

The syllabus of the discipline
Fundamentals of circuitry

A.M. Zelenin,
Professor of the INE dept, Ph.D., Associate Professor,
E-mail: anatolii.zelenin@nure.ua

Field name	Detailed content, comments
Name of the faculty	Faculty of Infocommunications
Level of higher education	First (bachelor's)
Code and name of the specialty	172 Telecommunications and radio engineering
Type and name of educational program	EPP "Information and Network Engineering"
Name of the discipline	Fundamentals of circuitry
Number of ECTS credits	6
Discipline structure (distribution by types and hours of study)	36 hours - 18 lectures, 16 hours - 8 practical classes, 20 hours - 5 laboratory classes, 6 hours - 3 consultations, 96 hours - homework, type of control: exam
Schedule (terms) of studying the discipline	2nd year, III semester
Prerequisites for studying the discipline	Basic knowledge of school subjects
Competences, knowledge, skills, understanding, which is acquired by the applicant in higher education in the learning process	The discipline is used to form the following competencies: in the process of technical design in the design office (department, specialized laboratory), using the vehicle, block diagram and electrical product scheme: determine the input and output parameters, perform schematic calculations and computer simulations means to substantiate the principle of systemic operation telecommunication units.
The quality of the educational process	Educational-methodical and material-technical resource provision of the educational program, within the framework of which the discipline is studied, meets the licensing requirements and accreditation conditions of the educational activity of the university. Annual monitoring and revision of the curriculum of the discipline in accordance with the requirements and recommendations of the Ministry of Education and Science, state certification of acquired competencies of graduates, standards of cooperation with employers to ensure a competitive level of training. Adherence to the principles of academic integrity (https://lib.nure.ua/plagiat). Contains public information on the requirements, competencies, level of education within the current educational program.

Description and content of the discipline

The purpose of the discipline is to acquaint students with the basic circuit structures (including chips) of analog, analog-digital and digital devices of telecommunication systems (scalable amplifiers, operational converters, resistance converters, active filters, logarithmizers, calculators and exponents relaxation and harmonic oscillations, signal multipliers, analog-code and analog-code converters).

Content

Content module 1. Introduction. Circuitry of linear devices

Topic 1. Introduction. Analysis of the inverting amplifier stage, the inverting amplifier stage and the differential measuring amplifier stage.

Topic 2. Practical use of the properties of differential (difference) amplifiers in telecommunication devices (amplitude and phase manipulators, decoupling devices, level regulators, etc.).

Topic 3. Principles of construction of operational converters (OPR). Integrating OPR. Differentiating ODA. Phase filters and phase correctors.

Topic 4. Analog resistance converters. Positive resistance converter. Negative resistance converter. Positive resistance inverter (gyrator).

Topic 5. The main types, characteristics and parameters of active filters (AF). Basic schemes of AFNCH, AFVCH, ASF, etc. Filters with variable parameters. Determination of AF parameters by the structure of canonical forms of transfer functions.

Content module 2. Circuitry of nonlinear devices and basic devices of telecommunications

Topic 1. Nonlinear inclusions of OP. Logarithmic and antilogarithmic amplifiers and amplitude limiters on OP. Comparators.

Topic 2. Generator devices on the OP. Relaxation generators. Controlled multivibrators. Single vibrators. Generators of harmonic oscillations on OP and their analysis.

Topic 3. Analog signal multipliers (circuits and analysis). Radio engineering transformations based on analog multipliers (AP). Converters to OP with AP in the feedback circuit. Dynamic amplitude companders. Application of AP in regulating elements of telecommunication devices.

Topic 4. Principles of construction of digital circuit devices. Fundamentals of logic algebra. Carnot maps. Construction of digital logic circuits. Triggers. Registers. Counters.

Topic 5. Principles of implementation of DAC and ADC. DAC based on the programmable amplifier. ADC based on delta modulation. Structural synthesis of signal processing devices in the elemental basis of AEP. Linear optimal filter (LOF) of a single video pulse. Agreed filter for discrete information transmission equipment.

Learning outcomes of higher education

As a result of studying the discipline, students must:

know: basic methods of analysis of linear and nonlinear basic devices on the OP. Rules for the implementation of typical system telecommunication units (amplifiers, active

filters, modulators and demodulators, companders, generators, frequency correctors, etc.).
Basic logical elements of digital devices;

be able to: synthesize circuit structures of telecommunication devices on the basis of basic circuits, perform electrical calculations of these circuits with the help of reference books, reasonably choose the element base and calculate their system parameters;

possess (list of competencies): in the process of technical design in the design office (department, specialized laboratory), using the technical specifications, block diagram and electrical diagram of the product: determine the input and output parameters, perform sketch calculations and model by computer, justify the principle actions of system telecommunication units.

Assessment system according to each task for passing the test / exam

To assess the work of a student during the semester, the final rating score Q_{sem} is calculated as the sum of marks for different types of classes and control activities.

