Flexible Solutions for Technical and Engineering Training Labs

GalSen®

Greetings!

GalSen Group was founded in Chelyabinsk, a major historic, industrial, metallurgical, power, scientific and transport hub in Southern Ural part of Russia, back in 2001 by two professionals with profound electrical engineering background: Yuri Galishnikov, professor, D.Sc., and Pavel Senigov, Ph.D.

The enterprise develops, produces and supplies modular educational equipment of its own GalSen® brand for technical, engineering skills and vocational training on all levels, as well as for professional development of personnel, especially in industries, power engineering and transportation. The range of hands-on skills that can be practiced using the labware goes from basics electronics, electric installation work, life safety, and up to complex disciplines like automation, electromechanics, electrical power engineering, radio engineering.

During more than its 15-year work on local CIS and ex-USSR market, GalSen Group has earned its reputation of a reliable partner, actively working with all major universities in Russia in educational labware supplies and state procurement. The company's achievements are recognized by independent experts at regular exhibitions, forums and contests.

Driven by its internal ISO 9001 certified quality management system, the company implements its own innovation policy in development of new products. For example, with booming interest towards renewable energy, the company produces labware dedicated to study of solar and wind energies. Monitoring latest technological developments and listening closely to feedback from universities and colleges helps the company make improvements, spot possibilities for upcoming trends in labware and fulfill clients' requests.

This is all made possible by the GalSen Group strong team which consists of product developers and designers with vast teaching expertise coupled with highly professional production staff from former military plants of Chelyabinsk region.

In the recent time the company has expanded its international business activities to Azerbaijan, Georgia, India, Indonesia, Vietnam, UAE, South Africa. We hope you too will become our new partner to promote GalSen® brand and quality in your region.

Southern Ural is known for its majestic nature, ancient Arkaim site – and Chelyabinsk meteor burst on February, 15, 2013.

A warm welcome from GalSen Group founders (right to left): Yuri Galishnikov, Professor, D.Sc. and Pavel Senigov, Ph.D.

Our team's experience in design & production at your service

GalSen Group's own facilities are in Chelyabinsk, Russia

TVET students enjoy easy-to-use GalSen® kits

Advancing Professional Training Together

Many educational institutions all across Russian Federation, as well as in neighbouring countries for more than 17 years trust us to revamp their laboratories in accordance with the global quality requirements of the educational process, and make good use of GalSen® labware.

Among our customers and partners there are also industrial, energy and transport companies. One of the top priorities for them is continuous training of their engineers and technicial personnel using modern training equipment, and we appreciate their credit:

MIEM has been cooperating with EPC "Uchebnaya Tekhnika" for more than two years. During this time, we have equipped three laboratories. The main criterion for selection of this equipment was its reasonable price, and also the wide capabilities it has for organizing laboratory workshops. The labware is compact and features modern design. We advise other institutions of higher education to get this equipment.

Pertosyants K., Dean of the Faculty of Automation and Computer Science, Moscow State Institute of Electronics and Mathematics (MIEM)

During operation since December 2012, the stands on electrical engineering proved to be an ample aid in training students specializing as underground electricians. The stands are made with all the safety requirements for use in technical schools. The labware is easy to use and equipped with a sufficient set of elements to produce a large amount of laboratory work.

Accompanying material contains detailed information on the progress of the work, well understood by both teachers and students. Classes held using the labware draw great interest from students and ensure a high percentage of the digestibility of the material.

Gerusov A., Chief Designer, Training Centre of "TKM UzhKuzbassUgol"

Chelyabinsk branch of Engineering School of South Urals Railways (branch of "Russian Railways") purchased four sets of "Theory of Electric Circuits & Fundamentals of Electronics" labware in June 2005.

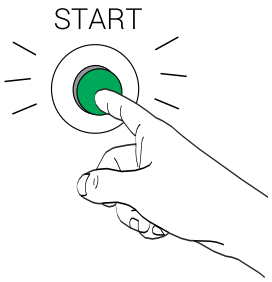
The choice of this particular equipment manufacturer was made considering the key factor that the leading universities such as the Ural State University of Railway Transport, Samara Academy of Railway Transport Engineers, Moscow State Open University of Railways (Voronezh branch) and others have a long time ago purchased a variety of products of this company and are successfully using it in the educational process.

The first acquaintance with the equipment demostrated its thorough design and high quality workmanship, as well as its great educational capabilities.

Mosin A., Head of Chelyabinsk Technical School of South Urals Railways (branch of JSC "Russian Railways")

Take a Closer Look

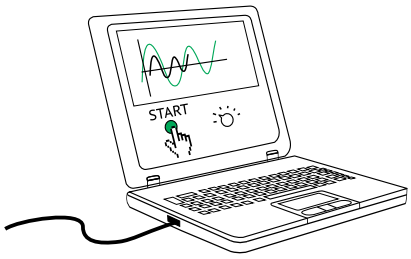
GalSen® Product and Service Advantages



Manual Control

Labware sets with manual control let students get acquainted with the full-scale models (analogues) of real electrical, electronic and electromechanical devices, study how they work, acquire skills of assembling electrical and electronic circuits of various configurations, as well as to explore a wide variety of processes in them.

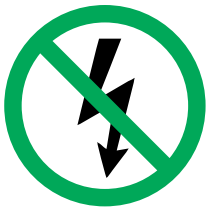
One of the advantages of such sets — there is no need for adjusting and tuning. The sets come ready to use in your laboratory. You can quickly start using them provided the power supply in your laboratory matches required specifications.



SCADA Control

Labware sets with computerized control make it possible to implement an additional feature of the automated control of individual modules or groups of modules, and to measure the parameters of their modes, create visual display on virtual instruments and oscilloscopes. These sets in some cases may require tuning.

The standard package includes a computer (notebook) and SCADA peripherals required for connection to the computer (connector, I/O board, accessories, etc).



Robust Protection From Misuse

To ensure safe and comfortable work the labware includes:

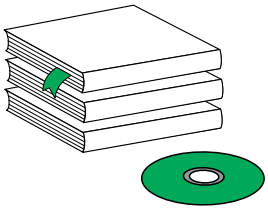
- automatic circuit breaker in case of overload and short circuits;
- a key on 3-phase power supply module to protect against unauthorized power supply to the labware;
- emergency power outage switch;
- plugs and sockets with protective contacts;
- protective earth;
- durable coating of units and front panels resistant to abrasion, wear, moisture and cleaning liquids containing alcohol.

Customization For Your Country

We provide additional services for translation of the front panel markings, printed materials and software into English or the chosen language of your country.

