**SYLLABUS**

**regarding the qualification cycle FROM 2023 To 2024**

1. Basic Course/Module Information

|  |  |
| --- | --- |
| Course/Module title | Microcontrollers |
| Course/Module code \* |  |
| Faculty (name of the unit offering the field of study) | *College of Natural Sciences* |
| Name of the unit running the course | *Institute of Materials Engineering* |
| Field of study | mechatronics |
| Qualification level | FIRST-CYCLE STUDIES |
| Profile | *PRACTICAL* |
| Study mode | *FULL-TIME STUDIES* |
| Year and semester of studies | *YEAR 2, SEMESTER 4* |
| Course type | *LECTURES AND LABORATORIES* |
| Language of instruction | ENGLISH |
| Coordinator | WOJCIECH ŻYŁKA, PhD, Eng. |
| Course instructor | *MARCIN GROCHOWINA, PhD, Eng.* |

\* - as agreed at the faculty

1.1.Learning format – number of hours and ECTS credits

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Semester  (n0.) | Lectures | Classes | Colloquia | Lab classes | Seminars | Practical classes | Internships | others | **ECTS credits** |
| 4 | - | - | - | 30 | - | - | - | - | 5 |

1.2. Course delivery methods

- conducted in a traditional way

~~- involving distance education methods and techniques~~

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)

pass with a grade

2. Prerequisites

|  |
| --- |
| 1. BASICS OF ELECTRONICS  2. EXPERT PROGRAMMING IN C LANGUAGE |

3. Objectives, Learning Outcomes, Course Content, and Instructional Methods

3.1. Course/Module objectives

|  |  |
| --- | --- |
| O1 | *O1 - UNDERSTANDING THE ARCHITECTURE OF MICROPROCESSOR SYSTEMS.* |
| O2 | O2 - PROGRAMMING IN C LANGUAGE FOR EMBEDDED SYSTEMS IN BARE-METAL MODEL. |

3.2. Course/Module Learning Outcomes (to be completed by the coordinator)

|  |  |  |
| --- | --- | --- |
| Learning Outcome | The description of the learning outcome  defined for the course/module | Relation to the degree programme outcomes |
| LO\_01 | KNOWLEDGE:  THE STUDENT HAS KNOWLEDGE ABOUT PROGRAMMING SYSTEMS EMBEDDED IN BARE-METAL MODELS USING THE C LANGUAGE, INCLUDING ACCESS TO THE PERIPHERALS OFFERED BY MICROPROCESSOR SYSTEMS. |  |
| LO\_02 | SKILLS:  THE STUDENT CAN CREATE SOFTWARE THAT RESPONDS TO EXTERNAL SIGNALS REACHING THE MICROPROCESSOR SYSTEM. |  |
| LO\_03 | FINAL COURSE OUTPUT - SOCIAL COMPETENCES  THE STUDENT UNDERSTANDS THE ESSENCE OF CREATING RELIABLE AND HIGH QUALITY EMBEDDED SYSTEMS SOFTWARE AND THE CONSEQUENCES OF POSSIBLE ERRORS AND MISTAKES |  |

**3.3. Course content (to be completed by the coordinator)**

1. Laboratories

|  |
| --- |
| Content outline |
| 1. PROGRAMMING IN C LANGUAGE FOR EMBEDDED SYSTEMS. |
| 2. INTRODUCTION TO MICROPROCESSORS AND EMBEDDED SYSTEMS AS WELL AS TOOLS NEEDED TO IMPLEMENT PROGRAM CONTENT. EXAMPLES OF EMBEDDED SYSTEMS. DEFINITIONS: PROCESSOR-MICROPROCESSOR-MICROCONTROLLER. THE HISTORY OF MICROPROCESSORS. |
| 3. ARCHITECTURE OF MICROPROCESSORS AND MICROCONTROLLERS. RISC VS. CISC, VON NEUMANN VS. HARVARD. RAM / ROM MEMORY. PROCESSING INSTRUCTIONS. ARM MICROPROCESSOR. ARCHITECTURE OF EMBEDDED SYSTEMS. |
| 4. COMMUNICATION PROTOCOLS. UNIVERSAL ASYNCHRONOUS RECEIVING AND TRANSMITTING INTERFACE (UART). SERIAL PERIPHERAL INTERFACE (SPI). INTER INTEGRATED CIRCUIT INTERFACE (I2C). |
| 5. PERIPHERAL SYSTEMS OF MICROCONTROLLERS. GENERAL PURPOSE INPUT-OUTPUT (GPIO), REAL-TIME CLOCK (RTC), ANALOG TO DIGITAL CONVERTER (ADC), DIGITAL TO ANALOG CONVERTER (DAC), PULSE WIDTH MODULATION (PWM). |