Type of lesson / control measure	Rating
Lc №1,2	$(5...10) \times 2 = 10...20$
Lb №1,2	$(5...10) \times 2 = 10...20$
Practice Control testing	10
Checkpoint 1	30...50
Pr №2,3	$(5...10) \times 2 = 10...20$
Lb №3,4	$(5...10) \times 2 = 10...20$
Practice Control testing	10
Checkpoint 2	30...50
Total for the semester	60...100

Each practical lesson is evaluated in 10 points (3 points for attendance, 2 points for preparation for the lesson (written answer to the question) and 5 points for work in the lesson). Each laboratory work is estimated at 10 points (3 points for attendance, 2 points for training, 5 points for defense). Auditory test ACR - 10 points. The maximum rating during the semester is 100 points.

As a form of final control in the discipline "Fundamentals of Circuitry, Part 2" used a combined exam. With this type of control final evaluation P_p is calculated by the formula:

$$RP = 0,6Q_{\text{sem}} \times 0,4Q_{\text{isp}},$$

where Q_{sem} is a grade for the semester on a 100-point system, Q_{isp} is a score for the exam on a 100-point system.

The ticket for the written exam consists of two theoretical questions and a practical task(s). The results of the answers to the ticket questions are evaluated on a 100-point system:

- first question - 30 points;
- second question - 30 points;
- task - 40 points.

Qualitative evaluation criteria in the national scale and ECTS

Satisfactory, D, E (60-74). Show the required minimum of theoretical knowledge. Know the ways and methods of solving practical problems and be able to use them in practice.

Well, C (75-89). Firmly know a minimum of theoretical knowledge. Demonstrate the ability to solve a practical problem and justify all stages of the proposed solution.

Excellent, A, B (90-100). Show complete knowledge of basic and additional theoretical material. Unmistakably solve a practical problem, explain and justify the chosen method of solution.

Assessment scale: national and ECTS

The sum of points for all types of educational activities	ECTS assessment	Score on a national scale	
		for exam, course project (work), practice	for offset
90 – 100	A	perfectly	credited
82-89	B	fine	
74-81	C	satisfactorily	
64-73	D		
60-63	E		
35-59	FX	unsatisfactory with the possibility of reassembly	not credited with the possibility of re-assembly
0-34	F	unsatisfactory with mandatory re-examination	not credited with compulsory re-study of the discipline

Methodical support

Basic literature

1. Zelenyn A.N. Prymenenye lyneinykh yntehralnykh skhem v radyoelektronnykh ustroistvakh [Tekst]: Ucheb. posobyе/ A.N. Zelenyn. – Kharkov: KhPY, 1982. – 88 s.
2. Zelenyn A.N. Skhemotekhnika radyoelektronnykh ustroistv na analohovykh YS [Tekst]/ A.N. Zelenyn. – Kharkov: Teletekh, 2002. – 242 s.
3. Tymoshenko L.P. Analohovi elektronni prystroi [Tekst]: Navch. posibnyk dlia studentiv VNZ / L.P. Tymoshenko, A.M. Zelenin/ Za red. V.M. Shokalo. – Kharkiv: Kolehium, 2007. – 298s.
4. Zelenin A.M. Analiz ta proektuvannia aktyvnykh filtriv na operatsiinykh pidsyliuvachakh [Tekst]: Navch. posibnyk/ A.M. Zelenin, A.I. Kostromytskyi, D.V. Bondar. – Kharkiv: KhNURE, 2010. – 160 s.
5. Anysymov V.Y. Topolohycheskyi raschet elektronnykh skhem [Tekst]/ V.Y. Anysymov. – L.: Enerhiya, 1977. – 240 s.
6. Khorovyts P. Yskusstvo skhemotekhniky [Tekst]: Per. s anhl/ P. Khorovyts, U. Khyll. – 5-e yzd. pererab. – M.: Myr, 1998. – 704 s.
7. Zelenin A.M. Osnovy skhemotekhniky analohovykh elektronnykh prystroiv. Chastyna 1 [Tekst]: Navchalnyi posibnyk/ A.M. Zelenin, V.A. Zolotarov. – Kharkiv: KhTURE, 1999. – 112 s.

