Óbuda University Bánki Donát Faculty of Mechanical and Safety Engineering				Insitute of Mechatronics and Vehicle Engineering			
Subject title and code:		**Industrial Robot programming and simulation** **BMXRPY7BNE**				**Credits:**	*5*
Full-Time Study	2024/2025	*ac. year*	1.	*semester*			
The course is available at:		Mechatronical Engineering					
Supervised by:	Dr. István Nagy			**Lecturers:**	Bence Varga, Dr. István Nagy		
Prerequisite (neptun code):		Industrial robot kinematics and dynamics (BMXRRE5BNE)					
Weekly number of lessons							
Lecture:	1	Exercise:	-	Laboratory ex.:	2	Consultation	-
Way of assessment:		Midterm Grade (Writing)					
***Online Consulatation (in case it's required)*:**							
Educational goal:	*To acquire basic knowledge of programming industrial robots and manipulators, both theoretical and practical. Theoretical knowledge will be taught in lectures, while practical knowledge will be taught on a 3D robot simulation system. The robot simulation environment will be based on ABB (or, depending on time, FANUC) systems.*						

Schedule

Education week	Topics
1.	**Laboratory:** This module serves to introduce the RobotStudio environment, to guide the user through the process of creating the first project and to introduce the main concepts and terms used in the simulation environment.
2.	**Lecture1: Reviewing** the basics of mathematics used in robot systems: coordinate systems, Rotational matrices, translational matrices, HTM, D-H calculations, Jacoby matrices, basic path planning methods, …. **Laboratory:** The objective of this study is to create a simple virtual station assembly that incorporates robot and pheriferial devices.
3.	**Laboratory:** In this module the concept of offline programming and path planning will be introduced through a simple example program.
4.	**Lecture2: Introduction:** reviewing basics of robot technics: coordinate systems, joints, segments, DoF,…. Types of Robot controller(s): PLC controlled, own controller, combinations,..). Architecture and types of robot programs from program writing to execution (interpreter, compiler, ...). **Laboratory:** The module serves to introduce simple motion instructions and the basic concept of RAPID programming language.
5.	**Laboratory:** This module will introduce the programming of a simple PICK&PLACE robot. It will also present the path planning required for PICK&PLACE tasks and the functions offs() and RelTool() in RAPID.
6.	**Lecture3:** Description and characteristics of **On-Line** and **Off-Line programming methods.** Basic IT structures related to robot programming (macros, recursions, functions, subroutines, ...). **Laboratory:** This module will introduce the basics of I/O configurations of the IRC5 controller and corresponding RAPID instructions. Furthermore concept of "smart componets" of RobotStudio will be introduced
7.	**Laboratory:** 1st MIDTERM
8.	**Lecture4:** Levels of robot programs (machine code, objects, .., high-level program) and tools for robot programming (3D simulation system, PC, training panel) **Laboratory:** Introduction to Palettizing procedures and program flow control in RAPID.
9.	**Laboratory:** Solving a complex Palettizing procedure in RobotStudio.
10.	**Consultations** until 12:20; TDK, Retor's Holiday from 12:35 **Laboratory:** Introduction to conveyor tracking.
11.	**Laboratory:** Introduction to interrupt management and associated RAPID methods.

12.	**Lecture5:** Modes of motion control: low level control (at the level of motors, servos, sensors); high level control (levels of SWs). Examples with solutions for TP. **Laboratory:** Introduction to multitasking through ABB MULTIMOVE system.
13.	**Laboratory:** 2nd MIDTERM
14.	**Lecture6: Theory TP** **Laboratory:** MIDTERM retake

Mid-semester requirements

Test		Assignment to be submitted		Lab measurements	
Amount	Schedule	Amount	Deadline	Amount	Schedule
1+2	7., 13. and 14. week	1 pcs.	12. week	-	-

According to the Study and Examination regulations of Óbuda University attendance of group seminars and lab exercises are mandatory

Other requirements for participation in sessions not covered by the regulations and restrictions on substitutions:

As per the schedule above, students are expected to take two laboratory midterm and one theoretical tests during the semester. In order to successfully complete the course, students must obtain a minimum of 50% of the scores at each test.

A student will be withdrawn from the course:

- if the absences exceed the threshold given by the regulations (30%) and they are unable to provide a justification or;
- the student failed to participate on both laboratory midterm- or retake tests.

A signature denied entry will be given to those students who:

- participated both laboratory midterm tests;
- failed at least one of the midterm or retake tests.

Final grade is calculated based on the scores obtained from the midterm tests.

The one of the laboratory midterm test can be retaken on the 14. week of education.

Students with signature denied entry are eligible for a signature retake exam that can be taken in the first two weeks of the exam period. The assignments cannot be submitted in the exam period.

Test		Assignment to be submitted		Lab Measurement	
maximum points available	minimum score required to pass /test	maximum points available	minimum score required to pass / assignment	maximum points available	minimum score required to pass /lab
Theory: 100 p. Lab: 50 p.	Theory: 50 p. Lab: 12 p.	-	-	-	-

Total number of points achievable in semester:	150 points

Grading thresholds	**Pass** from 50 %	**Average** from 60 %	**Good** from 75 %	**Excellent** from 90 %

Other evaluation criteria: -

Receive a signature denied entry:	If a student's absences exceed the threshold given by the regulations and they are unable to provide a justification, or the student fails to participate in any of the midterm or retake tests.
Required references:	MOODLE

Recommended references:	J.N. Pires: *Industrial Robots Programming: Building Applications for the Factories of Future, Springer, 2007* more*: http://siva.bgk.uni-obuda.hu/jegyzetek/Mechatronikai_alapismeretek/IpRobProgrSzim/*
Quality assurance methods of the subject:	

Things, that are not included, can be found within the regulations of Óbuda University.