

Ministry of science and education of Ukraine

Ternopil Ivan Puluj National Technical University

Faculty Computer Information Systems and Software Engineering

Department Computer Systems and Networks

SYLLABUS

Digital communication systems

field of knowledge 12 Information technologies

level of higher education bachelor

speciality 123 Computer engineering

educational program Computer engineering

specialism _____

type of discipline optional

1. Discipline structure

Activity	Total hours	
	Full-time study	Part-time (distance) study
Number of credits/ hours	4.5/135	-
Classroom study, hours	54	-
Self-study, hours	81	-
Classroom study:		
• lectures, hours	36	-
• laboratory classes, hours	18	-
• practical classes, hours	-	-
• seminars, hours	-	-
Self study:		
Preparation for laboratory (practical, seminar) classes	41	-
Work on certain topics which lectures do not cover	8	-
Control papers	-	-
Individual tasks	-	-
Course projects (papers)	-	-
Preparation and taking credits, exams, test papers, reference papers, essays, tests	12	-
Examination	-	-
Credit	2	-

Student's self study share:

Full-time study - 60%;

Part-time (distance) study -%.

2. Purpose and objectives of the discipline

2.1. The aims of this course are to introduce the principles and applications of digital communication systems. The course will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies; how these are used to calculate the capacity of a communication channel, with and without noise; coding schemes, including error correcting codes; how discrete channels and measures of information generalise to their continuous forms

2.2. objectives

A student has to demonstrate such learning outcomes on the discipline (write 5-7 outcomes):

1. Skill to apply knowledge in practice
2. Skill to adapt to new situations
3. Skill to work both in team and by himself/herself
4. Skill to be responsible in work and to gain his/her end
5. Skill to apply knowledge and comprehension to solve problems of analysis and synthesis in the systems specific for chosen field
6. Skill to speak and write Ukrainian and a foreign (English, French, German) language
7. Skill to apply information and communication technologies to solve different research and professional tasks
8. Skill of information search in different sources for professional problems solving
9. Skill to make reasonable decisions and estimate their results
10. Skill of criticism perception, self-criticism, be self-critical to his/her actions, and criticize the results of work
11. Skill to follow the code of professional ethics, moral norms and valuables in behavior, keep to etiquette rules
12. Skill to apply basic knowledge of fundamental and applied mathematics in scientific-research and professional activity

13. Skill to apply basic knowledge of information technologies standards in information systems and technologies development and introduction

14. Skill to use computer aids at design and creation of computer systems and networks software and hardware

15. Be well-trained to use existing and develop new mathematical methods to solve problems on computer systems and networks design and use

16. Skill to use probabilistic-statistical methods at computer systems hardware and software design

The teaching of this discipline aims at formation and development of the following students' competences:

general:

1. Ability to apply knowledge in practice
2. Ability to adapt and work in unknown situation
3. Ability to work both in team and by himself/herself
4. Ability to provide and estimate quality of work
5. Ability of analysis and synthesis
6. Ability to speak and write mother tongue
7. Skills of information and communication technologies use General
8. Ability of information from different sources search, processing and analysis
9. Ability to find, set and solve problems
10. Ability to be critical and self-critical a
11. Ability to work in international context

professional:

- 1 Well-trained in mathematics to use mathematical apparatus at solving applied and scientific tasks of computer engineering
- 2 Well-trained in physics, theory of electric and magnetic circuits
- 3 Knowledge of random phenomena law and a skill in using probabilistic-statistical methods to solve professional tasks

3. Discipline description

3.1. Lectures

№	Topic and contents in brief	Number of hours	
		Full-time	Part-
1.	Model of the signaling system. Encoding a source alphabet. Mathematical foundations of information theory.	2	-
2.	The information channel. Channel relationships. Example of the binary symmetric channel	4	-
3.	Information	4	-
4.	System Entropies	4	-
5.	Mutual Information	2	-
6.	Channel Capacity	2	-
7.	Modulation. Amplitude Modulation.	2	-
8.	Phase Modulation (PM). Frequency modulation (FM).	4	-
9.	Some Particular Codes. The ASCII Code. Some Other Codes. Radix r Codes. Escape Characters.	2	-
10.	Theory and Practice of Error Control Codes. Introduction to Block Codes.	2	-
11.	Perfect codes. Generator Matrices. Parity Check Matrices Hamming Codes.	4	-
12.	Shannon-Fano Coding. Huffman Coding.	4	-
Total hours		36	-

