ROBOTICS

Robotics & Autonoumos Robots

Training Lab

About SES

An Edtech industry leader and innovator**, SES Scientific Educational Systems**, goes above and beyond to supply educators and learners with the best educational systems, including **Neulog, Degem Systems, MultiCenter** and **MagiClass.**

Renowned for their ability to cater to numerous fields, sectors and segments, SES systems spread across a wide spectrum, offering unique solutions in the fields of **electronics, microcontrollers, telecommunication, autotronics, mechatronics, pneumatics, hydraulics, CNC machines, refrigeration and air-conditioning, green energy, computerized systems, science, robotics, logger sensors and STEM.**

Each proprietary SES system and device is perfectly designed and manufactured from the highest quality materials in accordance with all safety requirements and regulations. SES is a quality assured firm with the certification of ISO-9001:2015.

SES solutions are used in over 50 countries worldwide by professional developers for high-level technological commercial products and both governmental and private institutions covering educational programs for universities, colleges, vocational training centers and schools, high schools, junior high schools and primary schools.

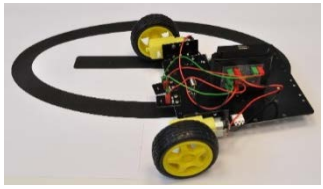
Sense Robotics Program

The Sense robotics builds innovation, creativity and coding skills composed of following units. Each unit has 15 lessons of 2 hours each.

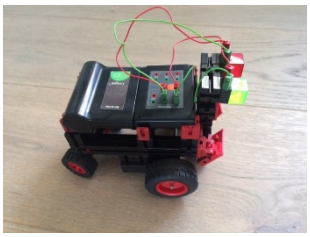
1. **Robot coding and basic algorithms**
   Principles of robotics, programming, movement algorithms, sensor reading, peripheral operation.

2. **Autonomous vehicles challenges**
   This unit introduces several of the challenge autonomous exercises. The idea is to let the user to think about algorithms and solutions to solve these challenges.

3. **Robot making**
   This unit uses the Sense-Make kit for constructing robot system with ROBO-206 controller, passive components (motors, lamps, switches and phototransistor) and brain units. The control unit and sensors enable implementing easily process control systems.



4. **Basic robotics with Fischertechnik**
   This unit uses the Fischertechnik kit for constructing computerized and robotics system with ROBO-206 controller, motors, lamps, switches, light sensor and a large set of construction components including wheels and gears. The control unit and sensors enable implementing easily process control systems.



5. **Robot coding in Blockly and Python**
   This unit covers the principles of robotics, programming, movement algorithms, sensor reading and peripheral operation wirelessly with Blockly and the Python with WIFI-203.

   Blockly – Visual block coding program of Google.
   Python – High level programming language that works on any computer platform.

6. **C Language programming**
   This unit covers the study of writing programs in C-language with the CARM-202 coding unit only. This unit has 8 switches and 8 LEDs for exercising.

   C language – Programming language that creates fast machine programs.

7. **Robot coding in C language**
   This unit teaches communication between CARM-202 and the SENSE robot, its peripherals and Neulog sensors in a certain communication protocol.

8. **Robot coding with Arduino**
   This unit teaches communication between Arduino unit and COM-202 and the SENSE robot, its peripherals and Neulog sensors in a certain communication protocol.

Sense Autonomous

Sense is a standalone modular robot with 6 built-in sensors expandable with **NeuLog sensors, IR Tracking unit, Brain Gripper** and more.

Plug and code with RobocklySense on PC or MAC.

Add extra coding unit for programming in **Robockly, Python, C language, C Arduino**.

Add **BAT-202** for cordless movement.

RobocklySense is available for download at **www.neulog.com**.

<u>The SENSE includes:</u>

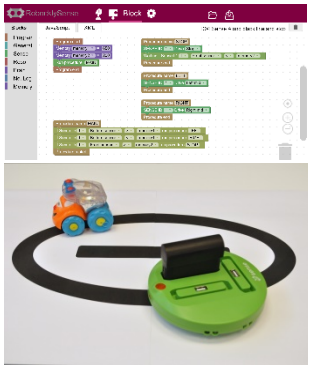
- Base unit
- 3 connectors for NeuLog sensors or add-on units
- 5 IR range sensors
- A bottom line detector
- Shaft wheel
- 2 motors with wheels
- A controller and flash memory for the user programs
- USB communication cable

The **SENSE** robot is a tool to explore and solve coding challenges such as:

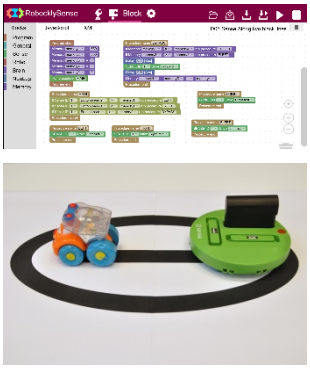
- Movement along black line or along walls.
- **Autonomous car** – challenge applications and algorithms.
- Following a moving body holding IR transmitter using tracking module
- **Environment monitoring** and measurement robot with NeuLog sensors
- Mobile robot with brain gripper.