Feel free contact us for more details.

Please note: the default labware language is Russian.



Original Didactic Guides and SCADA Software

Each set includes training materials for the tutor on paper and on CD-ROM:

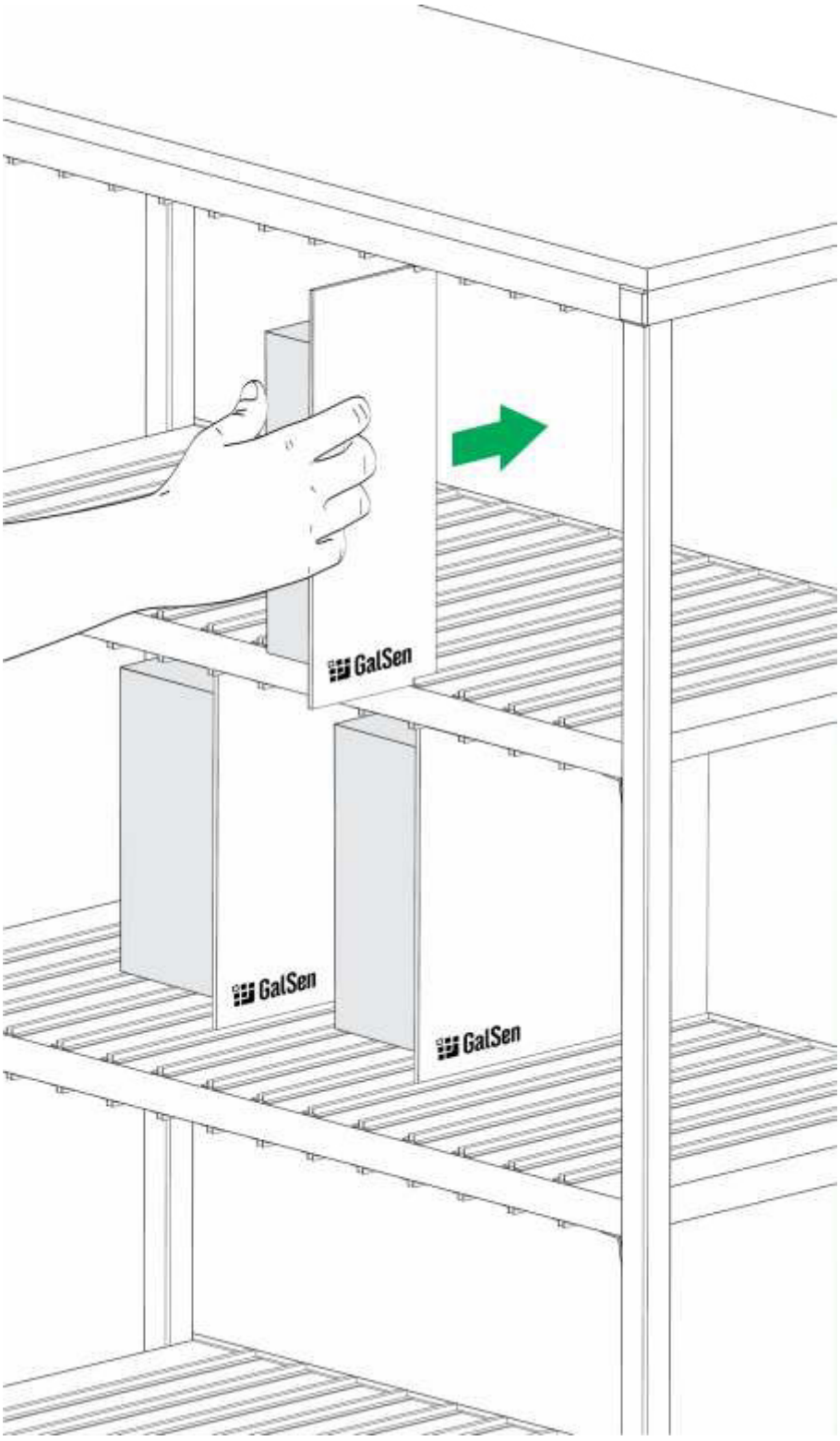
- guidelines to perform basic experiments with step by step description and connection diagrams;
- hardware manuals;
- assembly instructions for laboratory furniture;
- SCADA software: control panels, data recorders, multi-channel oscilloscope, virtual instruments, etc.

Product Warranty, Lifetime Support

The quality management system of the manufacturer is certified to comply with ISO 9001 standard.

Developers' support for the equipment is available and warranted for 24 months from the date of delivery.

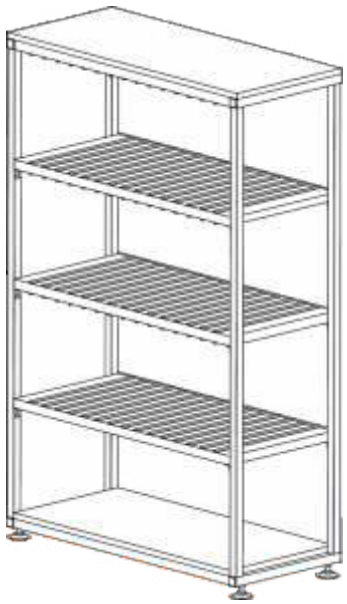
After-sales support and advice from our experts on the configuration expansion (i.e. purchase of additional GalSen® modules) according to your teaching objectives are available for the whole lifetime of the labware.



Compact Storage

Flexibility of the modular GalSen® structure lets you expand the range of study tasks within your educational process significantly by interconnecting existing functional GalSen® blocks freely, as well as by purchasing additional ones.

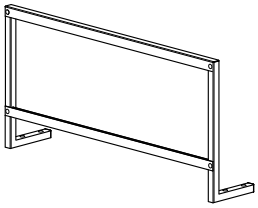
To help you store modules temporarily unused in your laboratory workshops, we have designed a practical rack. Modules are placed on the shelves by sliding their front panels into the upper and lower rails of the shelves, to ensures stable and secure storage.



