

SYLLABUS

Discipline name	Telephony
Profile	Electronics and Telecommunications Engineering
Specialization	Telecommunications Technologies and Systems
Code	51323809
Course leader	Associate Professor Zsolt Polgar, Ph.D – Zsolt.Polgar@com.utcluj.ro
Collaborators	
Department	Communications
Faculty	Electronics, Telecommunications and Information Technology

Sem.	Type of discipline	Course		Applications		Ind. study	TOTAL	Credit	Form of assessment				
		[ore/săpt.]		[ore/sem.]									
		S	L	P	S					L	P		
6	Speciality	2	-	2	-	28	-	28	-	94	150	5	Examen

Acquired competences :

Acquired skills (what the student is able to do):

- compute the distortions characteristic to PCM coding of the voice signal.
- appreciate the effects of the noise and distortions characteristic to telephone transmission systems over voice and data transmissions.
- compute different parameters characteristic to telephone circuits.
- compute the level of the echo in telephone systems and the stability of the telephone circuits.
- appreciate the bit rates transmitted in the digital subscriber loops (ISDN and xDSL) when the subscriber loop characteristics are known.
- compute the parameters of the jitter characteristic to digital transmission and multiplexing systems and appreciate the effect of the jitter on the transmitted signals.
- elaborate a PDH – SDH multiplexing strategy of the elementary flows characteristic to telephone transmissions..

Acquired abilities (what type of equipment/ instruments/ software the student is able to handle):

- program a small capacity PBX exchange.
- measure different parameters of the telephone circuits.
- use a telephone channel emulator/simulator.
- program a small capacity ADSL/SDSL access module.
- understand the allarm signals of the primary PCM transmissions.

Prerequisites (if necessary):

- Knowledge of signal theory – representation of signals with orthogonal functions, sampling of the analog signals, filtering of analog signals.
- Basic knowledge of the analog and digital circuits theory.
- Basic knowledge of information theory – definition of information measurement units, principles of error correcting and detecting codes.
- Knowledge of modulation techniques – base band transmissions, clock synchronization, modulation with harmonic carriers.
- Basic knowledge of computer networks – fundamental aspects related to network topologies and data transmission protocols.

A. Course/Lecture (course/lecture titles)

1	General view on fixed telephone network. Evolution of the classical telephone networks toward ISDN networks. General aspects and definitions related to telephone networks.
2	Analog/digital conversion of the voice signal in digital telephone systems. The primary PCM multiplex. Structure of the European (E1) and American (T1) PCM frames.
3	Transmission and synchronization of the E1 and T1 frames. Alarms associated to frames E1 and T1. Codirectional and contradirectional interfaces.
4	Telephone signaling systems. Basic aspects, classifications, signaling operations on subscriber and trunk lines.
5	The signaling system no. 7 (SS7). The components and the topology of the SS7 network. Signaling operations on trunk lines.
6	The SS7 signaling system (continuation). The model and the layers of the SS7 protocol. The structure and the transmission of the SS7 protocol data packets.
7	Narrow band ISDN networks. Characteristics, advantages, access techniques, data frame structures.
8	Digital access techniques used in telephone networks (DSL type access techniques). General aspects,

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	distortions characteristic to subscriber loops. SDSL type access techniques. The CAP (Carrierless Amplitude and Phase Modulation) modulation.
9	Digital access techniques used in telephone networks (continuation). ADSL and VDSL type access techniques. The DMT (Discrete Multitone Modulation) modulation. New ADSL (ADSL2, ADSL2+) and VDSL (VDSL2) techniques.
10	Multiplexing of digital signals – synchronous and asynchronous multiplexing. Frame synchronization.
11	Multiplexing in PDH systems (Plesiochronous Digital Hierarchy). The digital jitter.
12	Introduction in SDH (Synchronous Digital Hierarchy). Structure of SDH. Transmission of clock between the network nodes. Synchronous network architectures.
13	Multiplexing in SDH system. Mapping procedures. The „overhead” information. Pointers and operation with pointers in SDH system
14	Mapping procedures of the PDH tributaries in SDH data structures. The SDH reference model.

B1. Applications – Laboratory (list of laboratories)

1	Telephone devices with disk and keyboard. The hybrid transformer and the side effect.
2	The subscriber loop signaling. Programming/setting of a PBX.
3	Pulse coded modulation (PCM) with uniform and non-uniform quantization. Computation of the quantization noise
4	Practical implementation of PCM with non-uniform quantization.
5	Definition of level, attenuation and gain in mixed (analog/digital) telephone networks.
6	Telecommunication cables - internal structure and mathematical characterization.
7	Telecommunication cables. The crosstalk attenuation and the frequency characteristic of the cables.
8	Distortions induced by the telephone channel. Emulation/simulation of a telephone channel.
9	Stability of telephone networks. Echo performances.
10	ADSL and SDSL access techniques. Programming/setting of xDSL access modules and of xDSL modems.
11	ADSL and SDSL access techniques. Measurement of performances
12	Digital jitter. Regenerators and clock recovery circuits.
13	The PDH multiplexing hierarchy. Study of the positive justification process.
14	Revision, finalization of the laboratory mark.

C. Individual study (reference study contents, synthesis materials, projects, applications etc.)

2 synthesis reports

12 sets of problems (the preparation for laboratory and course homeworks)

Individual study structure	Course study	Problem solving, laboratory, project	Applications preparation	Examination time	Additional reference study	Total no. of individual study hours
Hours	24	23	22	3	22	94

References (Textbooks, courses, laboratory manual, exercise book)

1. Zs. Polgar – *Telefonie digitală. Tehnici de acces. Parametri. Sisteme*, Ed. Risoprint, Cluj-Napoca, 2006.
2. S. Zăhan - *Telefonia digitală în rețelele de telecomunicații*, Ed. Albastră, Cluj Napoca, 1997.
3. K. Feher - *Comunicații digitale avansate, vol. 1*, Ed. Tehnică București, 1993.
4. L. Pana - *Parametrii de transmisie ai circuitelor telefonice mixte analog/digitale*, CNSCC București, 1995.
5. L. Pana – *Tehnologii de acces și sisteme de transmisiuni digitale pe linii bifilare din rețelele locale*, INSCC București, 1998.
6. M. Radu - *Telefonie numerică*, Ed. Militară, 1988.

On – line references

1. Zs. Polgar - *Telephony, Course slides*: <http://users.utcluj.ro/~dtl/>
2. Zs. Polgar – *Telephony. Laboratory manual*: <http://users.utcluj.ro/~dtl/>

Final evaluation

Evaluation method	Written exam (E): problem solving (50%) and theoretical subjects (50%).
Mark components	Exam (E); Laboratory (L); Synthesis report (SR);
Mark computation	N=0,6E+0,25L+0,15SR; Pass if: N≥5; L≥5; MS≥5

Course leader,

Associate Professor Zsolt POLGAR, Ph.D.