London South Bank University
EST 1892

School of Engineering

Module Guide

Circuits, Signals & Systems

ENG_5_412

School of Engineering

Level 5

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1. MODULE DETAILS

Module Title:	Circuits, Signals and Systems
Module Level:	5
Module Reference Number:	ENG_5_412
Credit Value:	20
Student Study Hours:	200
Contact Hours:	26 hours lectures, 26 hours workshop, 13 hours tutorials
Private Study Hours:	135
Pre-requisite Learning (If applicable):	Complex number algebra, basic differential and integral calculus, dc and ac circuit theorems
Co-requisite Modules (If applicable):	None
Course(s):	BEng and MEng TE, EEE, EEPE
Year and Semester	Year 2 Semester 1
Module Coordinator:	Prof. Mohammad Ghavami
MC Contact Details (Tel, Email, Room)	020 7815 7196, ghavamim@lsbu.ac.uk, T802
Teaching Team & Contact Details (If applicable):	Prof Mohammad Ghavami
Subject Area:	Electrical and Electronic Engineering, Telecommunications
Summary of Assessment Method:	Examination: 70% Coursework: 30%
External Examiner appointed for module:	Dr Jonathan Loo, University of West London

2. SHORT DESCRIPTION

The module introduces methods to mathematically model circuits, signals and systems required for the engineering of electrical, electronic, telecommunication and control systems. It shows how to model and analyse complex signals with Fourier series, Fourier transforms and Laplace transforms.

The direct and indirect method of convolution is used to find the time response of systems to given inputs. First and second order LTI dynamical systems are modelled with transfer functions and their zero-state and zero-input responses predicted when the inputs are any functions of time. The frequency responses of some common LTI two port filter circuits are also studied.

A MATLAB/SIMULINK workshop enables understanding of signal synthesis using the Fourier series, finding the frequency spectra of complex and noisy signals using FFT, and the time response and the frequency response of systems.

3. AIMS OF THE MODULE

- To provide second year undergraduate students with the fundamental knowledge of signal analysis and synthesis, intellectual skills in theory and design, practical skills in workshops and capability for problem analysis and solving.

- To develop knowledge and the ability of the analytical methods used to model and predict the behaviour of signals and systems in electrical, electronic, telecommunications and control systems engineering.

4. LEARNING OUTCOMES

At the end of the module, students will be able to undertake the actions described in each of the four areas below.

Science and Mathematics (SM)

- Understanding the formulation of the mathematical models of simple circuits and systems.
- Familiarity with the basic concepts of linear systems theory including convolution, Laplace transform analysis, transfer functions, time response, and frequency response. (A1, A2) [SM1i, SM2i]

Engineering Analysis (EA)

- Understanding the types of signal, their classification and different applications in engineering with particular emphasis on electrical and electronic engineering.
- Familiarity with the engineering significance of Fourier series, Fourier transform and Laplace transform. (B1, B2) [EA1i, EA2i]

Engineering Practice (EP)

- Utilising Matlab and Simulink for development and application of analytical models to solve engineering problems. (C1, C2) [D1i, D2i]

Additional General Skills

- Perform teamwork in laboratory environment and competently maintain a logbook. (D1) [D4i]

5. ASSESSMENT OF THE MODULE

The assessment of the module consists of the end of module examination and the course work:

- Two-hour examination assesses the entire taught syllabus (70%)
- Coursework (30%):
  - One-hour phase test around week 8 (10%) for the assessment of all taught materials up to the end of Fourier Transform
  - Workshop report/logbook (20%)

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

- Introduction to signals and the mathematical representation of complex signals
- Trigonometric and exponential Fourier series
- The Fourier transform
- The Laplace transform as the extension of Fourier transform
- Time-responses of first and second order electrical circuits and the use of convolution
- Frequency response of linear systems and Bode plots

7.2 Overview of Types of Classes

Lectures, tutorials and computer workshops

- Lectures:
  Two hours per week
- Tutorials:
  One hours per week
- Workshops:
  Two hours per week

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 135 hours of self-managed study.