Supporting literature

8. Aleksenko A.H. Mykroskhemotekhnika [Tekst]: Ucheb. posobyе dlia vuzov/ A.H. Aleksenko, Y.Y. Shahuryn/ Pod red. Y.P. Stepanenko. – M.: Radyo y sviaz, 1982. – 416 s.
9. Polkovskiy Y.M. Skhemotekhnika mykroelektronnoi apparatury [Tekst]/ Y.M. Polkovskiy, V.P. Stytsko, Yu.E. Rudberh – M.: Radyo y sviaz, 1981. – 320 s.
10. Voishvylo H.V. Usylytelnye ustroistva [Tekst]: Uchebnyk dlia vuzov/ H.V. Voishvylo. – 2-e yzd. pererab. y dop. – M.: Radyo y sviaz, 1983. – 264 s.
11. Mamonkyn Y.H. Usylytelnye ustroistva [Tekst]: Ucheb. posobyе dlia vuzov/ Y.H. Mamonkyn. – 2-e yzd. pererab. y dop. – M.: Radyo y sviaz, 1977. – 359 s.
12. Lamekyn V.F. Shyrokopolosnye yntehralnye usylytely [Tekst]/ Pod red. S.Ia. Shatsa. – M.: Sov.radyo, 1989. – 224 s.
13. Efymov V.V. Proektyrovanye usylytelnykh ustroistv [Tekst]: Uchebnoe posobyе/ V.V. Efymov, V.N. Pavlov, Yu.P. Sokolov y dr.; / Pod red. N.V. Terpuhova.– M.: Vyssh. shkola, 1987. – 335 s.
14. Opadchyi Yu.F. Analohovaia y tsyfrovaia elektronyka (Polnyi kurs) [Tekst]: Uchebnyk dlia vuzov/ Yu.F. Opadchyi, O.P. Hludkyn, A.Y. Hurov. – M.: Horiachaia lynia – Telekom, 1999. – 768 s.
15. Lenk Dzh. Rukovodstvo dlia polzovatelei operatsyonnykh usylytelei [Tekst]: Per. s anhl. / Dzh. Lenk / Pod red. Y.N. Tepliuка. – M.: Sviaz, 1987. – 328 s.
16. Shcherbakov V.Y. Elektronnye skhemy na operatsyonnykh usylyteliakh [Tekst]: Spravochnyk/ V.Y. Shcherbakov, H.Y. Hrezdov. – K.: Tekhnika, 1983. – 213 s.
17. Kherpy M. Analohovye yntehralnye skhemy [Tekst]: Per. s anhl./ M. Kherpy. – M.: Radyo y sviaz, 1983. – 416 s.

18. Sklof S. Analohovye yntehralnye skhemy [Tekst]: Per. s anhl./ S. Sklof. – M.: Myr, 1988. – 583s.
19. Horshkov B.Y. Radyoælektronnye ustroistva [Tekst]: Spravochnyk/ B.Y. Horshkov. – M.: Radyo y sviaz, 1984. – 400 s., yl.
20. Aleksenko A.H. Prymenenye pretsyzyonnykh analohovykh YS [Tekst]/ A.H. Aleksenko, E.A. Kolombert, H.Y. Starodub. – M.: Sov. Radyo, 1980. – 224 s.
21. Peiton A.Dzh. Analohovaia elektronika na operatsyonnykh uslyteliakh [Tekst]/ A. Dzh. Peiton, V. Volsh. – M.: Bynom, 1994. – 352 s.
22. Tymonteev V.N. Analohovye peremnozhytely syhnalov v radyoelektronnoi apparature [Tekst]/ V.N. Tymonteev, L.M. Velychko, V.A. Tkachenko. – M.: Radyo y sviaz, 1982. – 112 s.
23. Hutnykov V.S. Yntehralnaia elektronika v yzmeritelnykh ustroistvakh [Tekst]/ V.S. Hutnykov. – 2-e yzd. pererab. y dop. – L.: Enerhoatomyzdat. Lenynhradskoe otdelenye, 1988. – 304 s.
24. Maslennykov V.V. Yzbyratelnye RC-uslytely [Tekst]/ V.V. Maslennykov, A.P. Syrotkyn. – M.: Enerhyia, 1980. – 216 s.
25. Shkrytek P. Spravochnoe rukovodstvo po zvukovoi skhemotekhnike [Tekst]: Per s nem. / P. Shkrytek. – M.: Myr, 1991. – 446 s.

Methodical instructions for different types of classes

26. Metodychni vказivky do praktychnykh zaniat z dystsypliny «Osnovy skhemotekhniky ch.2», dlia studentiv spetsialnosti napriamku «Telekomunikatsii» [Tekst]/ Uporiad.: A.M. Zelenin, A.I. Kostromytskyi, D.V. Bondar, P.V. Limarenko. – Kharkiv, KhNURE, 2008. – 68 s.
27. Metodychni vказivky do laboratornykh robit z dystsypliny «Osnovy skhemotekhniky», dlia studentiv usikh form navchannia spetsialnosti 172 «Telekomunikatsii ta radiotekhnika», osvithnia prohrama «Telekomunikatsii» [Tekst]/ Uporiad.: A.M. Zelenin, V.O. Vlasova. S.A. Ivanenko – Kharkiv, KhNURE, 2016. – 27 s.
28. Metodychni vказivky do samostiinoiroboty z dystsyplin «Osnovy skhemotekhniky», chastyna 2 dlia studentiv spetsialnosti napriamku «Telekomunikatsii» [Tekst]/ Uporiad.: A.M. Zelenin, A.I. Kostromytskyi, D.V. Bondar – Kharkiv, KhNURE, 2007. – 24 s.