MINISTRY EDUCATION AND SCIENCE
OF THE REPUBLIC OF KAZAHSTAN

SATBAYEV UNIVERSITY

«Approved»

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23. 08. 2020

Syllabus

ROB 1873 Basics of sensors and measurement technologies

(discipline)

For major
6B071600–Instrument making
3 credits

Semester: 5, 2020-2021 year

Almaty, 2020

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
SATBAYEV UNIVERSITY

Institute of industrial automation and digitalization named after A. Burkitbayev
Department of Robotics and Engineering tools of automation

1. About teacher:

Associated professor
Lecturer
Yeshmukhametov Azamat Nurlanovich
Office hours, room (Wednesday 9:00-11:00, IMS 207)
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Assistant
Salemkan Ainur Seitkhanovna
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2. The purpose of the course:

The purpose of the course is to provide basic knowledge about sensor modules, manufacturing technologies and their application . Objectives of the course - to master the basics of physical operation and devices of semiconductor parts, as well as their characteristics and performance, as well as the basic principles of analog circuits, signal generators, integrated circuits, functions and construction of integrated logic elements, combinatorial and know the methods of synthesis of logic elements.

3. Course description:

The purpose of the discipline is to study electronic phenomena and physical processes related to changes in concentration and location of charged particles in different environments and conditions (at different temperatures, under the influence of electronic and magnetic fields), the principles of construction and operation of electronic devices, their voltage and parameters. To study the principles of construction of logic (digital) circuits in switches, generators and sensor modules.

During the course the student must know:

Must know:

- physical principles, characteristics, indicators and equivalence scheme of sensors;
- standard schematic calculations of generators, pulse signal generators, logic elements and power supply, amplifier circuits;
- the basics of calculation and analysis of electronic circuits.

Must be able to:

- the use of various electronic devices in electrical circuits, the choice of type of electronic devices depending on the specifics of their use;
- use of electronic circuits;
- analyze the operation of electronic circuits, determine their features depending on the function and the conditions of their use;
- work with technical literature, references, ISO and technical documents.

4. Pre-requisites

In order for students to understand and master the course "Electronics", they must have knowledge in the following disciplines: Mathematics, Physics, Electrical Engineering.

5. Post-requisites

The subject "basics of sensors and measurement technologies" is the basis of the following disciplines: Robotics and mechatronics, Integrated and microprocessor circuitry.

6. References

Main references	Additional references
1.Jacob Fraden, “Handbook of Modern Sensors”, Second	Бальян Р . Х. Трансформаторы для

edition. Springer.	радиоэлектроники. М.: Сов. радио, 1971.
2. Jeremy Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, second edition 2006. Wiley press.	Типовие устройства экектропитающих установок средств связи. Л.: ЛЭИС им. проф. М. А. Бонч-Бруевича, 1977.
3. . Д. Кратиров и др. Электропитание устройств связи: - М.: Радио и свиязь, 1981.	
4. Бурбаева Н.В., Днепровская Т.С. Сборник задач по полупроводниковой электронике (2004).	
5. Китаев В.Е, Бокуняев А. А. Расчет источников электропитания устройств связи:-М.:Связь, 1979	
7.Прянишников В.А. Электроника.- СПб.: Учитель и ученик, 2003.	
8.Степаненко И.П. Основы микроэлектроники. – ДМК Пресс, 2001.	

7. Schedule-topic calendar

Weeks	Lecture titles	Laboratory works	References	Assignment	Deadline
1	Introduction to sensors. Sensors classification	Basics of sensor modules	[1-5]		
2	Sensor characteristics: Transfer function Span Accuracy Hysteresis Calibration error	Basics of sensor stimulus	[1-6]		
3	Physical principles of sensing	Physical principles of sensing	[1-6]	Physical principles of sensing	5
4	Interface electronic circuits	Electronic board input and outputs	[3,7]	Electronic board input and outputs	7
5	Position, level, and displacement	Wiring of potentiometric sensors and ultrasonic sensors	[1,8]		
6	Occupancy and motion detectors	Wiring of PIR sensors. Human detection sensors	[1,8]		
7	Velocity and acceleration sensors	Wiring of accelerometer	[2,5]		
8	**Midterm**			Test multiple choice	Week 8
9	Force and strain sensors	Wiring of force sensors and pressure sensor	[5]		
10	Pressure sensors	Wiring of	[2]	Wiring of pressure	13