3.4. Methods of Instruction

LABORATORY - WORK IN GROUPS, ANALYSIS OF EXAMPLES, DISCUSSION, INDEPENDENT IMPLEMENTATION OF PROJECTS-TASKS.

4. Assessment techniques and criteria

WRITTEN CREDITS FOR INDIVIDUAL ISSUES. EXECUTION OF LABORATORY EXERCISES.

4.1 Methods of evaluating learning outcomes

|  |  |  |
| --- | --- | --- |
| Learning outcome | Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes) | Learning format (lectures, classes,…) |
| LO-01 | *OBSERVATION DURING CLASSES* | laboratories |
| LO\_02 | OBSERVATION DURING CLASSES, project | laboratories |
| LO\_03 | OBSERVATION DURING CLASSES | laboratories |

4.2 Course assessment criteria

|  |
| --- |
| LABORATORY. OBTAINING POSITIVE GRADES FROM ORAL ANSWERS ON ISSUES RELATED TO THE EXERCISES PERFORMED. CORRECT EXECUTION OF REPORTS ON THE IMPLEMENTATION OF EXERCISES. VERIFICATIONS OF LEARNING OUTCOMES IN THE CLASSROOM WITHOUT THE PARTICIPATION OF TEACHERS ARE MADE BY ASSESSING THE STUDENT'S PREPARATION FOR LABORATORY EXERCISES AS WELL AS BY EVALUATING THE COMPLETED PROJECT AND THE REPORTS. FINAL RATING BASED ON THE AVERAGE OF PARTIAL GRADES. |

5. Total student workload needed to achieve the intended learning outcomes

– number of hours and ECTS credits

|  |  |
| --- | --- |
| Activity | Number of hours |
| Scheduled course contact hours | 30 |
| Other contact hours involving the teacher (consultation hours, examinations) | 15 |
| Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.) | 80 |
| Total number of hours | 125 |
| Total number of ECTS credits | 5 |

\* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

|  |  |
| --- | --- |
| Number of hours |  |
| Internship regulations and procedures |  |

7. Instructional materials

|  |
| --- |
| Compulsory literature:  - KILIAN. MODERN CONTROL TECHNOLOGY. 3RD ED., CENGAGE LEARNING, 2005.  - USER MANUAL FOR uC LPC2142 or STM32F103  - HENNESSY AND PATTERSON. COMPUTER ARCHITECTURE. A QUANTITATIVE APPROACH. 5TH ED., MORGAN KAUFMANN, 2011.  - BALL. EMBEDDED MICROPROCESSOR SYSTEMS: REAL WORLD DESIGN. NEWNES, BURLINGTON, 2002.  - BARR AND MASSA. PROGRAMMING EMBEDDED SYSTEMS: WITH C AND GNU DEVELOPMENT TOOLS. O’REILLY, 2006. |
| Complementary literature:  - LEE AND SESHIA. INTRODUCTION TO EMBEDDED SYSTEMS. 2ND ED., MIT PRESS, 2015.  - GNU COMPILER COLLECTION, GCC.GNU.ORG.  - GNU MAKE, GNU.ORG/SOFTWARE/MAKE/MANUAL |

Approved by the Head of the Department or an authorised person