To a wall

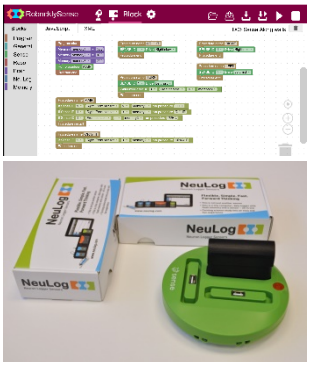
Along a black line



Along two lines



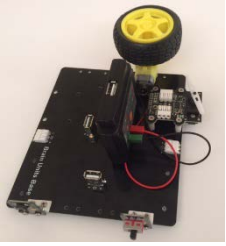
Along walls



To a wall with distance sensor

Tracking robot with IR transmitter

Sense-Make for making robots

The Sense-Make uses brain units for making smart machines and robots the way modern systems are built today.

Programming brain units is simple, like indicating a required angle to servo motor instead of controlling it. Getting processed data from a sensor saves analyzing raw data, and so on.

The kit includes the ROBO-206 controller that can control passive components connected directly to its terminals.

The ROBO-206 can also control a chain of brain units and brain sensors when they are connected to the brain unit base. Robo-206 and NeuLog sensors create excellent application systems for **process control**.

The SENSE-MAKE Robot Making Kit includes:

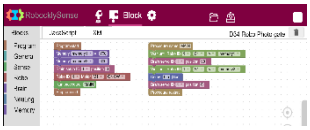
- ROBO-206
- 2 x SNS-161
- Passive actuators
- Passive sensors
- Construction units
- Input/Output control unit
- 2 x Brain servo motor unit
- 2 x DC motors, lamp, LEDs, buzzer
- 2 x tact switches, toggle switch, light sensor
- Brain units base, wheels, shaft wheel, mechanical parts

Plug and code with **RobocklySense** on PC or MAC.

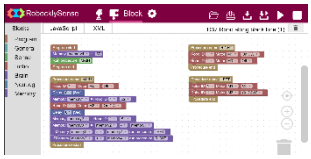
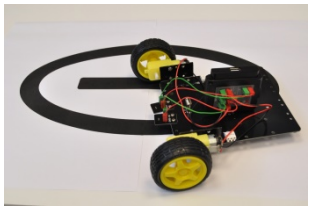
Add extra coding unit for programming in **Robockly, Python, C language, C Arduino**.

Add BAT-202 for cordless movement.

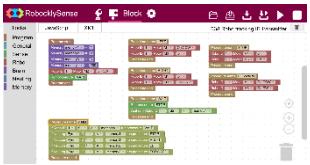
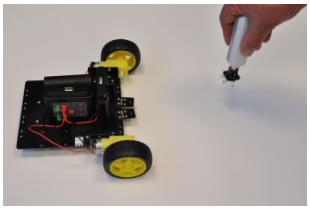
Photo gate and Brain servo



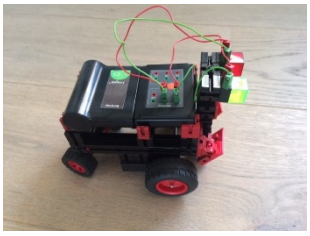

Along a black line

Tracking IR transmitter

TPS-3739 – Basic Robots

A robotic system includes mechanical parts, control unit, sensors and actuators (motors, lamps etc.) that are operated according the sensors and the control unit internal program. Robotics is a multidisciplinary study.

This course enables to study the fundamentals of the robotic systems through constructing and programming computerized systems.

More than 540 constructing components, gear and shaft components, sensors (light sensors, touch sensors, switches) and actuators (motors, lamps) enable to easily build computerized models such as a traffic lights, automatic cart, robots and more.

The kit unique ROBO-206 controller with 3 inputs for sensors and 3 outputs for actuators enables to operate and control all the kit models and more. The ROBO-206 can be expanded with the module ROBO-216 for having additional 3 inputs and 3 outputs (6 inputs and 6 outputs in total).

Robo-206 and NeuLog sensors create excellent application systems for **process control**.

The kit includes the following elements:

- 296 construction components
- 253 gear and shaft components
- Wheels
- 2 motors
- 3 lamps
- Light sensor
- 2 touch sensors
- ROBO-206 control unit
- USB cable
- Textbook (including exercises)
- Color pictures manual enabling constructing 40 models of manual, electrical and computerized models.

Plug and code with **RobocklySense** on PC or MAC.

Add extra coding unit for programming in **Robockly, Python, C language, C Arduino**.

Add BAT-202 for cordless movement.

High Languages Coding Units

WIFI-203 – Wireless Python and Blockly coding unit

WIFI-203 is an embedded Linux controller. It is a Wi-Fi module housed in a rigid plastic packaging with colored label.

The module works wirelessly with any computer platform: computers, tablets, IPADs and smart phones.

The module has two connectors for communication with NeuLog sensors or with brain I/O units. The module includes flash memory used as hard disk for program files.

Programming languages: **Python** and **Robockly**.