Storage Rack
for Functional Modules

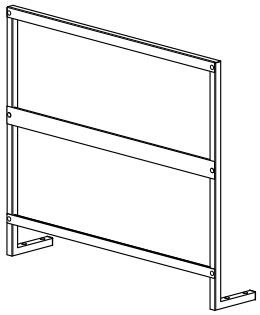
Total Dimensions, mm
(L x W x H)..... 875 x 385 x 1370

Customizable GalSen® Stand Design: Frame + Table



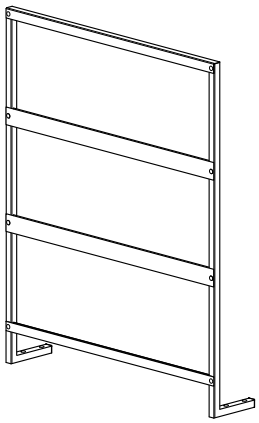
1-Level Frame for Mounting Functional Modules
Length: 910 mm, height: 400 mm

ITEM: 709.1R



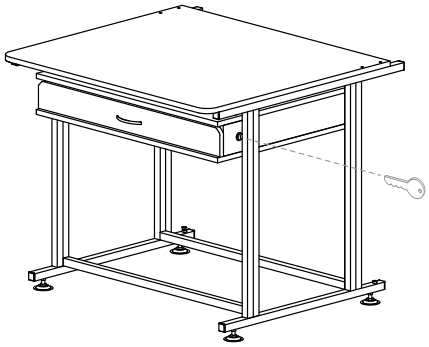
2-Level Frame for Mounting Functional Modules
Length: 910 mm, height: 800 mm

ITEM: 703R



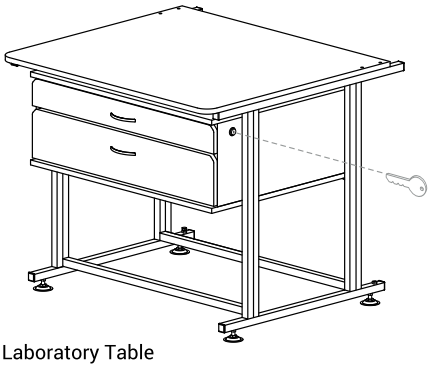
3-Level Frame for Mounting Functional Modules
Length: 910 mm, height: 1100 mm

ITEM: 719R



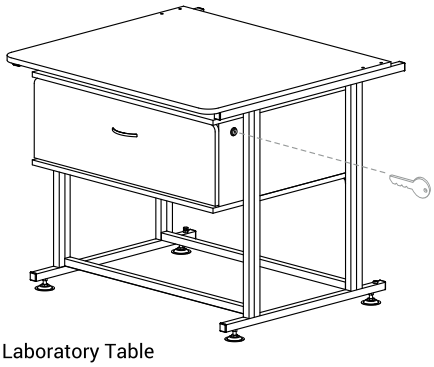
Laboratory Table
with Storage Container for Wires

ITEM: 709.1C



Laboratory Table
with 2-Section Storage Container

ITEM: 703C



Laboratory Table
with Storage Container for Functional Modules

ITEM: 709C

Tables Specification

Dimensions (w/o upper frames), mm:

Length (measured at front end)....910
Width....850
Height....800

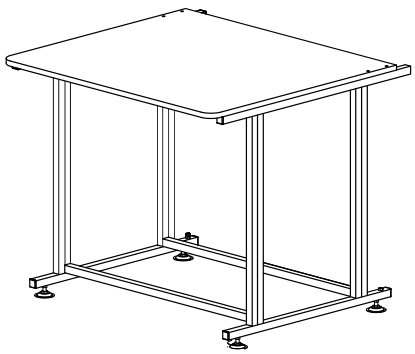
Appliance Class....01

Table Tops, Shelves,
Racks, Containers....Laminated Chipboard

Lower Frames....Steel, Powdered Coating

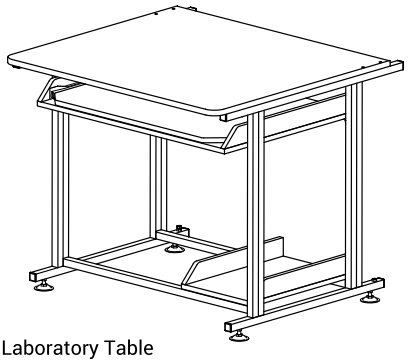
Legs....Height & Level Adjustable

The containers are locked with a key.
Two keys are supplied in a standard set.



Laboratory Table

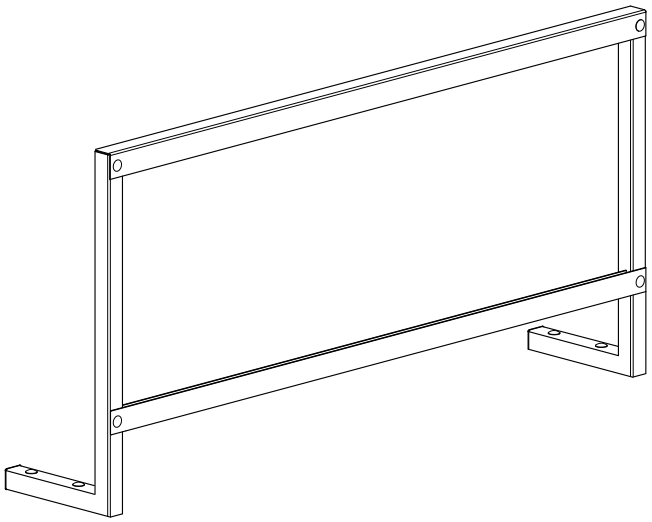
ITEM: 700



Laboratory Table
with Computer Rack and Pullout Keyboard Shelf

ITEM: 705

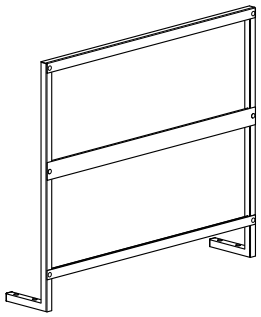
Customizable GalSen® Desktop Design: Frame + Container



1-Level Frame for Mounting
Functional Modules, height: 400 mm

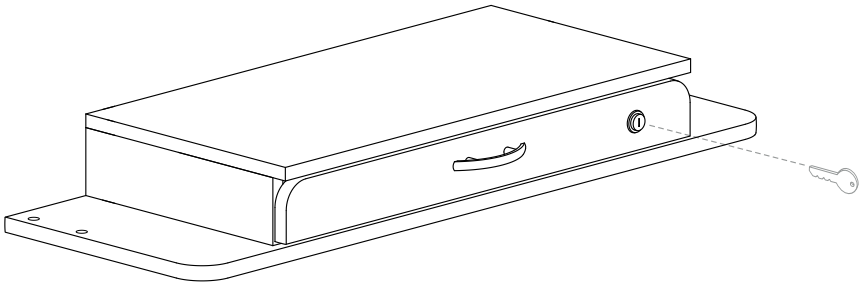
ITEM: 708.3R (length 910 mm)

ITEM: 708.4R (length 625 mm)



