СӘТБАЕВ УНИВЕРСИТЕТІ SATBAYEV UNIVERSITY

Institute of automation and information technologies

Department Electronics, telecommunications and space technologies

APPROVED by
Kalpeyeva Zh.B.

«20» 08 2024

SYLLABUS

ELC5693-GENERAL COMMUNICATION THEORY

6B07112 Electronic and Electrical Engineering

5 credits (1/1/1/2)

Semester: *autumn*, 2024-2025 academic year

Almaty 2024

Information about instructor:

1.1 lecturer:

Dosbayev Zhandos Makhsutuly, PhD, senior lecturer

Learning format – full-time/distance

office: IM&E, 169

Office-hours: Monday 11:00-12:00

E-mail:
zh.dosbayev@satbayev.university

1.2 Instructor(s), conducting the practical/laboratory work

Kengesbayeva Sara, master of engineering sciences, teacher

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Office-hours: Monday 11:00-12:00

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2 The purpose and the objective of the course

The purpose: The purpose of the course "General Communication Theory" is to provide students with a comprehensive understanding of the fundamental principles that govern the transmission and processing of information in communication systems. This course aims to explore the theoretical foundations of communication, including signal representation, noise, modulation, coding, and channel capacity. Students will learn to analyze and design communication systems that efficiently transmit information while overcoming the challenges posed by noise and interference. The course prepares students to apply these principles to real-world telecommunication systems, data networks, and modern communication technologies, ensuring effective and reliable information exchange.

The objective:

- to provide a solid foundation in the fundamental principles of communication theory, including the concepts of signal representation, encoding, modulation, and decoding;

- to enable students to analyze and model the transmission of signals through various communication channels, taking into account factors such as noise, distortion, and interference and evaluate channel capacity;

- to study different modulation techniques (analog and digital) and their applications in improving signal transmission and efficiency;

- to learn About Coding and Error Correction: To understand the role of coding in error detection and correction, and to learn about various error-correcting

codes and their implementation;

- Understand System Performance: To assess the performance of communication systems in terms of reliability, efficiency, and data integrity, and to propose improvements based on theoretical insights;

3 Course Description:

The course is intended for students of the educational program «6B07112-Electronic and Electrical Engineering». This course covers the essential concepts of signal transmission, including the representation of signals, modulation methods, and the impact of noise and interference on signal quality. Students will gain an understanding of both analog and digital communication techniques, focusing on how signals are encoded, transmitted, and decoded. Key topics include modulation techniques (such as AM, FM, and digital modulation schemes), error detection and correction through coding, and the capacity of communication channels as described by the Shannon-Hartley theorem.

4. Learning outcomes

Upon completion of the course, the student will know:

– the core concepts of communication theory, including signal representation, modulation, and encoding;

– analog and digital modulation methods, such as amplitude modulation (AM), frequency modulation (FM), and digital modulation schemes like QPSK and QAM;

– the concept of determining of channel capacity and its relationship to data rate and bandwidth, including the Shannon-Hartley theorem.

be able to:

– evaluate and analyze the performance of various communication systems, considering factors such as signal quality, noise, and interference.

– utilize and design error detection and correction codes to improve the reliability and performance of communication systems.

Have skills:

– Basic skills in using simulation software to model and analyze communication systems;

– problem-solving and analytical skills necessary for designing, optimizing, and troubleshooting communication systems;

– implementation and applying different modulation techniques (analog and digital) to optimize signal transmission and improve system efficiency.

5 Calendar and thematic plan

Week	Topic of the lecture	Topic of the practical work	Topic of the laboratory work	SIS/TSIS	Reference to the literature	Deadline
1	Key concepts and definitions of the general communication theory	Practical qork 1 Introduction. Analysis of Information, Messages, and Signals	Laboratory work 1. Measurement of deterministic signal parameters.		[1]6-15 [3] 8-20 [2] 6-20	
2	Informational Characteristics of the Message Source and Communication Channel	Practical work 1 Introduction. Analysis of Information, Messages, and Signals	Laboratory work 1. Measurement of deterministic signal parameters.		[1]31-15 [6] 145-150	
3	Classification of Signals in Communication Systems	Practical Work 2: Determining Signal Parameters	Laboratory work 2. Analysis of periodic signal spectra.	SIS 1. Mathematical Models of Messages, Signals, and Noise.	[1]152-184 [6]153-163	4th week
4	Fundamentals of Information Theory. Qualitative Indicators of Information Transmission	Practical Work 2: Determining Signal Parameters	Laboratory work 2. Analysis of periodic signal spectra.		[1]97-103 [2]126-157 [6]131-137	
5	Methods and Forms of Signal Representation	Practical Work 3: Calculating the Quality Indicators of Information Transmission	Laboratory work 3. Signal transformation in a nonlinear circuit.		[1]28-56 [2]49-73	
6	Efficient Coding. Huffman and Shannon-Fano Methods	Practical Work 3: Calculating the Quality Indicators of Information Transmission	Laboratory work 3. Signal transformation in a nonlinear circuit.	SIS 2. Mathematical Models of Communication Channels.	[1]8-11 [3]6-15	7th week
7	Modulation. Analog Modulation and Demodulation	Practical Work 4: Coding Using the Huffman and Shannon-Fano Methods	Laboratory work 4. Study of amplitude-modulated signals.		[1]66-69 [3]68-79 [14]71-78	
8	Discrete, Pulse, and Digital Modulation	Practical Work 4: Coding Using the Huffman and Shannon-Fano Methods	Laboratory work 4. Study of amplitude-modulated signals.		[1]84-96 [3]150-162 [4]270-288	
	The mid-term control-The first attestation				**First attestation**	Week 8
9	Discretization	Practical Work 5:	Laboratory		[1]67-86 [3]75-82	