CARM-202 – C language coding unit

CARM-202 is a C language coding unit with 8 switches and 8 LEDs housed in a rigid plastic packaging and colored label.

CARM-202 can be also used as a stand-alone module for ARM microcontroller and for C language programming.

Programming languages: **C language**.

COM-202

COM-202 is an adapter card for the Arduino units plugged into one of the system's connectors (NeuLog sensor, SENSE robot or brain unit base) and through it to all the system's units.

The COM-202 card includes outlet wires for connecting to the communication and power terminals of the Arduino coding cards.

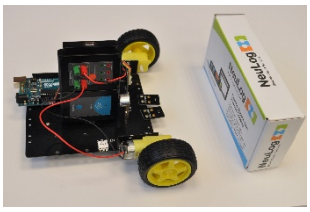
COM-202 comes with software functions that enable communicating with all the system units.

Programming languages: **C Arduino**.

Program in C language

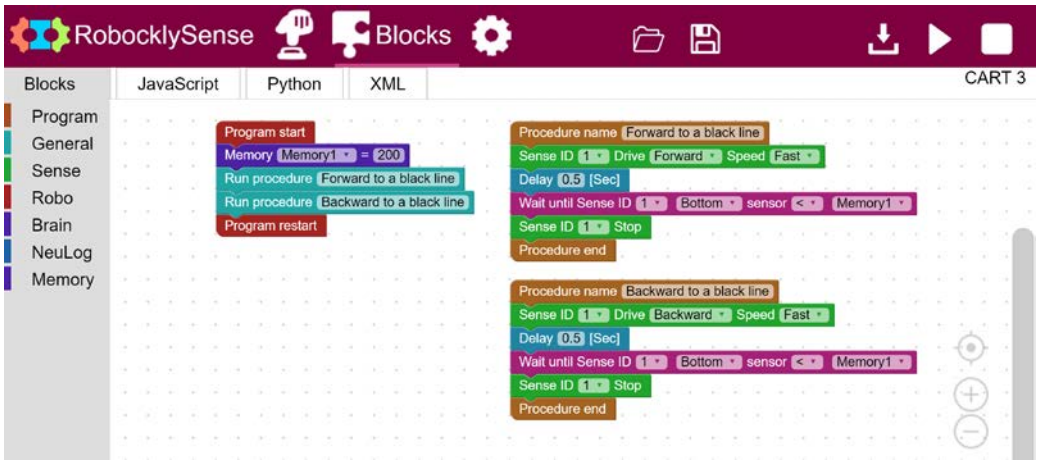
Sense with Wi-Fi and iPad

Robot with Arduino coding unit



Coding Languages

RobocklySense



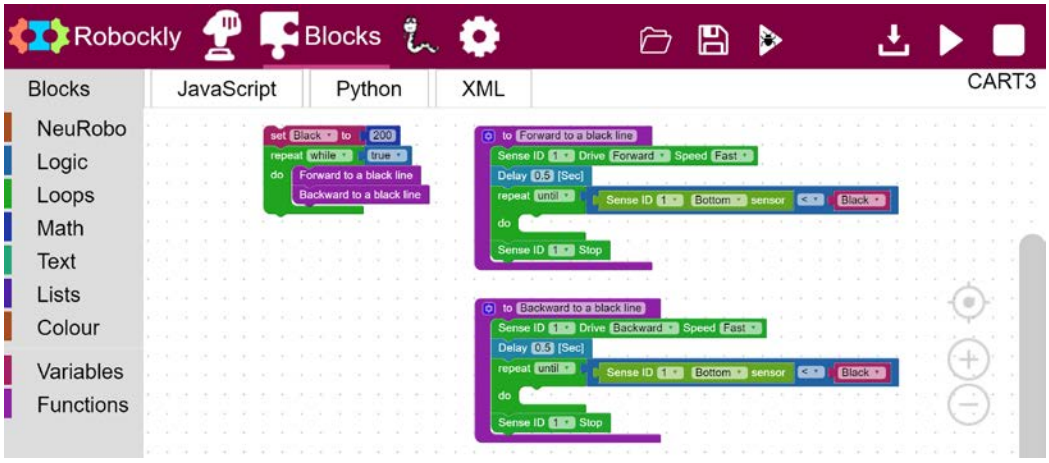
The **RobocklySense** is the best visual block-programming editor to start with. It is the most intuitive robotics software.

The **RobocklySense** uses special blocks for NeuLog SENSE robots and controllers that read the inputs, operate the outputs and read any of the **NeuLog** sensors.

The **RobocklySense** is very friendly and it is easy to create and run robotics programs.

RobocklySense is available for download at **www.neulog.com**.

Robockly



Robockly has **Blockly** (**Google** program) instructions, enhanced with **SENSE** and **NeuLog** instructions.

It has rich instruction sets such as loops, logic, mathematics, functions, arrays, text and variables.

The **Robockly** uses special blocks for NeuLog SENSE robots and controllers that read the inputs, operate the outputs and read any of the **NeuLog** sensors.

