory environment.

5. ASSESSMENT OF THE MODULE

The assessment of the module consists of the end module examination and the course work. The examination mark contributes 70% the overall module result and the course work 30%.

The end-of-module examination paper contains the questions to measure students' appreciation of

- Concepts and principles in signal sampling and data processing.
- Finding results using mathematical transform formulas.
- Design methods for digital filters (FIR and IIR).

The course work is divided into two categories: the project work and the phase test. The project work is worth 20% and the phase test 10%.

The project is aimed to check student's ability to use the knowledge acquired in class to solve engineering problems. The project work is about the design of a digital filter.

Students should sit the phase test in week 8. Questions of the phase test cover the contents taught in lectures from week 1 to 5.

6. FEEDBACK

Feedback will normally be given to students soon after the phase test and the submission of their course work. The students' comments on the teaching organisation will be fed back as soon as possible; and the relevant measures will be taken to satisfy the student requirements.

7. INTRODUCTION TO STUDYING THE MODULE

7.1 Overview of the Main Content

- Fundamental concepts of DSP:
  - Introduction
  - Characteristics of signals
  - System response to an arbitrary input
  - ADC and DAC
- Transform methods:
  - Z-Transform
  - Fourier Transform
  - Discrete Fourier Transform
  - Fast Fourier Transform

- Design of digital filters
  - Design of FIR filters
  - Design of IIR filters

- Skills to work with Matlab

7.2 Overview of Types of Classes

Lectures, tutorials and computer workshops

- Lectures:
  Two hours each week
- Tutorials:
  One hour each week (in average)
- Workshops:
  Two hours each week (even weeks only), focusing on the use of the Matlab tools for programming, digital signal processing and simulation

If required, there will be an extra 12 hours extra workshop and 12 hours extra tutorials available.

7.3 Importance of Student Self-Managed Learning Time

You are expected to carry out a significant amount of self-managed learning, which will include going through the lecture notes on regular basis, further reading to enhance your understanding of the subject matter, solving tutorial examples, and preparing to participate in discussions during formal tutorial sessions. You are required to carry out 126 hours of self-managed study.

7.4 Employability

Enhancing employability is an important issue this module should not ignore. Using the knowledge acquired in class to solve engineering problems will be stressed through teaching. Some key issues associated to job hunting in the field of DSP will be advised.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Module Calendar

Study Area	**activity**	**Week No**
Introduction, signals and systems, ADC and DAC, sampling, quantisation, convolution	Lecture and Tutorial	1,2
Z-transform	Lecture and Tutorial	3,4,5
Discrete Fourier transform and FFT	Lecture, Tutorial and Test	6,7,8
Digital filters, design of FIR filters	Lecture and Tutorial	9,10
Design of IIR filters	Lecture and Tutorial	11,12,13

9. STUDENT EVALUATION

The analysis of the last year's student feedback at the end of the semester showed that the majority of the class felt very happy with the module lecturers and their presentations. In particular, Module

Materials, Quality of Teaching and Assessment were all voted “good” or “very good” by 80%-90% of the students. There were no highly negative responses on any item of the questionnaire.

10. LEARNING RESOURCES

10.1 Core Materials

- IFE, Emmanuel, “Digital Signal Processing: A Practical Approach”, IFE, Addison-Wesley, 2002.
- John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing Principles, Algorithms, and Applications” (4th edition), Prentice Hall, 2006.

10.2 Optional Materials

- Mark J.T. Smith, Russell M. Mersereau, “Introduction to digital signal processing: a computer laboratory textbook”, New York : Wiley, 1992. LSBU Library Class No: 621.382IFE.
- Stranneby, Dag, “Digital signal processing and applications“, Oxford: Newnes, 2004. LSBU Library Class No: 621.382 STR.

11. COURSEWORK PREPARATION AND SUBMISSION

11.1 Lab Coursework Brief

A. Requirements for a Formal Laboratory Report

A coursework assignment will be given to check student’s ability to use the knowledge acquired in class to solve engineering problems by investigating the PCM on Matlab. The more detail will be given in the coursework specifications. You are asked not only work out the simulations, but also write a formal report to describe how you carry on the assignment. The report should include a cover page (showing the report title and student’s name & ID number) and reference page (listing the references used).

- References must be appropriately cited in a laboratory report.
- The so-called “cut & paste” approach is inhibited in order to avoid the plagiarism while writing any technical report.
- A laboratory report should consist of the following sections
  - Introduction
  - Simulation system design according to the CW requirements.
  - Analysis and Discussions
    Explanations of the measured results and observations
  - Conclusions
  - References
    A list of references at the end must be cited within the main text.

B. Coursework Submission Deadline

Deadline: **Friday, 20 May 2016**.

You will submit a soft copy of your CW to the assignment part of the VLE site. A TurnitIn link will be arranged for you to check your coursework’s originality.
Work submitted within one week after the deadline will be awarded a maximum mark of 40%.
Work submitted more than two weeks after the deadline awarded a zero mark.

11.2 Marking Scheme for Coursework

Each report will be assessed according to the following criteria:

Sections	Suggestions	% Marks
Report structure and presentation	Report should have a good structure with the contents page and the whole document should be well presented. A general introduction to the experiment. Should include aims and objectives	20
Background Theory	The underlying theory that you know or tried to learn in this course work. Background study of this subject.	20
Matlab Programming	Program structure, functions; indentation and comments of your source code.	20
Analysis and Comments	Explanation of the measured results and observations. Finding of your simulations.	30
Conclusions & References	Conclusions based on the work carried out. A list of references at the end. Must be cited within the main text.	10

11.3 Laboratory Work

Experiment 1. The Representations & implementation of Signals and Systems using MATLAB
The aim of this lab session is to get familiar with the representations and implementation of signals and systems using MATLAB.

Experiment 2. Analysis of the Discrete-time System Using MATLAB
The aim of this lab session is to study how to use MATLAB to implement the Discrete Time Fourier Transform and inverse z-transform which is a core part of system analysis.

Experiment 3. Sampling and Quantization Using MATLAB
The aim of this lab session is to study how to use MATLAB to implement the sampling and quantization in DSP.

Experiment 4. DESIGN OF WINDOWED FIR FILTERS USING MATLAB
The aim of this lab session is to familiar the FIR filter design using Matlab program.

11.4 Report Assessment Form

Name:_____Lab Tutor:_____
ID: ___ ___Course: _____Date: _____

Sections	Suggestions	% Marks	You scored	Feedback
Report structure and presentation	Report should have a good structure with the contents page and the whole document should be well presented. A general introduction to the experiment. Should include aims and objectives	20		
Background Theory	The underlying theory that you know or tried to learn in this course work. Background study of this subject.	20		
Matlab Programming	Program structure, functions; indentation and comments of your source code.	20		
Analysis and Comments	Explanation of the measured results and observations. Finding of your simulations.	30		
Conclusions & References	Conclusions based on the work carried out. A list of references at the end. Must be cited within the main text.	10		