Week	Topic of the lecture	Topic of the practical work	Topic of the laboratory work	SIS/TSIS	Reference to the literature	Deadline
	and Quantization of Continuous Signals. Kotelnikov Theorem	Calculating Modulation Parameters	work 5. Study of frequency and phase modulated signals.		[8]78-85 [2]82-120	
10	Noise and Distortions in Communication Channels	Practical Work 5: Calculating Modulation Parameters	Laboratory work 5. Study of frequency and phase modulated signals.		[1]65-74 [2]82-100	
11	Random Variables and Their Characteristics	Practical Work 6: Studying Noise-Resistant Codes	Laboratory work 6. Study of phase-shift keying (PSK) signals.	SIS 3. Study of Analog and Digital Modulation Processes.	[1] 19-23 [2]257-262 [3]45-68 [4]354-366	12th week
12	Fundamentals of Coding Theory	Practical Work 6: Studying Noise-Resistant Codes	Laboratory work 6. Study of phase-shift keying (PSK) signals.		[3]354-380 [4]368-375	
13	Noise-Resistant Codes. Methods for Constructing Hamming Codes	Practical Work 7: Error-Detecting Codes. Error-Detecting and Correcting Codes	Laboratory work 7. Detection of amplitude-modulated signals.	SIS 4. Study of error-correcting codes	[3]358-365 [4]391-394	14th week
14	Cyclic Codes. Encoding and Decoding Algorithms	Practical Work 7: Error-Detecting Codes. Error-Detecting and Correcting Codes	Laboratory work 7. Detection of amplitude-modulated signals.		[3]340-372 [4]354-366	
15	Information Transmission Systems with Feedback	Practical Work 8: Calculating Noise-Resistant Cyclic Codes	Laboratory work 8. Study of cyclic codes		[3]340-372 [4]354-366	
	The second final attestation					Week 15
	Examination					Based on the schedule

6 Literature

Required	Supplementary
[1] Ray Horak. Telecommunications and data communications handbook. John Wiley & Sons, Inc., Hoboken, New Jersey, 2020.	[4]Modem Theory.An Introduction to Telecommunications. Richard E. Blahut. Cambridge University Press, New York. 2022
[2] Васюков В.Н. Общая теория связи: Учебник. –Новосибирск: Изд-во НГТУ, 2017. –580 с.	[5] В.А. Григорьев Теория электрической связи. Сборник задач – СПб: НИУ ИТМО, 2019. – с. 74.
[3] Бабанин И. Г. Общая теория связи.учеб.пособие / И. Г. Бабанин, Д. С. Коптев; Юго-Зап. гос. ун-т. – Курск, 2018. – 110 с. – Библиогр.:108–109 с.	[6] Васюков В.Н. Общая теория связи: сборник задач и упражнений: учеб.пособие – Новосибирск: Изд-во НГТУ,2019. – 72 с.

* *The literature is available in the electronic resources of the library.*

** *The main literature should not be older than 10 years.*

~ *The literature is available on the teacher's learning portal.*

7 Competence framework

Learning Descriptors	Competences				
	Natural science and theoretical worldview	Socio-personal and civil	General engineering professional	Cross-cultural and communicative	Special-professional
Knowledge and comprehension	+		+		+
Application of knowledge and comprehension			+		+
Expression of judgments and analysis of actions		+		+	
Communication and creative abilities		+		+	+
Self-learning and digital skills			+		+

8 Schedule of submission of mandatory assignments

# s/n	Type of control	Max score of the week	Weeks															Total max points
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Activeness in lecture discussions **Questionnaire**					*						*					*	
2	Task execution (TSIS)				1,5			1,5				1,5			1,5			6
3	Student Independent Study (SIS)					2			2				2			2		8
4	Performing the practical tasks			2		2		2		2		2		2		2	2	16
5	Performing the laboratory tasks			2		2		2		2		2		2		2	2	16
6	1st attestation										7							7
7	2nd final attestation																7	7
8	Final exam*																	40
	In total																	100

