The syllabus of the discipline

Guiding systems of electrical and optical communication

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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	Guiding systems of electrical and optical communication
Number of ECTS credits	4
Discipline structure (distribution by types and hours of study)	24 hours - 12 lectures, 4 hours - 2 practical classes, 20 hours - 5 laboratory classes, 8 hours - 4 consultations, 64 hours - homework, **type of control**: exam
Schedule (terms) of studying the discipline	4th year, VIII semester
Prerequisites for studying the discipline	students must study the disciplines: 1) Higher mathematics 2) Physics 3) Fundamentals of information and communication technologies 4) Technologies of TCRT means 5) Fundamentals of computer modeling and design of TCRT
Competences, knowledge, skills, understanding, which is acquired by the applicant in higher education in the learning process	The discipline is used for formation the following competencies: FC-3 Ability to use basic methods, techniques and tools receipt, transfer, processing and storage information; FC-4 Ability to perform computer modeling of devices, systems and processes with using universal application packages programs; FC-5 Ability to use regulatory and legal documentation relating to information telecommunication networks, telecommunication and radio engineering systems (laws of Ukraine, technical regulations, international and national standards, recommendations of the International Telecommunication Union, etc.) to solve professional problems; FC-6 Ability to carry out instrumental measurements in information telecommunication networks, telecommunication and radio engineering systems; FC-8 Willingness to promote introduction of advanced technologies and standards; FC-9 Ability to accept and develop new equipment in accordance with current regulations; FC-10 Ability to carry out installation, adjustment, adjustment, adjustment, pilot testing, testing and commissioning of telecommunications facilities, means and equipment and willingness to promote the introduction

	of advanced technologies and standards for new generations of technologies; FC-15 Ability to perform calculations in the process of designing facilities and means of information and telecommunication networks, telecommunication and radio systems, in accordance with the terms of reference using both standard and self-created methods, techniques and software design automation.
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 studying the discipline - Mastering the physical foundations of fiber-optic communication, mastering the principles of light transmission through optical fibers and determining their basic parameters; principles and features of installation and purpose of various components of fiber-optic communication lines (FOCL) such as fiber optics, passive components, optical cables.

Content

Content module 1. The main features, principles and parameters of light transmission over the Sun in accordance with the laws of geometric optics and wave theory.

Topic 1. Introduction. General information about fiber optic communication.
General provisions, purpose and objectives of the discipline. History of fiber optics. Features, advantages and disadvantages of using optical fibers in communication systems. Characteristics of the range of electromagnetic waves for optical communication.

Topic 2. Fiber-optic fiber as a transmission medium.
Design features of fiber optics. Principles of light propagation in fiber optics. Classification, types and characteristics of optical fibers.

Topic 3. Wave theory of light transmission through optical fibers.
Analysis of electromagnetic field components in an optical fiber based on Maxwell's equations. Wave equations of transmission. Solutions of wave equations and their connection with longitudinal and transverse components of the field.

Topic 4. Types of waves in optical fibers. Critical lengths and frequencies.
Types of waves propagating in light guides. Critical frequency and wavelength. Normalized frequency. Fiber and cable cut-off wavelength

Topic 5. Wave resistance, phase coefficient and speed of energy propagation through the fiber.

Wave resistance, phase coefficient of fiber optics, their dependence on frequency for the main types of waves. Phase velocity of electromagnetic wave propagation and its determination, dependence of phase velocity on frequency for basic types of waves.Group speed of fiber propagation and its definition, dependence of group speed on frequency for the main types of waves.

Content module 2. Attenuation and dispersion in the Sun and methods of their compensation.

Topic 6. Attenuation in fiber optics.

The main types of losses in the OB. Losses on absorption and scattering. Cable losses: losses on micro and macro bends. Dependences of attenuation in the optical fiber on the frequency and wavelength.

Topic 7. Dispersion in fiber optics.

Types of variance. Intermode variance. Chromatic dispersion. Polarization mode variance.

Topic 8. Methods of compensation of variance in optical communication lines

Ways to solve the problems associated with the compensation of variance in modern fiber optics. Compensation of chromatic dispersion by introducing compensating modules into the communication line. Dispersion compensators based on Breg lattices. Dispersion compensation by means of a phase filter. Dynamic variance compensation.

Topic 9. Classification, design features and labeling WOK.

Classification and design features of WOC. Marking of different types WOK. Methods of installation of OB. Methods of laying WOK.