Python

```python
Black = None

def Forward_to_a_black_line():
  global Black
  sense_drive( id=1, command="forward", speed="fast" )
  delay_sec(0.5)
  while not (sense_get_input( id=1, input="bottom" )) < Black:
    pass
  sense_stop( id=1 )

def Backward_to_a_black_line():
  global Black
  sense_drive( id=1, command="backward", speed="fast" )
  delay_sec(0.5)
  while not (sense_get_input( id=1, input="bottom" )) < Black:
    pass
  sense_stop( id=1 )


Black = 200
while True:
  Forward_to_a_black_line()
  Backward_to_a_black_line()
```

The **Python** is one of the most popular high-level programming language that works on any computer platform.

It is excellent for programs with many functions and procedures that are limited in visual block programming languages.

C Language

```c
int main (void)
{
 float   BLACK = 250;
 float   VAL;

 NVIC_SetVectorTable(NVIC_VectTab_FLASH, INTERUPT_VECTOR_START);
 USART1_Interupt_Init();
__enable_irq(); //  (Enable Interrupts)

 Send_AT_Command("AT+SetSpeed:[Sense],[1],[0],[150]");          //Set Sense speed
 Send_AT_Command("AT+SetMotor:[Sense],[1],[0],[Cw]");           //Sense forward

 VAL = 900;
 while(VAL > BLACK)
  {
   Send_AT_Command("AT+GetInput:[Sense],[1],[1]");

   if((stringComplete)&&(inputString[0] != 'F')&&(inputString[1] != 'a'))
    {
     InputString_to_val();    //update inputStringVal
     VAL = inputStringVal;
    }
  }
 Send_AT_Command("AT+SetMotor:[Sense],[1],[0],[Off]");           //Sense stop

 End_of_program();
}
```

C is a coding language for creating machine programs. These machine programs are fast and work directly with the system hardware components and not through interpreters as the programs above do.

Sense Add-on Units

SNS-101 – Brain Tracking Unit

SNS-101 Brain Tracking Unit is housed in a rigid plastic case, and is plugged into one of the SENSE sockets, with three IR (Infrared) sensors that enable tracking the IR transmitter.

SNS-160 – IR Transmitter

SNS-160 IR Transmitter is an infrared transmitter that can be plugged into any of the SENSE sockets or in backup battery socket to be followed by the brain tracking unit.

SNS-167 – Brain Gripper Arm with servo motors unit

SNS-167 Brain Gripper Arm with 2 Servo Motors Unit is a brain unit housed in a rigid plastic case plugged into one of the SENSE robot sockets.

BAT-202 – Backup battery

BAT-202 Backup Battery is a rechargeable battery that can be plugged into any of the SENSE autonomous sockets or into any other NeuLog or SENSE unit for cordless operation.

BLT-202 – Bluetooth Module

BLT-202 is a Bluetooth module that contains a 2300mAh rechargeable battery and works through **RobocklySense** application software that can be found in Apple and Google stores.

NeuLog Series

The NeuLog Series includes over fifty different sensors designed for experimentation in chemistry, physics, biology and environment.

NeuLog Sensors may be linked to each other (as a chain) and create a network of sensors.

NeuLog sensors are designed as brain units and can be added to any Sense and Brain system.

ROBO-206 – Input output control unit

The ROBO-206 is an input and output control unit that connected by mini-USB cable to a computer and to receive power from the computer. No external power supply is required.

<u>The module includes:</u>

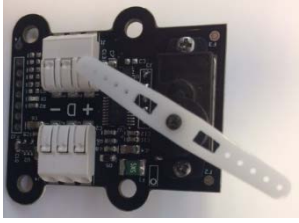
- 3 analog/digital inputs with LED indicators for passive sensors (switch, potentiometer, photo transistor, LDR, thermistor) reading.
- 3 bidirectional output ports with drivers and over current protection with LED indicators for driving motors and lamps.

The module has two connectors for any NeuLog sensors and the smart I/O units.

The module includes flash memory for saving a program and can run independently when a standard backup battery is connected to it.

The ROBO-206 module also functions as USB module for NeuLog sensors.

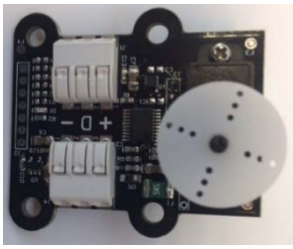
SNS-161 – Brain Servo Motor Unit



SNS-161 Brain Servo Motor Unit operates with the levers in a brain card and with two communication connectors; it can be connected in a chain to other brain units and to the ROBO-206.

The SNS-161 brain controls the lever angle according to the received message.

SNS-162 – Brain DC Motor with Gear and Wheel Unit



SNS-162 Brain DC Motor with Gear and Wheel Unit is a DC motor with a gear in a brain card and two communication connectors which can be connected in a chain to other brain units and to the ROBO-206.

The SNS-162 brain controls the motor speed and direction as programmed by the received message.