2-Level Frame for Mounting Functional Modules
Length: 910 mm, height: 800 mm

ITEM: 703R



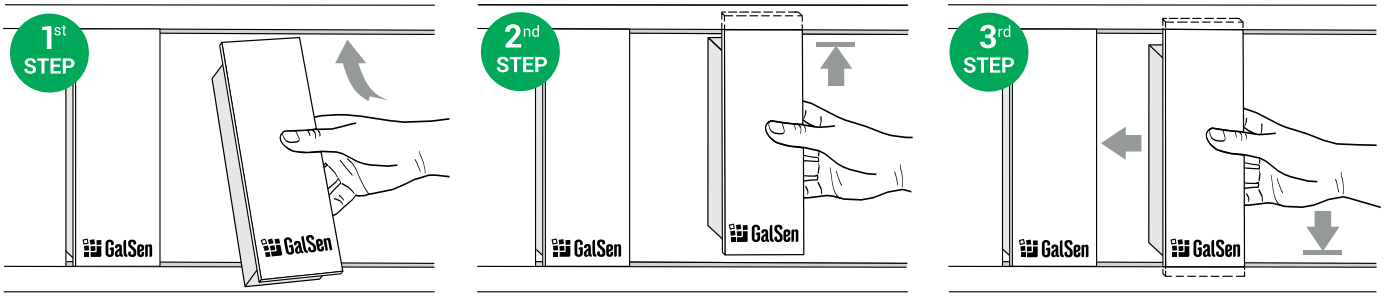
Desktop Storage Container for Wires
and Didactic Materials (width 500 mm)

ITEM: 708.3K (length 910 mm)

ITEM: 708.4K (length 625 mm)

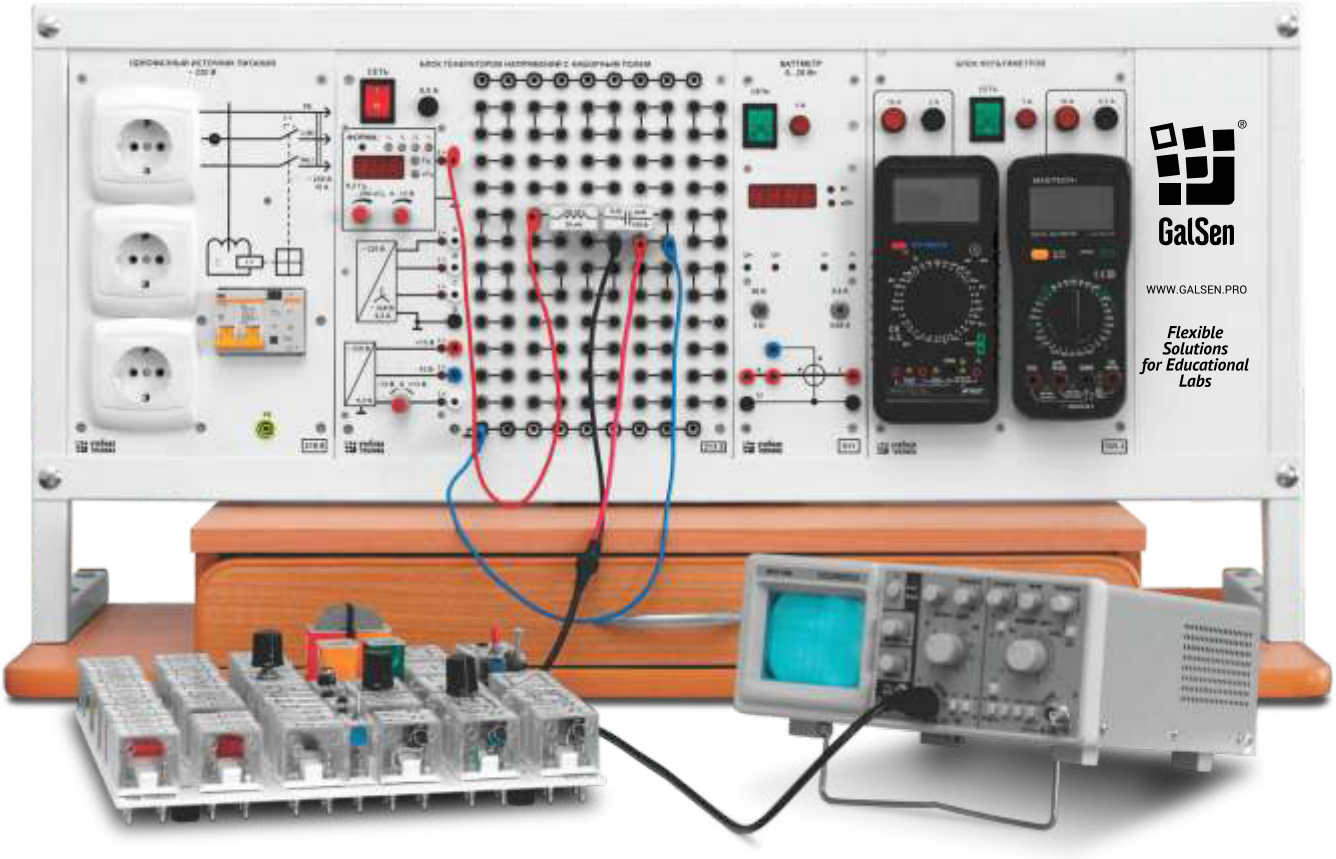
The container is locked with a key.
Two keys are supplied in a standard set.

Three Easy Steps to Mount & Arrange Modules in Frames:



Functional GalSen® modules are easily installed into the frame rails. Modules can be slided smoothly along the rails, effortlessly taken out by hand and rearranged in the desired order without the use of any instruments.