3.2. Laboratory classes

№	Topic	Number of hours	
		Full-time	Part-
1.	MATLAB Basics for Communication System Design	2	-
2.	Communication Signals: Generation and Interpretation	2	-
3.	Time And Frequency Domain	2	-
4.	System Entropies	4	-
5.	Amplitude Modulation (Simulink Implementation)	2	-

6.	Reed-Solomon Code in Integer Format	2	-
7.	Hamming Codes	4	-
Total hours		18	-

3.3. Self study

№	Name of work	Number of hours	
		Full-time	Part-
1.	Preparation practical class “MATLAB Basics for Communication System Design and important contributions”	5	-
2.	Preparation practical class “Communication Signals: Generation and Interpretation”	6	-
3.	Preparation practical class “Time And Frequency Domain”	6	-
4.	Preparation practical class “System Entropies.”	6	-
5.	Preparation practical class “Amplitude Modulation (Simulink Implementation)”	6	-
6.	Preparation practical class “Hamming Codes”	6	-
7.	Preparation practical class “Reed-Solomon Code in Integer Format”	6	-
8.	Entropy of Markov Process	4	-
9.	Shannon’s Main Theorem	4	-
10.	Delta Modulation	4	-
11.	Purpose of the Gray Code	5	-
12.	Preparation test 1	6	-
13.	Preparation test 2	6	-
14.	Credit	2	-
Total hours		81	-

4. Criteria of students' progress assessment

Form of final term control – credit

Module 1			Module 2				total on
Classroom work and self-study			Classroom work and self-study				
Theoretic al classes (tests)	Practical classes		Theoretic al classes (tests)	Practical classes			
20	20		20	15		25	100
№ of lecture	Types of classes	points	№ of lecture	Types of classes	points	3 points of term mark equals to 1 point of final term mark	
Lecture 1	Lab. Work №1	5	Lecture 7	Lab. Work №5	5		
Lecture 2	Lab. Work №2	5	Lecture 8				
Lecture 3	Lab. Work №3	5	Lecture 9	Lab. Work №6	5		
			Lecture 10				
Lecture 4	Lab. Work №4	5	Lecture 11	Lab. Work №7	5		
Lecture 5							
Lecture 6			Lecture 12				

6. References

Basic

1. Edwin H. Armstrong. Some recent developments in the audion receiver. Proc. Inst. Radio Engineers (IRE), 3:215–247, 1915. 143
2. Patrick Cambre. A one transistor super-regenerative FM receiver. [http://web.archive.org/web/20090121123846/http://braincambre500.freeservers.com/rss\(1\)\(1\)\(1\).htm](http://web.archive.org/web/20090121123846/http://braincambre500.freeservers.com/rss(1)(1)(1).htm). Archived 2009-01-21; accessed 2015-06-09. 143
3. R. W. Chang. Synthesis of band-limited orthogonal signals for multi-channel data transmission. Bell System Technical Journal, 45(10):1775–1796, 1966. 113
4. J.P. Costas. Synchronous communications. Proceedings of the IRE, 44(12):1713–1718, Dec 1956. 131
5. Martijn de Milliano. Simple FM radio. www.millibyte.nl/index.php?page=fm-radio, 2002. Accessed: 2015-06-09. 143
6. Steven Dufresne. Crystal radios. www.rimstar.org/equip/crystal_radios.htm and www.youtube.com/watch?v=VqdcU9ULA1A. Accessed: 2015-06-09. 142
7. Evan Everett and Michael Wu. Eec 433 architecture for wireless communications. www.warpproject.org/trac/wiki/Rice_ELEC_433. Accessed: 2015-06-12). 145[9] Simon Quellen Field. A simple AM transmitter. http://sci-toys.com/scitoys/scitoys/radio/am_transmitter.html. Accessed: 2015-06-09. 142

Additional

1. Digital Communications - by John Proakis, TMH
2. Communication Systems - by Simon Hay kin, John Wiley
3. Communication Systems –by Sanjay Sharma
4. Digital Communication Fundamentals & Applications –by Bernard Sklar
5. Principles of Digital Communications – by P.Chakrabarthy
6. Theory and Design of Digital communication Systems –by Tri T HA 7.

Information resources

<https://online.stanford.edu/courses/ee379-digital-communication>

8. Alterations and amendments to the Syllabus

№	Contents	Date and № of minutes of the	Notes
1			
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N			