Sense with Add-on Units

BAT-202
Rechargeable battery

SNS-101
Infra-red tracking

SNS-160
IR transmitter

WIFI-203
Wireless programming
NUL-204
Light sensor

SNS-167
Gripper

COM-202
Arduino adapter

CARM-202
C-Language programming

Robotics Study Program

The robotics program is composed of units. Each unit has 15 lessons of 2 hours each.

Unit	Subject	Books
1	**Robot coding and basic algorithms**	**Sense Autonomous**
2	**Autonomous vehicles challenges**	**Sense Autonomous Vehicle Algorithms**
3	**Robot making**	**Sense-Make Robotics and Brain Units**
4	**Basic robotics**	**Basic robotics with TPS-3739**
5	**Robot coding in Blockly and Python**	**Blockly & Python with WIFI-203**
6	**C Language programming**	**C Coding with CARM-202**
7	**Robot coding in C language**	**SENSE C coding with CARM-202**
8	**Robot coding with Arduino**	**SENSE with Arduino and COM-202**

The program can be changed according to the student age and level, and teacher preferences. Some units include 'Free mission' lessons for building the student creativity.

The programming in the first three units is based on the visual block programming editor **RobocklySense**.

The **RobocklySense** is simple and has small number of instructions, but on the other hand enables to perform complex robotics programs.

RobocklySense is ideal robotics program to start with and enables to concentrate on understanding the robotics systems and translating a robot mission into a series of instruction to the robot.

Units 1 and **2** cover the principles of robotics, programming, movement algorithms, sensor reading, peripheral operation and more.

Units 3 and **4** cover the principles of robotics, programming, sensor reading, peripheral operation, robot construction, robot components and more.

Units 1, 2, 3 and **4** can be taught in **primary school, junior high school** or **high school**.
Unit V is based on the **WIFI-203** module, which contains the **Blockly** and the **Python** programs in it.

Blockly is a very rich visual block programming editor. Its blocks are automatically converted to Python.

Python is one of the most popular programming software. Its popularity comes from its program ability to work on any computer platform.

Unit 5 is aimed for **junior high school** and **high school**.

Unit 6 covers the C-languages with **CARM-202** only. **CARM-202** is a standalone training module for C-language.

C language is a coding language that creates machine programs. Machine programs are the fastest programs and work directly with the controller CPU and its peripherals and not through interpreters as with all the above programs.

Unit 7 teaches communication between CARM-202 and the SENSE robot, its peripherals and Neulog sensors in a certain communication protocol. This is how modern systems work.

Unit 8 is similar to **unit 7** but with **Arduino** and **COM-202**.

Units 6, 7 and **8** are aimed for **high school**.

Unit 1 – Robot coding and basic algorithms

Principles of robotics, programming, movement algorithms, sensor reading, peripheral operation.

Equipment:

- Sense Mobile robot
- BAT-202 Rechargeable Battery

- NUL-204 Light sensor (optional)
- NUL-212 Sound sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)
- SNS-101 IR tracking module (optional)
- SNS-160 IR transmitter (optional)
- SNS-167 Servo gripper (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	Robot direct operation	Movement and sensors
2	First programs	Forward and backwards, Turning left and right, program download
3	Interactive programs	Memories and variables, black line sensor, Wait-Until command, endless loop
4	Procedures	Programs and procedures, Definitions, range sensor, between a wall a line, along black line
5	Conditions and decisions	If-Then command, OFF and ON with different values, AND condition, OR condition, along two lines, along walls
6	Counting	Using variables for counting black lines
7	Automatic movements	Movements with turns
8	Loops	Movements with turns and loops
9	Loops and procedures	Movements with loops and procedures
10	Sensing robot	'Do not touch me' robot
11	Robots in a convoy	Robots in a convoy on black line or around a box
12	Movement in a labyrinth	Exit a labyrinth
13	Exit a circle	Exit an open round black line
14	Along a wall	Along a wall using two range sensors
15	Along corridors	Along corridors with two side walls
16	*Brain units and sound sensor	Sound and dB, wait for a sound as a trigger
17	*Motion sensor	Movement in distance range
18	*Light sensor	Light sensor, movement to a light source
19	*Magnetic sensor	The magnetic sensor as a compass
20	*IR tracking unit	Tracking robot with IR transmitter
21	*Gripper arm	Robot and gripper missions
22	*Painting robot	Painting programs with robot and gripper holding marker
23	*Robot science experiment	Running sensor experiment while movement, light vs distance, magnetic field vs distance

* Optional in rotation

Unit 2 – Advance algorithms for autonomous vehicles

This unit introduces several of the challenge autonomous exercises. The idea is to let the user to think about algorithms and solutions to solve these challenges.

The SENSE is a tool for such challenge exercises.