Electrical Engineering and Electronics



Electric Circuits and Electronics Fundamentals

MODEL: GALSEN® ECEFMD1

Basic Experiments:

- **Electric DC circuits** (Measurement of resistance, current, voltage and electric power; Series connection of resistors; Shunt connection of resistors; Combined connection of resistors; Readout of volt-ampere characteristics of nonlinear elements)
- **Electric circuits of single-phase sinusoidal current** (Series connection of R, L and C; Shunt connection of L and C)
- **Electric circuits of three-phase sinusoidal current** (Star load connection; Triangle load connection; Faults in three-phase circuits)
- **Magnetic circuits** (Experimental study and calculation of the magnetic circuit with DC; Experimental study of the magnetic circuit with AC; Testing single-phase transformers)
- **Fundamentals of electronics** (Study of diode; Study of bipolar transistor; Study of single-phase rectifiers; Study of three-phase bridge rectifier; Study of controlled rectifiers and thyristor regulators; Study of bipolar transistor work in key mode; Study of two stage transistor amplifier; Study of DC voltage stabilizers; Study of RS trigger, multivibrator and single-shot trigger; Study of circuits with operational amplifiers)

Modules / Components:

Voltage Generators Module with Composition Field
Single-phase Power Supply
Two Multimeters Unit
Wattmeter
"Electric & Electronic Components" Mini-modules Set
Desktop Containter with 1-Level Frame
Accessories Kit
Basic Experiments Guide
Single-Channel Oscilloscope

Electric Circuits Theory and Electronics Fundamentals

MODEL: GALSEN® ECTEFCS1

Basic Experiments:

- **Electric DC circuits** (Parameters of electrical DC circuit. Ohm's law. Resistor circuits: Linear resistors, Heat-variable resistor with negative temperature factor, Heat-variable resistor with positive temperature factor, Varistor, Photoresistor, Series resistor connection, Parallel resistor connection, Series-parallel resistor connection, Resistance voltage divider. Voltage (EMF) source Series connection of voltage (EMF) source. Parallel connection of voltage (EMF) source. Electrical power and energy. Electrical efficiency. Voltage, current and power matching between voltage (EMF) source and load. Charge and discharge of capacitor. Switching-on and switching-off circuit with inductor)
- **Electric AC circuits** (Parameters of sinusoidal voltage and current. Circuits of sinusoidal current with capacitors. Circuits of sinusoidal current with inductors. Circuits of sinusoidal current with resistors, capacitors and inductors. Transformers: Magnetic linkage factor, Transformation factor, Resistance conversion by means of transformer. Three-phase circuits of sinusoidal current. Failure modes of three-phase circuit when load connected star. Failure modes of three-phase circuit when load connected delta. Circuits with nonsinusoidal applied voltage. Transients in linear circuits)
- **Long-distance line** (Voltage distribution along homogeneous long-distance line. Input resistance of long-distance transmission line as function of its electrical length and load resistance. Reflected waves)
- **Electronic devices** (Rectifier diodes: Diode characteristics: Single-phase half-wave uncontrolled rectifier, Single-phase bridge-circuit uncontrolled rectifier, Three-phase bridge-circuit uncontrolled rectifier, Three-phase zero uncontrolled rectifier. Stabilitron: Characteristics, Parametric voltage stabilizer, Smoothing ripples of rectified voltage. Diodes with special properties (LED, Varicap). Bipolar transistors: Testing layers and study of rectifying action of bipolar transistors, Distribution of current in the transistor and the control effect of the base current of the transistor, Transistor characteristics, Setting the operating point of the transistor, and study of effect of resistor in the collector circuit to the voltage gain of the amplifier stage with a common emitter, Amplifiers using bipolar transistors, Linear voltage regulator, Linear current regulator. Unipolar (field) transistors: Testing layers and study of rectifying action of unipolar transistors, Turn-on of transistor gate, Control effect of n-type transistor gate, The output characteristics of transistor, Amplifiers. Thyristors: Characteristics of diode thyristor, Characteristics of triode thyristor,. Phase control of thyristor. Logic elements (AND, OR, NO, NAND, NOR). Operational amplifiers: Inverting amplifier, Non-inverting amplifier, Summing amplifier, Differential amplifier, Dynamics of operational amplifier)

Modules / Components:

Voltage Generators Module; Single-phase Power Supply; Testing Board; Connector; Long-distance Line Model; Module Of Two Multimeters; Mini-modules Set "Electric And Electronic Elements"; Mini-modules Set "Transformers"; Computer Table Laboratory Table With 2-section Container and 1-level Frame; Accessories Kit; Basic Experiments Guide ; Personal Computer With Software

Electrical Engineering and Electronics Fundamentals

MODEL: GALSEN® EEEFMD3

Basic Experiments:

Electrical and magnetic circuits

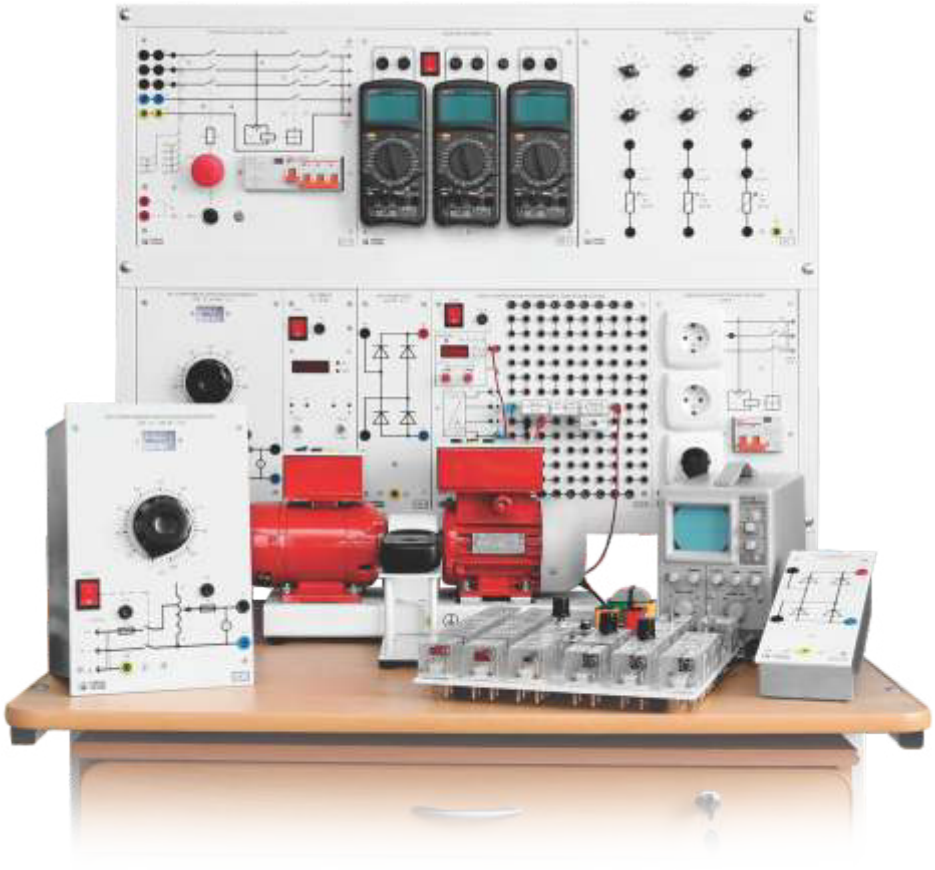
- **DC circuits** (Parameters of electrical DC circuit. Volt-ampere characteristics of nonlinear elements in DC circuit)
- **Single-phase AC circuits** (Series connection of elements R, L and C (sinusoidal current). Parallel capacitor-inductor connection)
- **Three-phase AC circuits** (Star connection of three-phase electrical load. Delta connection of three-phase electrical load. Failure modes of three-phase circuit when load connected star. Failure modes of three-phase circuit when load connected delta)
- **Magnetic circuits** (DC magnetic circuits. AC magnetic circuits. Test of single-phase transformer)
- ***Fundamentals of electronics*** (Single-phase rectifier. Three-phase bridge-circuit controlled rectifier. Controlled rectifiers and thyristor regulator. Two-stage transistor amplifier. DC voltage stabilizer. RS-trigger, multivibrator and single-shot trigger. Circuits with operational amplifiers)