Learning outcomes of higher education

As a result of studying the discipline, students must:

know: about the most promising areas of fiber optic development and the components used to build them; about current trends in the development of optical communication lines; design features, characteristics and parameters of the components of the optical guide systems; basics of technical operation of linear communication facilities.

be able to: use the acquired knowledge to calculate the main characteristics of fiber optics and their design, taking into account the requirements of speed, reliability, manufacturability and ease of technical operation; perform work with optical fiber on its installation and installation; to measure the main parameters of the aircraft and other components of fiber optics with appropriate measuring instruments and equipment.

to own: PRN1. Knowledge of theories and methods of basic and general engineering sciences to the extent necessary to solve specialized problems and practical problems in the field of professional activity; PRN2. Ability to apply basic knowledge of basic regulations and reference materials, current standards and specifications, instructions and other regulations in the field of electronics and telecommunications; PRN5. Ability to calculate elements of telecommunication systems, infocommunication and telecommunication networks, radio systems and television and radio broadcasting systems, according to the terms of reference in accordance with international standards, using design automation tools, including created independently; PRN7.Ability to participate in the design of new (modernization of existing) telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc.; PRN8. Ability to apply modern achievements in the field of professional activity in order to build advanced telecommunication systems, infocommunication,

telecommunication networks, radio systems and television and radio broadcasting systems, etc.; PRN11. Ability to diagnose the state of equipment (modules, blocks, units) of telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc .; PRN13. Ability to choose methods and tools for measuring the parameters and performance of telecommunications systems, infocommunications, telecommunications networks, radio systems and television and radio systems and their elements; PRN14. Skill managerial and organizational work in the team (team, group, team, etc.), the ability to evaluate and distribute tasks among employees and be responsible for the results of their own and team work.

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

As a form of final control in the discipline combined exam is used. With this type of control is final P_P assessment calculated by the formula:

$$P_P = 0.6Q_{sem} + 0.4Q_{isp},$$

where Q_{sem} – assessment per semester on a 100-point system, the system.

Q_{isp}- 100-point exam score.

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

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

Type of lesson / control measure	Rating
Lc № 1, 2, 3, 4, 5	1x5=5
Lb № 1	6
Pr № 1	6
Control testing 1	23
Checkpoint **1**	**40**
Lc № 6, 7, 8, 9, 10, 11, 12	1x7=7
Lb № 2, 3, 4, 5	6x4=24
Pr № 2	6x1=6
Control testing 2	23
Checkpoint **2**	**60**
Total for the semester	**100**

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**		
64-73	**D**	satisfactorily	
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. Optycheskye napravliaiushchye systemy [Elektronnyi resurs] / TsPS, Dystantsyonnoe obuchenye. – Rezhym dostupa: www/URL: http://www.do.sibsutis.ru/bakalavr/sem6/course105_2/run.htm - 15.04.2009 h.
2. Volokonno-optycheskye systemy peredachy [Elektronnyi resurs]: ynteraktyvnyi kurs lektsyi. Rezhym dostupa: http://www.do.sibsutis.ru/magistr/courses_work/vosp_work/lectures_index.htm
3. Fryman, R. Volokonno-optycheskye systemy sviazy [Tekst] / R. Fryman. – M.: Tekhnosfera, 2003. – 440 s.
4. Ubaidullaev, P.P. Volokonno-optycheskye sety [Tekst] / P.P. Ubaidullaev. – M.: Eko-Trenz, 1998. – 268 s.
5. Portnov, Э.L. Optycheskye kabely sviazy y passyvnye komponenty volokonno-optycheskykh lynyi sviazy [Tekst]: Uchebnoe posobye dlia VUZov / Э.L. Portnov. – M: Horiachaia lynyia – Telekom, 2007. – 464 s.
6. Sterlynh, Dzh. Tekhnycheskoe rukovodstvo po volokonnoi optyke [Tekst] / Donald Dzh. Sterlynh. – M.: Yzd. «LORY», 1998.
7. Yvanov, A.B. Volokonnaia optyka: komponenty, systemy peredachy, yzmerenyia [Tekst] / A.B. Yvanov. – M.: Kompanyia SAIRUS SYSTEMS, 1999. – 672 s.
8. Portnov, Э.L. Optycheskye kabely sviazy y passyvnye komponenty volokonno-optycheskykh lynyi sviazy [Tekst]: Uchebnoe posobye dlia VUZov / Э.L. Portnov. – M: Horiachaia lynyia – Telekom, 2007. – 464 s.
9. Klymash M.M., Lavriv O.A., Bak R.I. Optychni ta radiokanaly telekomunikatsii. – Lviv: 2010. – 424 s.

