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| **Identification** | **Subject** **(code, title, credits)** | ETR-385 **Designing Radio Electronic Devices** |
| **Department** | Department of Physics and Electronics |
| **Program**  | Undergraduate, bachelor |
| **Term** | 2019 spring |
| **Instructors** |  Ph.D, Associate Prof. Shahmerdan Sh. Amirov |
| **E-mail:** | **Phys\_med@mail.ru** |
| **Phone:** |  050 2100520 |
| **Classroom/hours** | Monday$ 18^{40}-20^{10}$ Thursday $18^{40}-20^{10}$$15^{00}$ |
|  | **Office hours** | $$9^{00}-18^{00}$$ |
| **Prerequisites** | Radio-engineering equipment, English |
| **Language**  | English |
| **Compulsory/Elective** | Compulsory |
| **Required textbooks and course materials** | **Core Textbook**: 1. **Dogadin N.B. Fundamentals of Radio Engineering, Moscow 2007**

**Supplementary Textbooks:** **1.Sebastian Bittrich Basic Radio Physics , Pokhara, Nepal 2009** 2.R.Z.Kazimzade and J.S.Asgerov Fundamentals of electro- and radioengineering Baku-20133.Davudov B., Dashdemirov K. Radiophysics Baku-20084.Gershunsky B.S. Fundamentals of electronics Moscow-19775.Khromoy B.P.,Moiseev U.G. Electro- and Radio measurements. |
| **Course website** | Under preparation |
| **Course outline** | Introduction. Elements of signal theory. Basic radio-engineering signals their parameters. Classifying signals. Harmonic signal. Pulsed signal. Analytic , temporary and spectral description of signals. Periodic and nonperiodic signals. Modulation. Spectral analysis of periodic and nonperiodic signals. Signal energetic spectrum. Signals with discrete spectrum Calculating circuit at stationary regime. Analysis the transition processes in radio-engineering devices. |
| **Course objectives**  | **Course objectives for the Students:*** Develop a high level of understanding of the fundamental principles of signal theory.. radio-engineering devices
* Work cooperatively to facilitate a collegial atmosphere conducive to learning for all students in the class.
* Prepare for and attend each class by reading the assigned sections before class, completing homework, and participating in class discussions and team activities.

**Course objectives for the Instructor:** To provide all students the tools necessary to succeed in their pursuit of a high level of understanding of the principles of Common characteristics of radio-engineering equipment. Linear devices. Pulse, transition and frequency characteristics. Conditions for conversion the signals without distortion in linear equipment. Differentiating and integrating circuits. Trigonometric method for analysis the linear circuit. Methods of complex amplitude and vector diagram. Induced oscillations in series circuit. Filtering properties of series circuit. Filtering properties of parallel circuit. Filtering properties of adjustable circuits. Complex electric filters. * To provide all students with an atmosphere conducive to learning the principles of **radio-physics**.
* To provide sufficient feedback to students, enabling them to gauge their progress towards achieving their goal in learning the principles of **radio-physics.**
* To facilitate student learning through the use of appropriate activities, appropriate technology, and the illustration of physics applications in the real world.
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| **Learning outcomes** | * Students will know and will be able to explain the concepts
* Radio-receiving equipment. Technical characteristics and classification of radio-receiving equipment. Detecting of amplitude modulated signal. Detecting of frequency modulated signal

Students will be able to collect, analyze, and explain data from physics experiments in Nonlinear equipment. Resonance amplifying frequency and its multiplication. Detecting. Detectors of amplitude, frequency and frequency. Parametric circuits. Longer lines and their wave equations. Reflection of waves at the edge of lines.Input resistance of lines. Nonlinear elements, their characteristics. Graphic and analytic methods for analysis of nonlinear characteristics.* to communicate physics concepts effectively both orally and in writing.
* Students will demonstrate a comprehension of physical and environmental reality by understanding how fundamental physical principles of P-n junction in semiconductors (s/c).Properties of p-n junction under external electric field. S/c resistors- Thermoresistors. Photoresistors. Varistors. S/c diodes- Rectifying diode. Pulse diode. Tunnel diode. Photodiode. Light diode the huge variety of natural phenomena and their interconnectedness.
* Students will demonstrate a comprehension of technology by understanding how things work on a fundamental level.