Weeks	Lecture titles	Laboratory works	References	Assignment	Deadline
		pressure sensor		sensor	
11	Flow sensors. Temperature sensors.	Working with electromagnetic valve	[2]		
12	Acoustic sensors, Light detectors, Radiation detectors, electromagnetic field detectors.	Studying of microphone	[7]	Working with electromagnetic	14
13	Humidity and moisture sensors	Wiring of DHT sensor	[3]		
14	Sensor technologies	Sensors fabrication technologies	[8] [5]		
15	**Endterm**			Test multiple choice	Week 15
	Exam			Tickets	By schedule

**In schedule-topic calendar might have a changes due to national holidays*

8. Assignments and instructions

✓ **Student self-assignment:**

1. Semiconductors conductivity
2. Semiconductors physical properties
3. Piezoelectric effect
4. Pyroelectric effect
5. Hall effect
6. Peltier effect
7. Noise in sensors and circuit
8. Piezoelectric force sensors
9. Differential amplifier
10. Analogue electronics
11. Digital electronics
12. Capacitive occupancy detectors
13. Relay and their applications
14. Electromagnetic velocity sensors
15. Encoder types
16. Gyro sensor

✓ **Students assignment with teachers:**

1. Wiring and data acquisition from sensors
2. Input characteristics of interface circuits
3. Sensor module integration with other modules
4. Basic sensors coding

✓ **Laboratory works:**

The student's practical work is based on a calendar-thematic plan. Practical work is aimed at solving specific problems and developing the structure of the robot based on the foregoing material. All practical work should be performed according to the schedule and formalized according to the

standard.
Midterm 1 – Multiple choice test in written form (all passed materails for the first 7 weeks)
Endterm 2 - Multiple choice test in written form (all passed materails for the first 14 weeks)

✓ **Exam**
Covers and summarizes all course material. The exam is carried out on tickets in writing, includes lecture materials, assignment materials, a practical solution to a specific problem. The duration of the exam is 2 academic hours. The written answer must be accurately framed, contain a correct, complete and clear presentation of theoretical material with illustrations by examples, the correct and optimal solution of practical problems strictly in accordance with the task formulated in the examination ticket.

9. Assessment criteria:

№ п/п	Type of exam	Max. score for the week	Weeks															Total max scores
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Activity in lecture discussions	0,5		*	*	*	*	*	*		*	*	*	*	*	*		6
2	Activity in laboratory work discussion	0,5		*	*	*	*	*	*		*	*	*	*	*	*		6
3	Assignments	1,0		*		*		*			*		*		*			6
4	Homework	1,0			*		*		*			*		*		*		6
5	Project work	4,0					*											4
6	Midterm	10,0								*								10
7	Project work	4,0													*			4
8	Assignment	1,0		*		*	*	*			*		*	*	*			8
9	Endterm	10,0															*	10
	Exam																	40
	Total score																	100

** It is possible to receive bonus points for completing additional tasks*

10. Late submission policy:
Observe the deadlines for the delivery of practical work, CDS, SRSP. If the work is not completed on time, the maximum score will be reduced by 10%.

11. Policy of attending classes
Do not be late and do not miss classes, turn off cell phones during classes, be prepared for classes, punctual and obligatory. If you are forced to miss the midterm control or final exam for valid reasons, you must notify the teacher in advance before the control or exam.

12. Policy of Academic Conduct and Ethics: Be tolerant, respect other people's opinions. Formulate objections in the correct form. Plagiarism and other forms of dishonest work are not allowed. Prompting and cheating during exams, passing the exam for another student is inadmissible. A student caught falsifying any course information will receive a final grade of "F". Within the framework of training in the discipline, any manifestations of corruption in any form are unacceptable. The organizer of such actions (teacher, students or third parties on their behalf) bear full responsibility for violation of the laws of the Republic of Kazakhstan.

Considered at a meeting of the department (Robotics and Engineering tools of automation), protocol №1 from «_7_»_08_ 2020 year.

Compiled by: *Associated professor* Yeshmukhametov A.N.