Equipment:

- SENSE Mobile robot
- BAT-202 Rechargeable Battery

No.	Title	Topics
1	Along black lines	Exploring the best way to move along black line
2	AGV-Automatic Guided Vehicle	AGV goes along black line and stops in front of a station
3	AGV between stations	AGV that moves from one station to another
4	Autonomous car along a building block	Exploring the best way to move along walls around a block
5	Autonomous car along a building block and bypass cars	Moving around a block while by passing obstacles
6	Autonomous car along a building block with stop sign	Moving around a block with waiting a little on black lines on the way
7	Autonomous car along a building block with stop for pedestrian	Moving around a block with waiting on a black line until the pedestrian moves away.
8	Autonomous building block guard robot	Moving around a block while counting corners
9	Autonomous two buildings guard robot	Moving around two blocks while counting corners
10	Autonomous museum guard robot	Moving through corridors and room
11	Autonomous taxi	Moving around a block while counting lines and stopping on a certain place
12	Autonomous taxi with passenger	Moving around a block while counting lines, stopping on a certain place and moving to another certain place
13	Home vacuum clean robot	Moving along walls in a room close to and far from the walls
14	Free mission	Inventing and implementing robot mission
15	Free mission	Inventing and implementing robot mission

Unit 3 – Robot making

This unit uses the **Sense-Make** kit for constructing robot system with **ROBO-206** controller and passive components (motors, lamps, switches and phototransistor) and with brain units (neulog sensors, IR tracking unit, brain servo motor).

Equipment:

- SENSE-MAKE Robot making kit
- BAT-202 Rechargeable Battery

- NUL-204 Light sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	Controller Direct Mode	Devices (motor, buzzer, LED, lamp, light sensor, switch, touch switch) test
2	Controller first program	blinking LED, Program download, Blinking LEDs
3	Procedures	Programs and procedures, Definitions, range sensor, between a wall a line, along black line
4	Switches	Memories and variables, black line sensor, Wait-Until command, endless loop, motor controlled by tact switch
5	Conditions and decisions	If-Then command, OFF and ON with different values, AND condition, OR condition, motor controlled by two tact switches
6	Counting	Using variables for counting black lines
7	Automatic movements	Movements with turns
8	Loops	Movements with turns and loops
9	Loops and procedures	Movements with loops and procedures
10	Brain units	Light gate, Brain servomotor
11	Automatic Machine	Washing machine
12	Motorized Cart	Automatic cart
13	Movement along a Black Line	Eliminating ambient light effect
14	Process control	Controlling outputs according to sensor inputs
15	Free mission	Inventing and implementing robot mission
16	*Motion sensor	Motion sensor as a distance sensor, movement in distance range
17	*Light sensor	Light sensor, movement to a light source
18	*Magnetic sensor	Magnetic sensor, movement to a magnetic source, the magnetic sensor as a compass
19	*Robot science experiment	Running sensor experiment while movement, light vs distance, magnetic field vs distance

* Optional in rotation

Unit 4 – Basic robotics

This unit uses the **TPS-3739** kit for constructing robot system with **ROBO-206** controller and **Fischertechnik** components (construction components, gears, motors, lamps, switches and phototransistor).

Equipment:

- TPS-3739 Basic robotics kit
- BAT-202 Rechargeable Battery

- NUL-204 Light sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	Controller Direct Mode	Devices (motor, buzzer, LED, lamp, light sensor, switch, touch switch) test
2	Controller first program	blinking LED, Program download, Blinking LEDs
3	Procedures	Programs and procedures, Definitions, range sensor, between a wall a line, along black line
4	Switches	Memories and variables, black line sensor, Wait-Until command, endless loop, motor controlled by tact switch
5	Conditions and decisions	If-Then command, OFF and ON with different values, AND condition, OR condition, motor controlled by two tact switches
6	Counting	Using variables for counting black lines
7	Automatic movements	Movements with turns
8	Loops	Movements with turns and loops
9	Loops and procedures	Movements with loops and procedures
10	Brain units	Light gate, Brain servomotor
11	Automatic Machine	Washing machine
12	Motorized Cart	Automatic cart
13	Movement along a Black Line	Eliminating ambient light effect
14	Process control	Controlling outputs according to sensor inputs
15	Free mission	Inventing and implementing robot mission
16	*Motion sensor	Motion sensor as a distance sensor, movement in distance range
17	*Light sensor	Light sensor, movement to a light source
18	*Magnetic sensor	Magnetic sensor, movement to a magnetic source, the magnetic sensor as a compass
19	*Robot science experiment	Running sensor experiment while movement, light vs distance, magnetic field vs distance

* Optional in rotation

Unit 5 – Robot programming in Blockly and Python

Principles of robotics, programming, movement algorithms, sensor reading and peripheral operation with more powerful programming tool wirelessly.

This unit is based on the **WIFI-203** module, which contains the **Blockly** and the **Python** programs in it.

