National Technical University of Ukraine

"Igor Sikorsky Kyiv Polytechnic Institute"

APPROVED:

Head of the Subject Committee

Educational Program Coordinator

Yuliia YAMNENKO

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"__" "_____" 2022

AGREED:

Vice-rector for academic work

Anatoly MELNICHENKO

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"__" "_____" 2022

PROGRAM OF

ENTRANCE EXAMINATION

to study the educational program for the scientific degree

of Doctor of Philosophy

on specialty 171 Electronics

The program is recommended by the academic council of the Faculty of Electronics

Kyiv – 2022

CONTENT

I. GENERAL INFORMATION

The entrance exam for studying for the Doctor of Philosophy degree in the specialty 171 "Electronics" is held for those entrants who have a master's degree*.

The educational program "Electronics" corresponds to the mission and strategy of Igor Sikorsky Kyiv Polytechnic Institute, according to which the university's strategic priority is the deep theorization of specialist training. The peculiarities of the educational program are taken into account by choosing the appropriate sections of the entrance exam program. Conducting an entrance test should reveal the level of training of the entrant in the specialty chosen for admission.

The theoretical questions of the entrance exam contain three sections:

1. Power converters;
2. Electronic systems;
3. Microprocessors.

Each ticket contains three questions. The entrance test is a written exam lasting 120 minutes.

In the next section of the program, only those topics from the specified sections that relate to the performance of the tasks of the entrance tests are given.

Information on the rules of admission to study and requirements for entrants of the "Electronics" educational program is provided in the "Admission to postgraduate studies" section on the website of postgraduate and doctoral studies of KPI named after Igor Sikorsky at the link https://aspirantura.kpi.ua/

* According to Appendix 2 of Chapter XV of the Law on Higher Education, higher education at the educational and qualification level of a specialist is equated to higher education with a master's degree.

II. EXAMINATION TEST TOPICS

1. Power converters

1. Controlled and multi-level rectifiers.
2. Autonomous voltage inverters.

3. Autonomous current inverters.

4. Frequency converters with a direct current link.

5. Direct frequency converters.

6. Non-isolated DC-DC converters.

7. AC voltage regulators.

2.   Electronic systems

1.   Modulation of harmonic signal: amplitude, frequency, phase. Comparison of signal spectra with different types of modulation.

2.   Pulse modulation. Spectral composition of modulated signals with APM and PWM.

3.   Digital form of information, positional number system, direct coding, recovery, recovery errors.

4.   Communication systems. Discrete and continuous communication systems. Consistency of signals and communication channels.

5.   Effective encryption. Shannon–Fano and Huffman codes.

6.   Reduction of information redundancy. Block encryption.

7.   Bandwidth of the communication channel. Interference-resistant encryption.

3.   Microprocessors

1. Basic concepts of microprocessor technology. Advantages and disadvantages of microprocessor systems. Classification of microprocessor sets. RISC and CISC architecture.

2. Structure of i8086 MP. Physical and logical organization of memory. Segments of data, codes, stack.

3. Program model of microprocessor, memory, and input-output interface of i8086 MP. Types of addressing. Examples of commands with different types of addressing. Characteristics of command system.

4. Multi-core processors. Prerequisites for the transition to an MP multi-core structure.

5. Intel Core 2 Duo dual-core processors. Intel Core 2 Quad quad-core processor. AMD 4-core processor architecture. Comparison of Intel and AMD processors.

6. Features of STM32 32-bit microcontrollers family.

7. UART, SPI, I2C interfaces of STM32 microcontrollers. Communication with a PC.

III. LIST OF RECOMMENDED SOURCES

1. Trzynadlowski, A. M. (2016). Introduction to modern power electronics. John Wiley & Sons.

2. Dokić, B. L., Blanuša, B. (2015). Power Electronics (pp. 559-592). Springer.

3. Rashid, M. H. (Ed.). (2018). Power electronics handbook. Butterworth-Heinemann.

4. Information Theory and Network Coding by Raymond W. Yeung, The Chinese University of Hong Kong, Springer, August 2008, 604 pp., ISBN 978-0-387-79233-0.