Supporting literature

1. Volokonno-optycheskaia tekhnyka: ystoryia, dostyzhenyia, perspektyvy [Tekst]: sb. statei / pod red.. S.A. Dmytryeva, N.N.Slepova – M: Connect, 2000 – 375 s.
2. H. Ahraval. Nelyneinaia volokonnaia optyka. – M.: Myr, 1996.
3. Hrodnev, Y.Y. Volokonno-optycheskye lynyy sviazy [Tekst]: Ucheb. posobye dlia VUZov / Y.Y. Hrydnev. - M.: Radyo y sviaz, 1990. - 224 s.
4. Volokonno-optycheskye systemy peredachy y kabely: Spravochnyk / Pod red. Y. Y. Hrodneva. – M.: Radyo y sviaz, 1993.
5. Yaremenko Yu.Y. Teoretycheskye osnovy postroenyia y prymenenyia sredstv sviazy optycheskoho dyapazona. S-P: VAS, 1992. – 300 s.
6. Svyntsov, A.H. 30 let VOLS: evoliutsyia lazerov dlia volokonnoi optyky [Tekst] / A.H. Svyntsov // Foton-Эkspress. – 2003. - №4 (30). – S. 9-10.
7. Volokonnaia optyka y pryborostroenye. / Pod red. M.M. Butusova – L. Mashynostroenye, 1987. – 328 s.
8. Spravochnyk po volokonno-optycheskym lynyiam sviazy. / L.M. Andrushko, V.A. Voznesenskyi, V.B. Katok y dr. / Pod red. S.V. Svechnykova y L.M. Andrushko. K.: Tekhnyka, 1988. – 259 s.
9. Lomashevych S.A. K probleme priamoho usylenyia kommutatsyy optycheskykh syhnalov. // Elektrosviaz, 1992 №11 s 14-16
10. Torchyhyn V.P. Usylenye svetovykh ympulsov v svetovodakh s peryodychesky yzmeniaiushchymsia pokazatelem prelomlenyia. // Kvantovaia elektronyka, t.22 №5 1995. S. 509 – 511.
11. Unher Kh. Optycheskaia sviaz.: Per. s nem. /Pod red. N.A. Semenova. – M.: Sviaz, 1979. – 264 s.
12. Optyka y sviaz / A. Kozane, Zh. Flere, H. Mэtr, M. Russo: Per. s frants. / Pod red. V.K. Sokolova. – M.: Myr, 1984. – 415 s.
13. Tymchasove kerivnytstvo z ekspluatatsii volokonno-optychnykh linii zviazku miskykh telefonnykh merezh. Derzhavnyi komitet zviazku Ukrainy. Chynne z 01.03.98. Kyiv: Zviazok, 1998. – 80 s.
14. Stroytelstvo y tekhnycheskaia ekspluatatsyia volokonno-optycheskykh lynyi sviazy./ Pod red. B.V. Popova. – M.: Radyo y sviaz, 1995. – 198 s.

Methodical instructions for different types of classes

1. Metodychni vkazivky do laboratornykh robit z dystsypliny «Napriamni systemy elektrychnoho ta optychnoho zviazku» (chastyna 2) dlia studentiv spetsialnosti 172 «Telekomunikatsii ta radiotekhnika», osvitnoi prohramy «Telekomunikatsii» / Uporiad.: Yu.M. Koltun, N.A. Kharchenko – Kharkiv: KhNURE, 2017. – 56 s.
2. Metodychni vkazivky do samostiinoi roboty ta praktychnykh zaniat z dystsypliny «Napriamni systemy elektrychnoho ta optychnoho zviazku» (chastyna 2) dlia studentiv spetsialnosti 172 «Telekomunikatsii ta radiotekhnika», osvitnoi prohramy «Telekomunikatsii» / Uporiad.: Yu.M. Koltun, N.A. Kharchenko – Kharkiv: KhNURE, 2017. – 40 s.

Information support

Software package "Simulation of signal transmission through optical fibers". Developer: Art. gr. MDT-22 Sitnov N.Yu. Ker. project: Ph.D., prof. Gorlov NI
- SibGUTI, 2006.