7.4 Employability

This module will prepare students to work in all fields of engineering where electrical and communications infrastructure is to be specified, designed, commissioned and operated. Students will be equipped with the essential theory and practice enabling them to assess modern trends in the subject and maintain and update their knowledge.

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 laboratory experiments and tutorials. Some key issues associated to job hunting in the field of communications and control engineering will be advised. It will prepare graduates with relevant skills for various possible jobs in this field.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Module Calendar

Study Area	**Activity**	**Week No**
- Introduction to signals	Lecture, Lab and Tutorial	1
- Trigonometric and exponential Fourier series	Lecture, Lab and Tutorial	2,3
- Fourier transform	Lecture, Lab and Tutorial	4,5
- Laplace transform	Lecture, Lab and Tutorial	6,7
- Time-responses and convolution	Lecture, Lab, Tutorial and Phase test	8,9
- Frequency response and Bode plots	Lecture, Lab and Tutorial	10,11,12
- Review	Tutorial	13

9. STUDENT EVALUATION

The analysis of the last years' student feedback at the end of the semester showed that the majority of the class felt happy with the module lecturer and his presentations.

10. LEARNING RESOURCES

10.1 Core Materials

- Nilsson, James W. and Susan Riedel, "Electric Circuits", (10th edition), Prentice Hall, 2014.

10.2 Optional Materials

- Phillips, Charles L., John Parr and Eve Riskin, "Signals, systems, and transforms", (5th edition), Pearson, 2013.

- Roberts, Michael J., "Fundamentals of signals and systems", McGraw-Hill Education, 2007.

11. COURSEWORK PREPARATION AND SUBMISSION

11.1 Lab Coursework Brief

The assessment of the Lab Coursework, worth 20% of the total module mark, is through an **electronic logbook** (**formal report**) recording and documenting the workshop observations and results with the inclusion of relevant background theories. Discussion, analysis and comparison must also be included to explain the understanding of each exercise. Refer to the guidelines below when producing your report.

General Instructions to students:

General Requirement

- To complete the MATLAB exercises on a weekly basis.
- The weekly period will be from session to session.
- In general, each exercise has a programming part and written analysis.

Requirements for programming part

- For each exercise, you must record and documenting all the MATLAB output displays. These should be properly labelled and titled.
- If needed, you can use a personal logbook (not for submission) to do the documentation.

Word File

Each exercise requires you to write and run a MATLAB program. The program will produce output, usually in the form of a figure. Each of these figures should be copied and pasted into a word file with appropriate tile and labelling. The word file must be titled and dated.

The programs are often built in stages and the figures you present should reflect this.

Make sure you have the file loaded and ready for viewing during every session.

11.2 Marking Scheme for Coursework

Reports will be assessed according to the following criteria:

- Introduction and background theory (20% marks)
- Observation and results (30% marks)
- Analyses and discussion (20% marks)
- Conclusions (10% marks)
- General presentation and references (20% marks)

11.3 Laboratory Work

The Lab coursework comprises of the following:

- Understanding the concept of Fourier series and decomposition and Fourier transform utilising MATLAB to explore and generate different signals.
- Trigonometric Fourier series synthesis of signals such as square, half-rectified, triangular and saw-tooth waveforms.
- Fast Fourier transform to find the frequency components and the power spectrum of noisy complex periodic and aperiodic signals.
- Prediction of the unit step responses and frequency responses (Bode plots) of circuits and systems from their transfer functions.

11.4 Report Assessment Form

Student Name: ________________ **Student Number:** ______________

	A+	A	A-	B	C	D	E	F
Introduction and Background Theories (20%)								
Observations, Results, Analysis and Discussion (50%)								
Presentation, Conclusion and References (30%)								

Remarks	

Grade: **Assessed by:**

Date:

This grade is provisional and may be subject to change