5. Stone, J.V. Information Theory: A Tutorial Introduction, University of Sheffield, England, 2014, ISBN 978-0956372857. https://jamesstone.sites.sheffield.ac.uk/books/information-theory

6. Engineering of electronic systems. Volume 3. Microprocessors and microcontrollers / V.I. Boyko, A.M. Gurzhii, V.Ya. Zhuykov, A.A. Zori, Yu.S. Petergerya, V.M. Spivak, T.O. Tereshchenko, Yu.I. Yakymenko. - Kyiv: Vyshcha shkola, 2004. – 399 p. (ukr)

7. Microprocessors. The third edition, revised. / T.O. Tereshchenko, V.Ya. Zhuykov, Yu.S. Yamnenko. Ed. by O.V. Borisov. - Kyiv, 2015. - 440 p. (ukr)

IV. EVALUATING THE RESULTS OF THE ENTRANCE TEST

The applicant's initial rating for the exam is calculated based on a 100-point scale. When determining the overall rating of the entrant, the initial rating for the exam is converted into a 200-point scale according to the corresponding table (item 4).

Persons taking part in the entrance test receive examination tickets in random order. The total number of tickets is 7. Each ticket contains three questions.

At the exam, entrants provide a written answer to 3 tasks of the exam ticket.

Each of the three questions is evaluated on a 100-point scale (Table 1).

Table 1

95 – 100 points	Complete answer. The entrant demonstrated mastery of the material in full
85 – 94 points	True, but incomplete answer
75 – 84 points	The answer contains minor errors
65 – 74 points	The answer contains significant but non-principled errors
60 – 64 points	The answer contains fundamental errors
0 points	No answer

The level of knowledge and the ability to use it when performing practical tasks are assessed within the framework of the ECTS standard, i.e. on a 100-point scale (Table 1). The overall score O is obtained by arithmetically averaging the

scores O_i, i = 1, 2, 3, obtained for the answers to each of the three questions of the ticket:

$$O = (O_1 + O_2 + O_3) / 3.$$

The result is rounded according to the rules accepted in mathematics. Since the "Rules of admission to Igor Sikorsky Kyiv Polytechnic Institute in 2022" require the application of an evaluation scale of 100...200 points when calculating the competitive score, perform a recalculation of the assessment of the rating evaluation system into a 200-point scale in accordance with the correspondence table below (item 4).

The sum of points for the answers on the exam is converted to a 200-point scale according to the table:

Таблиця відповідності оцінок рейтингової системи оцінювання (РСО, 60...100) балам 200-бальної шкали (100...200)

Оцінка РСО	Бали 100...200	Оцінка РСО	Бали 100...200	Оцінка РСО	Бали 100...200	Оцінка РСО	Бали 100...200
60	100,0	70	125,0	80	150,0	90	175,0
61	102,5	71	127,5	81	152,5	91	177,5
62	105,0	72	130,0	82	155,0	92	180,0
63	107,5	73	132,5	83	157,5	93	182,5
64	110,0	74	135,0	84	160,0	94	185,0
65	112,5	75	137,5	85	162,5	95	187,5
66	115,0	76	140,0	86	165,0	96	190,0
67	117,5	77	142,5	87	167,5	97	192,5
68	120,0	78	145,0	88	170,0	98	195,0
69	122,5	79	147,5	89	172,5	99	197,5
						100	200,0

V. AN EXAMPLE OF AN EXAMINATION TICKET

National Technical University of Ukraine

"Igor Sikorsky Kyiv Polytechnic Institute"

Academic degree   *Doctor of Philosophy*

Specialty   *171 Electronics*

Academic course   *Entrance examination*

EXAMINATION TICKET № __

1. *Question 1.*

2. *Question 2.*

3. *Question 3.*

Approved

Educational Programs Coordinator _____ Yuliia YAMNENKO

<center>(signature)</center>

<center>Kyiv 2022</center>

PROGRAM DEVELOPERS:

Yuliia YAMNENKO, Head of Department of Electronic Devices and Systems

Ievgen VERBITSKIY, Professor of Department of Electronic Devices and Systems

Oleksandr BONDARENKO, Associate Professor of Department of Electronic Devices and Systems

The program is recommended by the academic council of the Faculty of Electronics, protocol № 02/2022 from February 21, 2022

Head of the academic council _____ Valery ZHUIKOV