RTU Course "Electron Devices"

13212 Elektroniskās aparatūras katedra

General data

Code	REA204
Course title	Electron Devices
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Electronics and Telecommunications
Responsible instructor	Arnis Gulbis
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Abstract	Electron devices as two and four terminal devices, their current-voltage characteristics. Small signal parameters of two and four terminal devices and corresponding equivalent circuits. Electron energy spectrum of solids, their division in metals, dielectrics and semiconductors. Intrinsic semiconductors and semiconductors with impurities. Electron statistics in semiconductors. P-n junction, its equilibrium and non-equilibrium properties. Heterojunction and contact metal-semiconductor. Rectifier, p-i-n, high frequency, pulse, tunnel, reverse, Zener, variable capacitance and Schottky diodes. Bipolar junction transistors, thyristors, field effect transistors and charge coupled devices. Structure, operation principles, current-voltage characteristics, parameters, mathematical models, advantages and drawbacks of devices considered. Influence of temperature on operation of electron devices.
Goals and objectives of the course in terms of competences and skills	To give knowledge about widely used semiconductor devices, their structure, operation principles, circuit diagrams, current-voltage characteristics and parameters. To develop ability to choose the most appropriate device for the application in question. On the basis of device properties in different circuit diagrams students should be able to choose the necessary circuit diagram and know how to switch the device correctly in the circuit. They must be able to determine whether the device is operational or out of order.
Structure and tasks of independent studies	Students independently must acquire knowledge about topics closely related to those considered at the lectures (questions related to small signal F and Z parameters). Students independently must prepare for laboratory work on the basis of theoretical materials considered at the lectures, they must process the results of work and defend the laboratory work report (the fulfillment of laboratory work and submission of lab work report, and its defense are monitored. Tutorials are provided upon necessity).
Recommended literature	Kursa teorētiskajai daļai 1.A.Gulbis, Elektronu ierīces, Lekciju kursa konspekts, RTU, Rīga, 2006 (sk. Jaunumu forumu) 2.A.Gulbis, Lādiņa saites ierīces (sk. Jaunumu forumu) 3.E. Lāme, Pusvadītāju ierīces, I, II,RPI, 1978 4.J. Beķeris, I. Prūsis, A.Gulbis, Bipolārie tranzistori, RPI, Rīga,1990 5.Kevin F. Brennan „Introduction to Semiconductor Devices. For Computing and Telecommunications Applications”, Cambridge University Press, 2005 6.Michael Shur „Physics of Semiconductor Devices”,PRENTICE HALL, Englwood Cliffs, New Jersey, 1990 7.Thomas L. Floyd, Electronic Devices,Fifth Edition,Prentice-Hall, inc., 1996 8.Электронные приборы, под ред. Г.Г. Шишкина, Энергоатомиздат, М., 1982 9.В.В. Пасынков, Л.К. Чиркин, Полупроводниковые приборы, Высшая школа, М., 1987 Laboratorijas darbiem 1.A.Gulbis, Elektronu ierīces, Laboratorijas darbu apraksts, RTU, Rīga, 2006 (sk. Jaunumu forumu) 2.Elektronu ierīces I, II, III, Laboratorijas darbu apraksti, Rīga, RPI, 1983 3.Электронные приборы I, II, III, Опис. лаб. раб., РПИ, Рига, 1983
Course prerequisites	RRE102 Electricity and Magnetism

Course outline

Theme	Hours
Classification schemes, operation modes and characteristic parameters of electron devices.	2
Two and four terminal devices, systems of their description, small signal parameters and equivalent circuits.	6

Electron energy spectrum in solids, electron statistics in semiconductors.	4
Equilibrium properties of p-n junction.	4
Non-equilibrium properties of p-n junction.	2
Heterojunction and contact metal-semiconductor.	2
Rectifier, p-i-n, high frequency, pulse, Zener, variable capacitance, tunnel, reverse and Schottky diodes.	8
Bipolar junction transistor, Ebers-Moll model, current-voltage characteristics in different circuit diagrams.	8
Thyristors.	2
Junction FET.	6
MOSFETs.	2
Charge coupled devices.	2

Learning outcomes and assessment

Learning outcomes	Assessment methods
Are competent about small signal parameters of semiconductor devices, understand their meaning and their approximate value range. Understand which power supply source (current or voltage) must be used in order to measure the corresponding parameter.	Defence of laboratory work reports and exam.
Have knowledge about current-voltage characteristics of two and four terminal devices in different circuit diagrams.	Defence of laboratory work reports and exam.
Are competent in fundamentals of semiconductor physics, understand equilibrium and non-equilibrium properties of p-n junction and contact metal- semiconductor.	Exam.
Understand principles of operation of different semiconductor devices, understand how they must be correctly switched into circuit using appropriate power supply source. Have general understanding about the operation velocity of semiconductor devices.	Defence of laboratory work reports and exam.
Have knowledge about advantages and drawbacks of different semiconductor devices and how the temperature affects their operation. Are able to determine whether or not the semiconductor devices is operational.	Defence of laboratory work reports and exam.
Have knowledge about equivalent circuits and simplest mathematical models of semiconductor devices.	Exam.
Know the designations of semiconductor devices in electrical circuits.	Defence of laboratory work reports and exam.

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	4.5	2.0	0.0	1.0		*	