



National Technical University of Ukraine "Igor Sykorsky Kiev Polytechnic Institute"
Department of Radioengineering

[D-3 Innovative Directions in Telecommunications and Radio Engineering Development]



Educational Program of the Educational Discipline (Syllabus)

Details of the discipline

| | |
|--|--|
| High education Level | The third (educational-scientific) |
| Field of knowledge | |
| Specialty | |
| Educational program | Telecommunication and Radio Engineering (2020-06-30); |
| Discipline Status | Normative |
| Form of study | Full-time |
| Year of study | 2 year, autumn semester |
| Discipline value | 3 cred. (Lectons 13 h, Pract. 13 h, independent 64 h) |
| Semester control | Exam |
| Educational Schedule | https://rozklad.kpi.ua |
| Educational language | Ukrainian / English |
| Information about the course leader / teachers | Lectons, practice : assistant prof Martyniuk |
| Placement of the discipline | |

Educational program of discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

Nowadays we are witnessing rapid development and great concentration of efforts in many areas within the specialty 172 Telecommunications and Radio Engineering. It is important to understand which areas are innovative, the development of

which will determine the overall technical development of the modern information society. It is necessary to distinguish innovative directions of development from cost modernization of existing systems.

The aim of the discipline is to review modern innovative areas of telecommunications and radio engineering, such as smart antennas, radio frequency identification systems, Internet of Things, radio photon radars, space radars for remote sensing of the Earth, 5G telecommunications systems and more.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

Normative discipline, code D3 in educational scientific program

3. The content of the discipline

1. Internet of Things (IoT)
2. 5G generation telecommunication systems.
3. Car radars.
4. Radio photon radars.
5. The use of artificial intelligence in telecommunications and radio engineering.
6. RFID tags.
7. Earth remote sensing radars.
8. Radio systems on one chip (System on chip)
9. Promising satellite telecommunication systems.
10. Terahertz radio technologies.
11. Digital antenna arrays (Smart antenna).
12. Modern systems of electronic intelligence and radio monitoring.
13. Modern systems of electronic warfare.
14. Equipment of 5G telecommunication systems.
15. Cloud technologies.
16. Active elements based on GaN technology.
17. Navigation positioning systems indoors.
18. Innovative biomedical radio systems.
19. Radio electronic systems of modern unmanned aerial vehicles.
20. Military work.
21. Smart Home System.
22. Radio-electronic technologies of Industry 4.0.

4. Educational resources and literature

Basic literature:

1. Бондаренко Б.Ф., Вишнівський В.В., Долгушин В.П. Теорія радіолокаційних систем. Підручник. Видавничо-поліграфічний центр "Київський університет", 2011. - 383с.

2. Технології інтернету речей. Навчальний посібник [Електронний ресурс]: навч. посіб.

для студ. спеціальності 126 «Інформаційні системи та технології», спеціалізація

«Інформаційне забезпечення робототехнічних систем» / Б. Ю. Жураковський, І.О. Зенів; КПІ ім.

Ігоря Сікорського. – Електронні текстові дані (1 файл: 12,5 Мбайт). – Київ: КПІ ім. Ігоря Сікорського, 2021. – 271 с.

Additional literature:

3. Верба В.С., Татарский Б.Г. Радиолокационные системы авиационно-космического мониторинга земной поверхности и воздушного пространства М.: Радиотехника, 2014. - 576 с.: ил. (Научная серия «Труды научных школ ОАО «Концерн радиостроения «Вега»)

4. Белоус А.И., Мерданов М.К., Шведов С.В. СВЧ-электроника в системах радиолокации и связи. Техническая энциклопедия в 2-х книгах. Учебное пособие. — 3-е изд., испр. — М.: Техносфера, 2021. — 782 с.: схем., ил., табл. — ISBN 978-5-94836-605-0.
5. Azrou M., Irshad A., Chaganti R. (eds.) IoT and Smart Devices for Sustainable Environment Cham: Springer, 2022. — 188 p.