9 Evaluation rating and possible final versions of assessments according to criteria

Letter grade	GPA	scores	Criteria
A	4	95-100	Shows the highest standards of knowledge, exceeding the volume of the course taught
A-	3,67	90-94	Meets the highest standards of knowledge
B+	3,33	85-89	Very good and meets high standards of knowledge
B	3	80-84	Good and meets most high standards of knowledge
B-	2,67	75-79	More than sufficient knowledge approaching high standards
C+	2,33	70-74	Sufficient knowledge that meets the general standards
C	2	65-69	Satisfies and conforms to most common knowledge standards
C-	1,67	60-64	Satisfies, but according to some knowledge does not meet the standards
D+	1,33	55-59	Minimally satisfying, but does not meet the standards for a large range of knowledge
D	1	50-54	Minimally satisfactory passing score with questionable compliance with standards
FX	0,5	25-49	Temporary assessment: Unsatisfactory low indicators, retake of the exam is required
F	0	0-24	Didn't try to master the discipline. It is also exposed when a student tries to get a grade on the exam by cheating

10 Evaluation criteria

Each work except tests is evaluated according to 4 criteria:

– precision and accuracy (A) – 30% (how accurately and neatly the work is calculated);

– inventiveness and creativity (T) – 30% (how and in what way the work is presented);

– completeness and maturity (H) – 40% (how profoundly, logically and structurally the work is solved);

– originality (O) – a special coefficient of 1.0, 0.5 or 0 is used.

Criteria	Excellent (0.9-1.0)	Good (0.7-0.9)	Satisfactory (0.4-0.7)	Unsatisfactory (0-0.4)
precision and accuracy	0,3	0,24	0,15	0,06
inventiveness and creativity	0,3	0,24	0,15	0,06
completeness and maturity	0,4	0,32	0,2	0,08
originality	0	0		0

The overall score will be calculated due to the formula:

$$Score = (A + T + 3) \times O$$

11 Late submission policy

The student must come prepared for lectures and practical (laboratory) classes.

Timely protection and full performance of all types of work (practical and independent) is required. The student should not be late and miss classes, be punctual and mandatory. It is planned to reduce the maximum score by 10% for untimely work. If you are forced to skip the intermediate certification for good reasons, you should warn the teacher in advance before it, so that you can pass the boundary control in advance. Skipping an exam for a disrespectful reason deprives you of the right to take it. If you miss the exam for a good reason, a special permit is issued and the date, time and place of the exam are assigned.

12 Academic Conduct and Ethics Policy

Be tolerant, respect the opinions of others. Formulate objections in the correct form. Plagiarism and other forms of dishonest work are unacceptable. Prompting and cheating during exams, passing the exam for another student are unacceptable. A student caught falsifying any course information will receive a final "F" grade.

Activeness in lectures and practical classes is mandatory and is one of the components of your final score / assessment. Many theoretical questions supporting the lecture material will be presented only at lectures. Therefore, skipping a class can affect your academic performance and final grade. However, attending classes in itself does not mean an increase in points. Your constant active participation in the classes is necessary. A mandatory requirement of the course is to prepare for each lesson. It is necessary to review the specified sections of the textbook and additional material not only in preparation for practical classes, but also before attending the corresponding lecture. Such training will facilitate your perception of new material and will contribute to your active acquisition of knowledge within the walls of the university.

Support: For advice on implementing the independent work, their submission and defending, as well as for additional information on the material covered and all other questions arising on the course being read, contact the teacher during their office hours or via electronic means of communication during working hours.

During the process of learning:

Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence, the student is obliged to notify the teacher within a day and explain the plan for self-study of the study material:

- mandatory reading of the presented materials before the lesson;
- submission of tasks on time;
- 20% non-participation in the audience (for a valid reason with the supporting documents) - rating "F (Fail)";
- plagiarism and cheating during the execution of the task are not allowed;
- mandatory use of electronic gadgets in the classroom that is welcome, but it is unacceptable to use them in the exam.

Any appearance of academic dishonesty, academic deception and corruption in any form are unacceptable within the framework of the sunject. The organizer of such actions (the teacher, students or third parties on their behalf) are fully responsible for violating the laws of the Republic of Kazakhstan.

In the beginning of the academic term, students need to familiarize themselves with the contents of the syllabus F KazNRTU 401-03. The journal of familiarizing.

Considered at the meeting of the ET&ST Department
Minutes №1, 20th of august, 2024

Head of the department _____ **Tashtay Y.**

Syllabus designer: _____ **Dosbayev Zh.**