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| **Teaching methods** | Lecture  | + |
| Group discussion | + |
| Experiential exercise | + |
| Case analysis |  |
| Problem Solving | + |
| Course paper |  |
| Others |  |
| **Evaluation**  | Methods | **Date/deadlines** | **Percentage (%)** |
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| Tests and Quizzes | At each lesson | 10 |
|  Active participation  | At each lesson | 10 |
| Attendance | During the semester | 5 |
| Individual Research Papers and Presentations | During the semester | 10 |
| Midterm Exam |  | 30 |
| Final Exam |  | 35 |
| Total  |  | 100 |
| **Policy** | **Methods of Assessment and Evaluation****Homework Portfolio**: 8 homework assignments will be assigned during the semester. Each homework assignment will contain 10 problems in physics. These problems provide ample opportunity for learning physics at the application and analysis levels of learning. Homework problems will be accumulated in a portfolio and collected by the instructor periodically. During the semester the instructor will provide assessment feedback to recognize and increase your performance in the learning process. Finally, at mid-term and at the end of the semester an evaluation will be made of the homework performance demonstrated by the student. In the case of a known absence, homework can be turned in by another student to the instructor**.****Late homework:** 20% will be deducted from the homework grade for each day it is late if it is not turned in on time. **Quizzes:**  During the semester in Problems Solving sessions there will be 20-minute written quizzes (4 in total) to evaluate whether assigned readings are completed. No make-up quizzes will be given. Quizzes missed due to a serious illness or a family emergency (these must be documented) will be dealt with on a case-by-case basis. **Exams**: There will be an in-class mid-term exam and a final exam. An in-class mid-term exam will be worth 30% of the total grade. The final exam will be worth 30% of the total grade as well. The mid-term and approximately one-half to two-thirds of the final are not cumulative other than the fact that some of the material will be dependent on previous material. The last portion (one-third to one-half) of the final exam will be cumulative. No make-up exams will be given. If you have a serious conflict with an exam time, you must discuss it with the instructor and take the exam early. Exams missed due to a serious illness or a family emergency (these must be documented) will be dealt with on a case-by-case basis.  For exams students will be allowed to bring an electronic calculator. No other materials or devices (including mobile phones) may be used during the exams. **Pass/Fail:** Khazar University uses 100 points grading system with 60 point passing grade for bachelor students. In case of failure, student will be required to repeat the course the followingterm or year.**Attendance /Activity**Every student is expected to attend every class, to arrive on time, to stay until the end of class, and to participate with high quality discussion. Those having legitimate reasons for absence (illness, family bereavement etc) are required to inform the instructor. Generally, **20 %** unauthorized absence marks will lead to the student’s expulsion from the Course. If student is late to the class for more than five (5) minutes, then he/she may not be allowed to enter and disturb the class. For successful completion of the course, the students shall take an active part during classes, raising questions and participating in-group discussions.Professional Behavior Guidelines: The student shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.**Honesty Issues:** All Khazar University students are bound by honor to maintain the highest level of academic integrity. By virtue of membership in the Khazar University community, every student accepts the responsibility to know the rules of academic honesty, to abide by them at all times, and to encourage all others to do the same. Cheating or other plagiarism during the mid-term and final examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.Students are supposed to read about the topics before they are discussed in lectures. It is not necessary that students study them carefully, but at least they should get the "smell of it". This should make it much easier for students to follow the lectures and find them more interesting. |
| **Tentative Schedule** |
| **Week** | **Date/Day****(tentative)** | **Topics** | **Textbook/Assignments**  |
| 1 | 11.02.19 |   ***Lecture №1.*** Elements of signal theory. Basic radio-engineering signals their parameters. Classifying signals. Harmonic signal. Pulsed signal. Analytic , temporary and spectral description of signals. Periodic and nonperiodic signals.  | [1], Chapter 1[2], Chapters 2 |
|  | 14.02.19 | *Seminar* $№ 1$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 2 | 18.02.19 |   ***Lecture №2.*** Modulation. Spectral analysis of periodic and nonperiodic signals. Signal energetic spectrum. Signals with discrete spectrum Calculating circuit at stationary regime. Analysis the transition processes in radio-engineering devices. Electronic devices, their components. Diode, Triode, Tetrode, Pentode. Cathode ray tube.  | [1], Chapter 2 [3], Chapters 2 |