Equipment:

- SENSE Mobile robot
- BAT-202 Rechargeable Battery
- WIFI-203 Wireless Python and Blockly coding unit

- NUL-204 Light sensor (optional)
- NUL-212 Sound sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)
- SNS-101 IR tracking module (optional)
- SNS-160 IR transmitter (optional)
- SNS-167 Servo gripper (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	About Blockly and Python	Robot direct operation, about Blockly and Python
2	First programs	Forward and backwards, Turning left and right, program download
3	Interactive programs	Memories and variables, black line sensor, Wait-Until command, endless loop
4	Procedures	Programs and procedures, Definitions, range sensor, between a wall a line, along black line
5	Conditions and decisions	If-Then command, OFF and ON with different values, AND condition, OR condition, along two lines, along walls
6	Counting	Using variables for counting black lines
7	Robots in a convoy	Robots in a convoy on black line or around a box
8	Movement in a labyrinth	Exit a labyrinth
9	Along a wall	Along a wall using two range sensors
10	Along corridors	Along corridors with two side walls
11	AGV-Automatic Guided Vehicle	AGV goes along black line and stops in front of a station
12	AGV-Automatic Guided Vehicle	AGV goes along black line and moves from one station to another
13	Autonomous car along a building block and bypass cars	Moving around a block while by passing obstacles
14	Autonomous car along a building block with stop sign	Moving around a block with waiting a little on black lines on the way
15	Autonomous taxi with passenger	Moving around a block while counting lines, stopping on a certain place and moving to another certain place
16	*Brain units and sound sensor	Sound and dB, wait for a sound as a trigger
17	*Motion sensor	Movement in distance range
18	*Light sensor	Light sensor, movement to a light source
19	*Magnetic sensor	The magnetic sensor as a compass
20	*IR tracking unit	Tracking robot with IR transmitter
21	*Gripper arm	Robot and gripper missions

* Optional in rotation

Unit 6 – C Language

This unit covers the study of writing programs in C-language with the CARM-202 coding unit only. This unit has 8 switches and 8 LEDs for exercising.

Equipment:

- CARM-202 C-Language coding unit

No.	Title	Topics
1	C Language	Machine language, Assembly language, High-level language, Memories, C language, Editor, compiler, linker and locator, HEX format, Variables
2	Writing Programs in C Language	Header file and #include
3	First C Program	WHILE – switches to LEDs
4	For	For instruction exercise, delays, counting up and down
5	Subroutines & Functions	Functions, define
6	If-Else and Logic Operations	Logic (AND, OR, NOT) operations, Logic operations on binary numbers. Logic conditions, Shifting binary numbers, break
7	Do-While	The difference between While and Do-While
8	Switch-Case	Switch-Case exercises
9	Arrays and Strings	Array initialization, Multi-dimension array, Strings
10	Pointers	Block manipulation using pointers, Variable manipulation using pointers
11	Enum, Struct, Union and Typedef	Header file and #include, Enum, Struct, Union, Typedef
12	Microcomputer Principles of Operation	Input, Output, memory, Clock, CPU, ARM microcontroller,
13	Integrated exercises	Challenge exercises combining the C language instructions
14	Integrated exercises	Challenge exercises combining the C language instructions
15	Integrated exercises	Challenge exercises combining the C language instructions

Unit 7 – Robot Programming in C language

This unit teaches communication between CARM-202 and the SENSE robot, its peripherals and Neulog sensors in a certain communication protocol.

Equipment:

- SENSE Mobile robot
- BAT-202 Rechargeable Battery
- CARM-202 C-Language coding unit

- NUL-204 Light sensor (optional)
- NUL-212 Sound sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)
- SNS-101 IR tracking module (optional)
- SNS-160 IR transmitter (optional)
- SNS-167 Servo gripper (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	Serial communication	Serial communication, communication with PC terminal
2	Sense robot	Communication between machines, the Sense robot, communication protocol
3	Robot movement	Forward and backwards, Turning left and right, program download
4	Interactive programs	Variables, black line sensor, endless loop, counting
5	Using functions	Definitions and functions, range sensor, between a wall a line, along black line
6	Robots in a convoy	Robots in a convoy on black line or around a box
7	Movement in a labyrinth	Exit a labyrinth
8	Along a wall	Along a wall using two range sensors
9	Along corridors	Along corridors with two side walls
10	AGV-Automatic Guided Vehicle	AGV goes along black line and stops in front of a station
12	AGV-Automatic Guided Vehicle	AGV goes along black line and moves from one station to another
13	Autonomous car along a building block and bypass cars	Moving around a block while by passing obstacles
14	Autonomous car along a building block with stop sign	Moving around a block with waiting a little on black lines on the way
15	Autonomous taxi with passenger	Moving around a block while counting lines, stopping on a certain place and moving to another certain place
16	*Brain units and sound sensor	Sound and dB, wait for a sound as a trigger
17	*Motion sensor	Movement in distance range
18	*Light sensor	Light sensor, movement to a light source
19	*Magnetic sensor	The magnetic sensor as a compass
20	*IR tracking unit	Tracking robot with IR transmitter
21	*Gripper arm	Robot and gripper missions

* Optional in rotation

Unit 8 – Robot Programming with Arduino

This unit teaches communication between Arduino unit with COM-202 and the SENSE robot, its peripherals and Neulog sensors in a certain communication protocol.