Educational content

5. Methods of mastering the discipline (educational component)

Full-time/distant form

Lessons and practice

| № з/п | The title of the lecture and a list of key issues (list of teaching aids, references to literature and tasks on independent work) |
|----------|---|
| 1 | General concepts and criteria of innovation. The process of innovation in telecommunications and radio engineering. The concept of innovation. General scheme and stages of creating an innovative product. Recommended literature: [1-5] |
| 2 | Innovative directions of radar technology development. Problems of classical radar systems. Small digital radar systems based on AFAR. UAV detection problems. Recommended literature: [1] |
| 3 | Innovative directions of development of space electronic systems. Antenna systems that ignite in space. The structure of modern microsattellites. Recommended literature: [1,3]. |
| 4 | Space radar systems for remote sensing of the Earth. Problems that solve polarimetric radar systems for remote sensing of the Earth. Block diagram of modern space radars with synthesized aperture. Algorithms for processing X-ray signals. Recommended Books: [1,3] |
| 5 | Radio photonics. Component base of radio photonics. Advantages of radio photonic systems. Recommended literature: [1, 4]. |
| 6 | RFID systems. Block diagrams of radio frequency identification systems. Innovative directions of development of such systems. Recommended literature: [2, 5]. |
| 7 | 5G generation telecommunication systems. Advantages and tasks of 5G telecommunication systems. Block diagram of building systems 5 G. Problems of implementation of 5G systems. MIMO systems. Recommended literature: [2,5]. |
| 8. | Internet of Things. Innovative directions of development of the Internet of Things. Smart house. Recommended literature: [2, 5]. |
| 9. | Terahertz radio technologies. Problems and motivation for mastering the terahertz range. Radar and telecommunication systems of the subtrahertz frequency range. Recommended Books: [4]. |

Individual classes (total 8 hours) are devoted to discussion with students of innovative components of future dissertations

6. Independent student work

The study of the discipline includes the following types of independent work:

- preparation for lectures and practical classes;
- preparation of presentations of reports on the content of the discipline item 3; exam preparation.

Policy and Control

7. Policy of academic discipline (educational component)

Recommended teaching methods: study of basic and auxiliary literature on the topics of lectures.

The student is recommended to keep a detailed synopsis of lectures. An important aspect of quality learning, testing methods and algorithms for solving the main tasks of the discipline is independent work. It includes reading literature, reviewing literature on the topic, preparation for classes, preparation of a presentation on one of the topics. exam preparation.

Academic integrity

Policies and principles of academic integrity are set out in Section 3 of the Code of Honor

National Technical University of Ukraine "Kyiv Polytechnic Institute named after Igor Sikorsky". Details: <https://kpi.ua/code>

Norms of ethical behavior

The norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor

National Technical University of Ukraine "Kyiv Polytechnic Institute named after Igor Sikorsky". Details: <https://kpi.ua/code7>.

... **8. Types of control and rating system of assessment of learning outcomes (RSA).** Rating system of assessment is based on assessments of:

- answers the teacher's questions during practical and lecture classes (maximum 5 points per answer)
- presentation on the topic (maximum 60 points)
- exam (maximum 40 points) Maximum number of points 100.

Table of correspondence of rating points to grades on the university scale

| Scores | Ratinga |
|----------------------------------|------------------|
| 100-95 | Excellent |
| 94-85 | Very good |
| 84-75 | Good |
| 74-65 | Satisfactory |
| 64-60 | Enough |
| Less 60 | Not satisfactory |
| Admission conditions are not met | Not allowed |

9. Additional information about discipline (educational component)

Description of material and technical and information support of the discipline

List of basic equipment of the Department of Radio Engineering ::

- 1) Anritsu 20 GHz Vector Network Analyzer (MS46122A) - Vector analyzer of circuits up to 20 GHz Anritsu (MS46122A); - the system can be used to measure the characteristics of matching, transmission and complex resistance of such components as: broadband antenna, receiver, microwave amplifier.
- 2) Tektronix Digital Phosphor Oscilloscope DPO 70804C - Digital Phosphor Oscilloscope

Tektronix DPO 70804C with DC frequency band...> 8 GHz, signal rise duration (10% -> 90%) 30-40 ps; - can be used to measure oscillograms and spectral characteristics of ultrashort pulses generated by the system, as well as pulses reflected from the target.

3) Anritsu spectrum analyzer 9 kHz - 13.5 GHz (MS2830A) - Spectrum analyzer of the frequency range 9 kHz - 13.5 GHz Anritsu (MS2830A); - will be used to measure the spectral characteristics and power levels of emitted EM waves in a wide frequency range from 0.5 to 8-10 GHz.

4) Anechoic chamber – chamber size 3x3x6 meters - will be used to measure the radiation characteristics of the antennas used (such as gain, width of the pattern, level of cross-polarization, etc.).

The Department of Radio Engineering also has a powerful list of other microwave equipment.

Educational program:

Developed by [assistant professor. Dr. Serhii Martyniuk](#);

Approved by Department of Radio Engineering(протокол № 05/2021 dated 25.05.2021)

Agreed Methodical commission of the faculty (protocol № 06-2021 dated 29.06.2021)