|  | 21.02.19 | Seminar $№ 2$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 3 | 25.02.19 |   ***Lecture №3.*** Common characteristics of radio-engineering equipment. Linear devices. Pulse, transition and frequency characteristics. Conditions for conversion the signals without distortion in linear equipment. . Trigonometrical method for analysis the linear circuit.  | [1], Chapter 3.[4], Chapter 4, |
|  | 28.02.19 | Seminar $№ 3$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 4 | 04.03.19 |   ***Lecture №4.*** Methods of complex amplitude and vector diagram.Induced oscillations in series circuit. Filtering properties of series circuit. Filtering properties of parallel circuit. Filtering properties of adjustable circuits. Complex electric filters. Nonlinear equipment. Resonance amplifying frequency and its multiplication.  | [1], Chapter 4[2], Chapter 5 |
|  | 07.03.19 | Seminar $№ 4$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 5 | 11.03.19 |  ***Lecture №5.*** Detecting. Detectors of amplitude, frequency and frequency. Detecting of amplitude modulated signal. Detecting of frequency modulated signal. Parametric circuits. Longer lines and their wave equations. Reflection of waves at the edge of lines.Input resistance of lines. Nonlinear elements, their characteristics. Graphic and analytic methods for analysis of nonlinear characteristics.  | [1], Chapter 5[3], Chapters 6  |
|  | 14.03.19 | Seminar $№ 5$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 6 | 18.03.19 |  ***Lecture №6.*** P-n junction in semiconductors (s/c).Properties of p-n junction under external electric field. S/c resistors- Thermoresistors. Photoresistors. Varistors. S/c diodes- Rectifying diode. Pulse diode. Tunnel diode. Photodiode. Light diode.. | [1], Chapter 6[3], Chapters 7  |
|  | 25.03.19 | Seminar $№ 6$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 7 | 28.03.19 |   ***Lecture №7.*** S/c triode (bipolar transistor). Circuits with common emitter and base. Amplifying parameters of bipolar transistors. Temperature and frequency response of bipolar transistor. Transistor as a switch. Field effect transistor. Transistor with a single junction. Four layer s/c devices .Thyristor  | [1], Chapter 7[2], Chapter 8 |
|  | 01.04.19 | Seminar $№ 7$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 8 | 04.04.19 |   ***Lecture №8.*** Amplifiers of electrical oscillations. Basic characteristics of amplifiers. Amplifying cascades with bipolar transistor. Amplifying cascades with field transistor. Double cascade wider band amplifier with RC- connection. Inverse link in amplifiers. Voltage amplifier of narrower band. | [1], Chapter 8[2], Chapter 9 |
|  | 08.04.19 | Seminar $№ 8$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
|  | 11.04.19 | **Midterm exam** |  |
| 9 | 15.04.19 |  ***Lecture №9.***  Amplifiers of direct current. Differential amplifiers. Operational amplifiers. Power amplifiers. Oscillatory circuits and selective amplifiers. Induced oscillations in series(voltage resonance) and parallel ( current resonance) oscillatory circuits. Bound oscillatory circuits .  | [1], Chapter 9[2], Chapter 10 |
|  | 18.04.19 | Seminar $№ 9$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 10 | 22.04.19 |   ***Lecture №10.***  Selective amplifiers. Generators of harmonic oscillations. Excitation of harmonic electrical signals. LC-autogenerators. RC-autogenerators. Frequency stabilizing for the oscillations generated in autogenerators.  | [1], Chapter 10[2], Chapter 12 |
|  | 25.04.19 | Seminar $№ 10$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 11 | 29.04.19 |  ***Lecture №11.***  Communication channel. Characteristics of communication channel. Structural network of radio link. Conversion of signal spectrum . Amplitude modulated signal. Frequency modulated signal. Other types of modulation. Conversion of frequency. Radio-receiving equipment. Technical characteristics and classification of radio-receiving equipment.  | [1], Chapter 11[2], Chapter 11 |
|  | 02.05.19 | Seminar $№ 11$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 12 | 06.05.19 |   ***Lecture №12.*** Basic elements of pulse and digital technique. Characteristics and parameters. Electronic switch. Simple formatters of pulsed signals. Differentiating and integrating circuits. Elements of logic. Triggers. Registers. Multivibrators. Blocking generator. Generators of linearly varying voltage. | [1], Chapter 12[2], Chapter 13 |
|  | 09.05.19 | Seminar $№ 12$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 13 | 13.05.19 |   ***Lecture №13.*** Rectifying circuits. Half -wave rectification of one phase alternating current. Full-wave rectification of one phase alternating current. Rectification of triple phase alternating current. Smoothing filters. | [1], Chapter13[2], Chapter 14 |
|  | 16.05.19 | Seminar $№ 13$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 14 | 20.05.19 |   ***Lecture №14.*** Basic parameters of stabilizers. S/c stabilizers of direct current. Stabilizers of alternating voltage. Current stabilizers. Conversion of direct voltage.  | [1], Chapter 14[2], Chapter 15 |
|  | 25.05.19 | Seminar $№ 14$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
| 15 | 29.05.19 |   ***Lecture №15.*** Antennas and propagation of waves. Classification and basic factors of aerials. Mirror-parabolic antennas. Propagating properties of longer, average , short and ultra short waves. | [1], Chapter 15[2], Chapter 16 |
|  | 30.05.19 | Seminar $№ 15$ Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details.Solving problems. |  |
|  |  | **Final Exam** |  |

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