Electrical machines and drives

- **DC generators with separate excitation** (Characteristic of idling $E_0=f(I_f)$. Characteristics of short circuit $I_K=f(I_f)$. Characteristics U=f(I), If=f(I) and $U=f(I_f)$
- **DC motors with shunt excitation and drive on its basis** (Electromechanical (speed) characteristics n = f (I). Mechanical characteristics of n = f (M). Speed control of DC motor by changing armature voltage. Speed control of a DC motor by field current changing. Determination of coordinates of electrical motor in motor, generator, and braking modes)
- **Three-phase asynchronous motor with squirrel-cage rotor and drive on its basis** (Electromechanical (speed) characteristic n=f(I). Mechanical characteristic n=f(M). Speed control by match changing frequency and magnitude of stator voltage. Determination of coordinates of electrical drive in motor, generator, and braking modes)

Modules / Components:

Electromechanical Unit (DC Machine, AC Motor And Angular Displacement Transducer); Module Of Voltage Generators With Testing Board; Frequency Converter; Single-phase Power Supply; Active Load; Excitation Rheostat Of DC Machine; Adjustable Autotransformer; Rectifier; Speed Indicator; Module Of Three Multimeters; Module Of Two Multimeters; Wattmeter; Voltammeter; “Electrical And Electronic Components” Mini-modules Set; Desktop Container With Two-level Frame; Desktop Container With Single-level Frame; Accessories Kit; Basic Experiments Guide; Single-channel Oscilloscope



Electrical Engineering and Electronics Fundamentals

MODEL: GALSEN® EEEFSM6

Basic Experiments:

Electrical and magnetic circuits

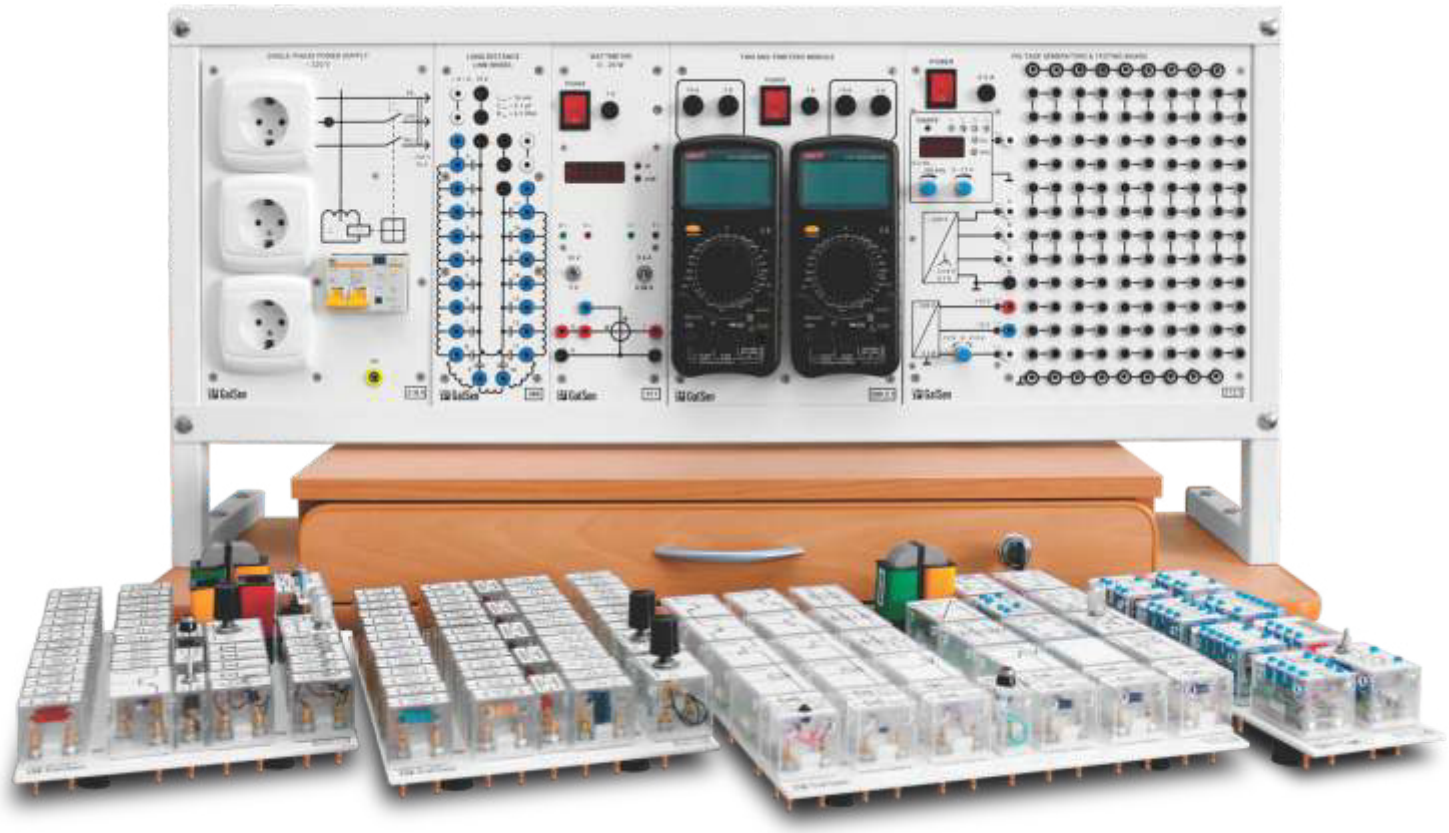
- **DC circuits** (Parameters of electrical DC circuit. Volt-ampere characteristics of nonlinear elements in DC circuit)
- **Single-phase AC circuits** (Series connection of elements R, L and C (sinusoidal current). Parallel capacitor-inductor connection)
- **Three-phase AC circuits** (Star connection of three-phase electrical load. Delta connection of three-phase electrical load. Failure modes of three-phase circuit with load connected star. Failure modes of three-phase circuit with load connected delta)
- **Magnetic circuits** (DC magnetic circuits. AC magnetic circuits. Test of single-phase transformer)
- ***Fundamentals of electronics*** (Single-phase rectifier. Three-phase bridge-circuit controlled rectifier. Controlled rectifiers and thyristor regulator. Two-stage transistor amplifier. DC voltage stabilizer. RS-trigger, multivibrator and single-shot trigger. Circuits with operational amplifiers)