Equipment:

- SENSE Mobile robot
- BAT-202 Rechargeable Battery
- COM-202 Arduino communication unit
- Arduino coding unit

- NUL-204 Light sensor (optional)
- NUL-212 Sound sensor (optional)
- NUL-213 Motion sensor (optional)
- NUL-214 Magnetic sensor (optional)
- SNS-101 IR tracking module (optional)
- SNS-160 IR transmitter (optional)
- SNS-167 Servo gripper (optional)

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

No.	Title	Topics
1	Serial communication	Serial communication, communication with PC terminal
2	Sense robot	Communication between machines, the Sense robot, communication protocol
3	Robot movement	Forward and backwards, Turning left and right, program download
4	Interactive programs	Variables, black line sensor, endless loop, counting
5	Using functions	Definitions and functions, range sensor, between a wall a line, along black line
6	Robots in a convoy	Robots in a convoy on black line or around a box
7	Movement in a labyrinth	Exit a labyrinth
8	Along a wall	Along a wall using two range sensors
9	Along corridors	Along corridors with two side walls
10	AGV-Automatic Guided Vehicle	AGV goes along black line and stops in front of a station
12	AGV-Automatic Guided Vehicle	AGV goes along black line and moves from one station to another
13	Autonomous car along a building block and bypass cars	Moving around a block while by passing obstacles
14	Autonomous car along a building block with stop sign	Moving around a block with waiting a little on black lines on the way
15	Autonomous taxi with passenger	Moving around a block while counting lines, stopping on a certain place and moving to another certain place
16	*Brain units and sound sensor	Sound and dB, wait for a sound as a trigger
17	*Motion sensor	Movement in distance range
18	*Light sensor	Light sensor, movement to a light source
19	*Magnetic sensor	The magnetic sensor as a compass
20	*IR tracking unit	Tracking robot with IR transmitter
21	*Gripper arm	Robot and gripper missions

* Optional in rotation

Recommended sets

Catalog No.	Description	Primary school (1-6)	Junior high school (7-9)	High school (10-12)
SENSE	Sense mobile robot	✓	✓	✓
SENSE-MAKE	Robot making kit	✓	✓	✓
TPS-3739	Basic robotics	✓	✓	✓
BAT-202	Battery module	✓	✓	✓
BLT-200	Bluetooth module	optional	optional	optional
WIFI-203	Wireless Python and Robockly coding unit		✓	✓
CARM-202	C language coding unit			✓
SNS-101	Brain tracking unit	optional	optional	optional
SNS-160	IR transmitter	optional	optional	optional
SNS-167	Brain gripper arm with servo motors	optional	optional	optional
NUL-204	Light sensor	optional	optional	optional
NUL-212	Sound sensor	optional	optional	optional
NUL-213	Motion sensor	optional	optional	optional
NUL-214	Magnetic sensor	optional	optional	optional

For best learning experience, two students per set is recommended.

The students can use the optional units in rotation, thus the units do not have to be purchased according to the number of students in the classroom.

SES Training LABs

The training labs are based on learning-by-doing, which makes the students learn more quickly and remember what they have studied by performing practical experiments. They provide the students high profession skills and the knowledge on how to improve their chance of employment and earning capacity.

The manuals and courseware that accompany each course provide the theory background and experiments.

Electronics Training Lab
This modular laboratory is aimed for the **Electronics** profession, but also for technology disciplines that are also based in electronics, such as: **Electricity, Mechanics, Automotive, Robotics, Automation, Process control**.

Autotronics Training Lab
This modular laboratory is aimed for the five stages that comprise the automotive program: **Basic and automotive electronics, Car sub-systems simulators, Car sub-systems demonstrators, Car diagnostic and troubleshooting methods, Troubleshooting faults in a real car**.

Mechatronics Training Lab
This modular laboratory is aimed for the mechatronics program which includes the following disciplines: **Basic electronics, Pneumatics systems, Hydraulics systems, CNC machines**.

Refrigeration and Air-Conditioning Training Lab
The Refrigeration and Air-Conditioning training lab covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

Technology Preparation Training Lab
The Technology Preparation (Tech Prep) laboratory is a classroom-integrated laboratory consisting of educational modules covering a wide range of subjects such as: **Green energy, Computerized systems, Basic electronics, Basic communication, Mechanical systems.**

Science Training Labs
These laboratories (for primary, secondary and high schools) introduce the students to the computerized sensors world, **nature and industry processes** and **nature laws**. It will help them understand modern technologies such as: **home and medical appliances, wearing sensors, precise agriculture** and more.

Robotics Training Labs
The robotics programs (for primary, secondary and high schools) help students to build innovation and creativity skills. The idea is to make the students understand how systems work, to believe that they can improve them and be able to realize their ideas.

MultiCenter Training Lab
The MultiCenter offers a variety of selected interactive learning environments, with a large range of topics and activities such as: **Science, Technology, Graphic Design, Digital Music, Robotics, Computer Technologies** and much more for all sectors of society, cultures, different socio-economic groups and different age groups – from very young children to senior citizens.

EDUCATION

Our Training Labs:

SCIENCE

ROBOTICS

ELECTRONICS

ELECTRICITY

TELECOMMUINCATION

AUTOTRONICS

MECHATRONICS

MULTICENTER

SCIENCE & ROBOTICS

TECHNOLOGY PREPARATION

REFRIGIRATION & AIR-CONDITIONING

ROBOTICS