

New York City College of Technology  
of the City University of New York

**DEPARTMENT:** Electrical and Telecommunications Engineering Technology

**SUBJECT CODE:** TCET 3102

**COURSE TITLE:** Analog and Digital Communications I

**COURSE DESCRIPTION:** The course introduces basic concepts in analog and digital communications. Topics covered include spectral analysis of electrical signals, Fourier series, Fourier transform, signal and noise filtering and amplification. Amplitude, frequency and phase modulation techniques as well as amplitude and pulse-code modulation in Analog to Digital converters are covered. Introduction to traffic engineering is studied in the laboratory.

**PREREQUISITES:** AAS in TCET or Department Approval

**TEXTBOOK:**

1. Djafar K. Mynbaev and Lowell L. Scheiner, *Essentials of Modern Communications*, Wiley, 2020.
2. Laboratory manual:
  - a. Part I developed by Professors Mynbaev and Hossain
  - b. Part II from Emona Technologies, LLC (TIMS)

**REFERENCE:** W.J. Palm III. *Introduction to MATLAB 7 for Engineers*, McGraw-Hill Higher Education, 2005.

**COURSE OBJECTIVES/** Upon completion of this course, students will be able to:

**COURSE OUTCOMES:**

1. To analyze the general architecture of the telephone network and the future trends in telecommunications. (ABET Criteria 3a, 3b, 3f).
2. To perform spectral analysis of periodic and aperiodic signals. (ABET Criteria 3a, 3b, 3f, and PC.d).
3. Use CAD software in the design and analysis of filters. (ABET Criteria 3a, 3b, 3f and PC.a).
4. Apply the concept of a transfer function to transmission channels, quantitatively describe the noise effect in a system, and calculate signal-to-noise ratio. (ABET Criteria 3a, 3b, 3f.).

5. Describe the need for modulation and quantitatively analyze amplitude-modulated and angle-modulated signals. (ABET Criteria 3a, 3b, 3f and PC.a).
6. Work in a group and gain hands-on experience in the lab by implementing, testing, and analyzing the amplitude-modulated and angle-modulated systems through hardware experiments. (ABET Criteria 3a, 3b, 3c, 3d and PC.a).
7. Present technical reports in oral and written forms. (ABET Criteria 3g, 3i, and 3k.).

**TOPICS:** Topics include the history and future trends in telecommunication systems, the use of CAD software such as MATLAB in the design and analysis of filters, transfer function, time/frequency analysis of electrical signals, Fourier series and Fourier transform, standard AM, FM, and angle modulation techniques, and SSB, VSB, DSBSC signals.

**CLASS HOURS:** 3

**LAB HOURS:** 3

**CREDITS:** 4

**PREPARED BY:** Course TCET 3102 Analog and Digital Communications I weekly schedule is prepared by Professor Emeritus Djafar Mynbaev, October 2021 ([dmynbaev@citytech.cuny.edu](mailto:dmynbaev@citytech.cuny.edu)).

The rest of the outline is prepared by Professors Kouar and Marantz and modified by Professor Hossain.

**COURSE** Professor Mohammed Kouar (718) 260-5316

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**Description of laboratory work:** Laboratory exercises include using MATLAB to analyze periodic signals by obtaining their frequency spectrums, design and application of Elliptic and Butterworth filters. Hardware experiments include signal analysis using oscilloscope and spectrum analyzer, implementation and analysis of DSBSC signals, standard AM signals, envelope recovery of standard AM signals, generation of FM signals using a VCO, and FM demodulation with a phase-locked loop (PLL).

**Course contribution in meeting ABET Criterion 5 requirements:** TCET 3102 meets criterion 5 by providing students with a strong foundation of principles and laboratory skills needed to design and analyze communication systems that utilize linear and non-linear modulation techniques as well as the synthesis and analysis of filters. Academic benchmarks, course outcomes,

and assessment requirements have been established to ascertain student comprehension of concepts and proper usage of test equipment. Additionally, by fostering critical thinking, communications, and team work, students develop the skills needed to solve problems in a classroom and laboratory environment, which will later serve them in the work place.

**GRADING POLICY: TCET 3102**

- Homework 5%
- Quizzes 10%
- Midterm Exam 20%
- Laboratory Reports 20%
- Term Paper 15%
- Final Exam 30%

Letter grade	Numerical Grade Ranges	Quality
A	93-100	4.0
A-	90-92	3.7
B+	87-89.9	3.3
B	83-86.9	3.0
B-	80-82.9	2.7
C+	77-79.9	2.3
C	70-76.9	2.0
D	60-69.9	1.0
F	59.9 and below	0,0

**Assessment:** The following assessment techniques are correlated to the course objectives as follows. In addition, each assessment technique incorporates one or more of the following ABET Criterion 3 outcomes (3a, 3b, 3c, 3d, 3e, 3f, 3g, 3i, and 3k).

Course objectives	Assessment
1. Describe the general architecture of telecommunication networks and future trends in telecommunications.	1.1 Distinguish between local, regional, and long-distance networks
	1.2 Use technical characteristics of cables to determine the length and applicability of a local loop.
	1.3 Determine the need for higher bandwidth systems for digital communications.
	1.4 Understand the emerging technology in communications.
	1.5 Analyze telephone network.

2. Perform spectral analysis on periodic and aperiodic signals.	2.1 Understand and apply the Fourier series and Fourier Transform to different signals.
	2.2 Use CAD tools to obtain the spectrum of signals.
3. Ability to use CAD software in the design and analysis of filters.	3.1 Understand the difference between various filter types such as band-pass, high-pass, low-pass, and their specific design parameters (Elliptic, and Butterworth).
	3.2 Understand how the various parameters in the design of filters affect their performance.
	3.3 Ability to use MATLAB in designing and analyzing filters.
4. Apply the concept of a transfer function to transmission channels and be able to describe the noise in a system quantitatively and calculate signal-to-noise ratios.	4.1 Being able to use filter transfer functions to calculate signal-to-noise ratios for a given system.
	4.2 Understand how transfer function relates output signals to input signals.
	4.3 Recognize the various sources of noise that exists in electronic circuits and how they affect communications systems. 4.4 Ability
	to calculate the signal to noise ratio of an input signal as it passes through a system.
5. Describe necessity for modulation and analyze amplitude modulated and angle modulated signals.	5.1 Understand the advantages of modulation for purposes of effective transmission.
	5.2 Ability to quantitatively and experimentally analyze various AM systems.
	5.3 Ability to quantitatively and experimentally analyze FM systems.
	5.4 Understand the use of the VCO, LPF, and amplifier in the various stages of a modulation system.
	5.5 Explain the concepts of multiplexing and its application to modern and future telecommunication systems.
6. Work in a group and gain hands-on experience in lab by implementing, testing and analyzing amplitude modulated and angle modulated systems through hardware experiments.	6.1 Work together as a member of a group.
	6.2 Achieve familiarity with equipment used in professional laboratories.
	6.3 Know how to apply knowledge to real world problems.
	6.4 Understand how to implement various modulation techniques in a practical setting.
	7.1 Demonstrate written communication competence.

7. Present technical report in oral 7.1 Demonstrate written communication competence. and written form.	7.2 Demonstrate oral communication competence.
	7.3 Meet project/ report deadline.

## Course TCET 3102 Analog and Digital Communications I

### Weekly schedule

Week	Topic	Reading assignment	Homework problems
1	Overview of the class, rules, and policies -History of the Telephone Network -General architecture of telephone network -How to breakdown and understand a typical 10-digit telephone number -Analog and digital transmission	5-12, 22-27, 75-85, 104-108, 708, 824.	Section 1.1: 1-14, Section 3.1, 1-15.
2	Define Bandwidth and its importance -Voice Characteristics - The anatomy of the Telephone -The Local Loop Twisted Pair - Broadband: DSL, cable TV, Wireless, Passive Optical Network (PON)	16-22, 42-46, 75-85, 99, 151-159, 999, 1002-1007.	Section 1.2: 1-14, Section 2.2: 30-52.
3	Time and Frequency Domains (Sine and Cosine) -Sums of Sines and Cosines -Power signals -Real Frequency & Complex Frequency - Fourier Series -Filtering	108-121, 130-146, 498-520, 546-566, 579-588, 594-598.	Section 2.1: 14-28, Section 6.1: 1-30, Section 6.3: 16-28.
4	Non-Periodic Signals -Energy Signals -Fourier Transforms of Triangle and Square waves	617-639, 646, 654-659	Section 7.1: 1-21, Section 7.2:

			1-20.
5	-Transfer Functions -Bode plot - Convolution	381-394, 447-490, 658-667	Section 5.2: 43-63, Section 5.4: 25-32, and 33-42, Section 7.2: 16-20.
<b>6</b>	<b>Midterm Exam</b>		
7	-Introduction to Noise -Why do we care? -What is the source of noise? - Signal to Noise Ratio/SNR-Noise figure	500, 807-810, 835-842, 1017.	Section 8.2: 38-42, Section 9.3: 30-50.
8	Signals and Modulation -Why do we modulate? -How do we Modulate: Analog Modulation and Digital Modulation	204-214, 710-714, 715-732.	Section 3.1: 32-35, Section 8.1: 1-17.
9	Amplitude Modulation: DSBSC, SSB, DSBAM -FDM - Modulation Methods -VSB	762-784.	Section 8.2: 1-21.
10	Amplitude Demodulation: Synchronous detection and Envelope Detection	725-732, 774-784.	Section 8.2: 21-24, Section 9.2: 16-21.
11	VCO-Angle Modulation -Frequency Modulation	733-754, 784-803.	Section 8.1: 30-41, Section 8.2: 25-36.
12	Angle Demodulation -Frequency Demodulation -PLL	746-750, 750-754, 784-810.	Section 8.1: 41-57, Section 8.2: 36-42.

13-14	Project Presentations and Review		
15	<b>Final exam</b>		

## Weekly Schedule for TCET 3102 Experiments

Week #	Experiment
1-2	Review MATLAB: -Introduce and use of the Demo and Help file -Operators, data types, variables, arrays -If-else, for, while - Plot, title, label - Functions
3	Fourier series using MATLAB
4	Synthesis and Analysis of a square wave using MATLAB.
5	Signal analysis using oscilloscope and spectrum analyzer.
6	Design and application of an elliptic filter using MATLAB.
7	Design and application of bandpass Butterworth Filter using MATLAB.
8	Introduction to TMS.
9	Modeling an Equation (using TMS).
10	Amplitude Modulation (using TMS).
11	DSBSC signal Generation (using TMS).
12	Envelope Recovery (using TMS)
13	Introduction to FM with VCO (using TMS).
14	FM demodulation with the PLL.
15	<b>Lab Exam.</b>

### New York City College of Technology Policy on Academic Integrity

Students and all others who work with information, ideas, texts, images, music, inventions, and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the College recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion. The complete text of the College policy on Academic Integrity may be found in the catalog.