Electrical machines and drives

- **DC generator with independent excitation** (No-load characteristic $E_0=f(I_F)$. Short circuit characteristic $I_{SC}=f(I_F)$. Characteristics U = f (I), I_F = f (I) and U = f (I_F)
- **DC motor** (Electromechanical (speed) characteristic n = f (I). Mechanical characteristics n = f (M)
- **Three-phase squirrel-cage induction motor** (Electromechanical (speed) characteristic n = f (I). Mechanical characteristic n = f (M)

Modules / Components:

Electromechanical Unit (DC Machine, AC Motor and Angle-to-digit Converter); Three-phase Power Supply; Voltage Generators & Testing Board Module; Single-phase Power Supply; Active Load; Adjustable Autotransformer; Rectifier; Tachometer; Stand For Tachometer; Three Multimeters Module; Wattmeter; "Electrical And Electronic Components" Mini-modules Set; Two-level Frame With Container; Accessories Kit; Basic Experiments Guide; Single-channel Oscilloscope



Electric & Magnetic Circuits, Electronics Fundamentals

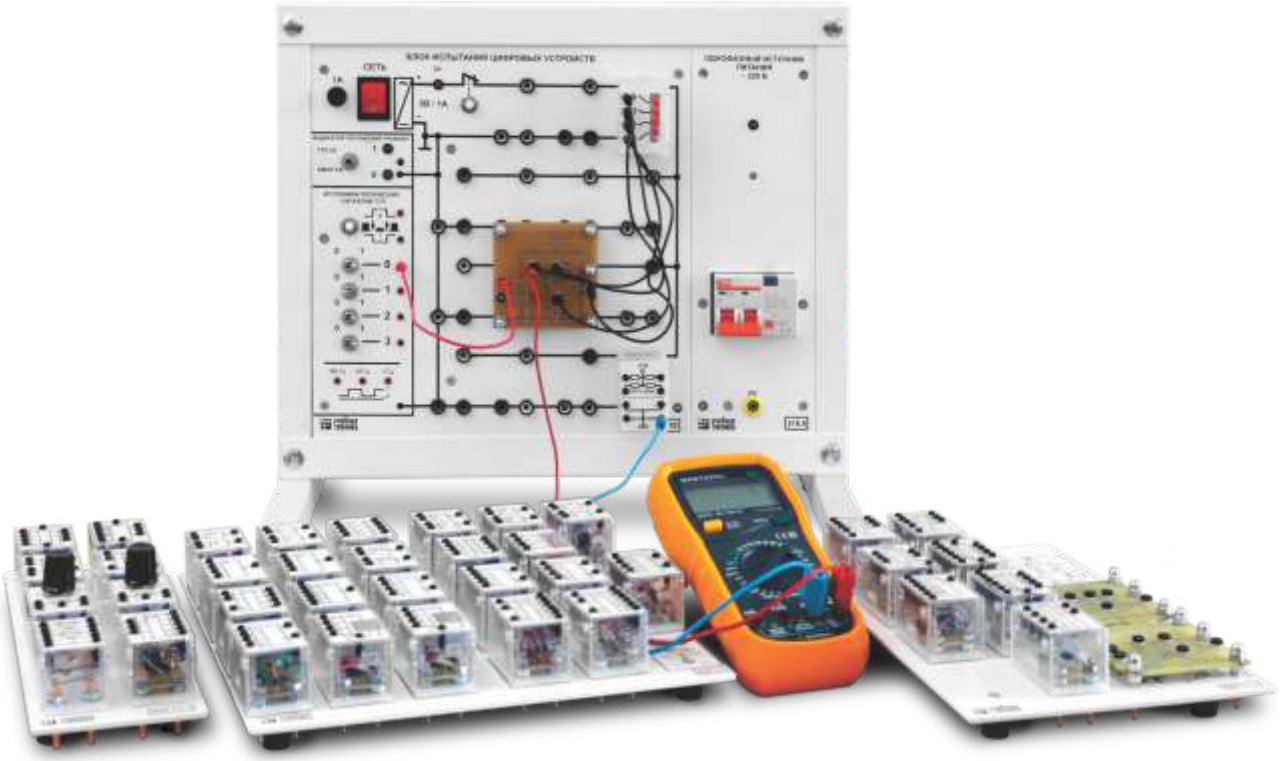
MODEL: GALSEN® EMCEFMD1

Basic Experiments:

- **Electrical and magnetic circuits** (Linear DC circuits. AC circuits. Three-phase circuits. Transients in linear electrical circuits. Quadripoles. Distributed-element circuits. Nonlinear electric and magnetic circuits)
- **Fundamentals of analog electronics** (Semiconductors. Electronic circuits and microcircuitry. Stabilizers and secondary sources of supply)
- **Fundamentals of digital electronics** (Testing basic logic elements. Assembly and test of simple combinational nodes of digital devices. Assembly and test of sequential nodes of digital devices)

Modules / Components:

Module of voltage generators with testing board; Single-phase power supply; Model of long-distance line Model; Module of two multimeters; Wattmeter; “Fundamentals of digital electronics” Mini-modules Set; “Analog electronics – Electrical components” Mini-modules Set; “Analog electronics – Electronic components” Mini-modules Set; “Electromagnetic components” Mini-modules Set; Desktop container with 1-level frame; Accessories Kit; Basic Experiments Guide; Two-channel oscilloscope (not shown)



Digital Electronics Fundamentals

MODEL: GALSEN® DEFMD1

Basic Experiments:

- **Testing basic logical elements**
- **Assembly and test of simple combinational nodes of digital devices** (Combinational node using basic logic elements to implement arbitrary logic function. Combinational nodes using basic logic elements for experimental confirmation of logic algebra laws. Single-digit half-adder and adder. Code converter and decoder. Multiplexer and demultiplexer)
- **Assembly and test of sequential nodes of digital devices** (Triggers. Counters. Registers)
- **Assembly and test of digital-to-analog converter** (Digital-to-analog converter with current output. Digital-to-analog converter with voltage output. Codes comparison. Pulse-length modulator)
- **Assembly and test of analog-digital converter** (Analog comparator. Analog-digital converter of sweep conversion. Analog-digital converter of tracing conversion. Analog-digital converter of successive approximation)
- **Assembly and test of multivibrators** (Test of chip in multivibrators modes. Test of timer in multivibrator modes)
- **Assembly and test of storages**
- **Assembly and test of parity control schemes**
- **Circuitry of logic elements**

Modules / Components:

Single-phase Power Supply
Module Of Testing Digital Devices
Mini-modules Sets “ Fundamentals Of Digital Technology”
Desktop Container With 1-level Frame
Accessories Kit
Basic Experiments Guide
Multimeter

Analogue Electronics Fundamentals

MODEL: GALSEN® AEFMD1

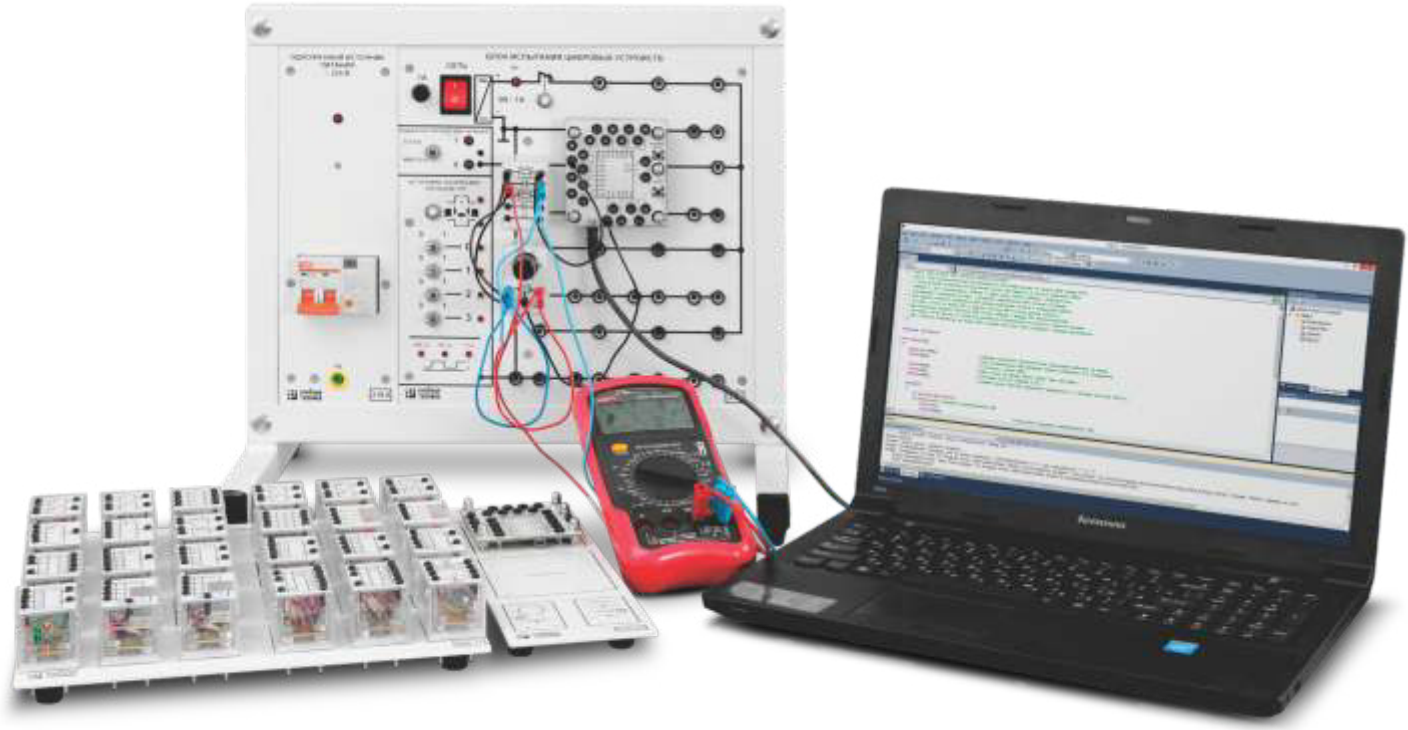
Basic Experiments:

- **Semiconductors** (Characteristics of semiconductor diodes for direct and alternating currents. Main characteristics of stabilitron and study of parametric voltage regulator. Current-voltage characteristics of LED. Variable capacitance diode (varicap). Test of p-n junctions of bipolar transistor and receiving its output characteristics with an oscilloscope. Static characteristics of transistor for direct current. Choice of bipolar transistor operating point and familiarization with AC voltage amplification mode of classes A, B, AB, and D. Static characteristics of a field-effect transistor with p-n junction.Static characteristics of field-effect transistor, insulated gate and induced channel.Main characteristics of thyristors.Basic characteristics and parameters of photocouplers)
- **Electronic circuits and microcircuitry** (Comparative study of single amplifier stages using bipolar transistors.Study of the amplifier stages using FET. Study of two-stage transistor amplifier. Study of the basic circuits of operational amplifier. Removing the frequency characteristics of operational amplifier. Summation, integration and differentiation schemes on operational amplifiers. RC-filter using operational amplifier. Simple logarithmic converter using operational amplifier. Generator of sinusoidal oscillations using operational amplifier. Schmitt trigger and relaxation oscillators using operational amplifier. RS-trigger, multivibrator and single-shot trigger. Analog integrated comparators and circuits with them.Self-oscillating and standby modes of analog timer using integrated chip.Generator of special form voltage (function generator) using integrated chip)

Modules / Components:

Module Of Voltage Generators With Testing Board; Single-phase Power Supply; Wattmeter; “Analogue Electronics - Electrical Components” Mini-modules Set; “Analogue Electronics - Electronic Components” Mini-modules Set; Desktop Container With 1-level Frame; Accessories Kit; Basic Experiments Guide; Two-channel Oscilloscope

- **Stabilizers and secondary sources of supply** (Half-wave and bridge-circuit rectifiers. Three-phase bridge-circuit rectifier and smoothing filters. Controlled rectifiers and thyrister regulator with phase control. Degenerative voltage and current stabilizers. Main schemes of coupling linear integral voltage regulator. PWM DC-DC converter. Integral pulse converter - voltage stabilizer with pulse-frequency modulation)



Digital & Microprocessor Technology Fundamentals

MODEL: GALSEN® DMTFCD1

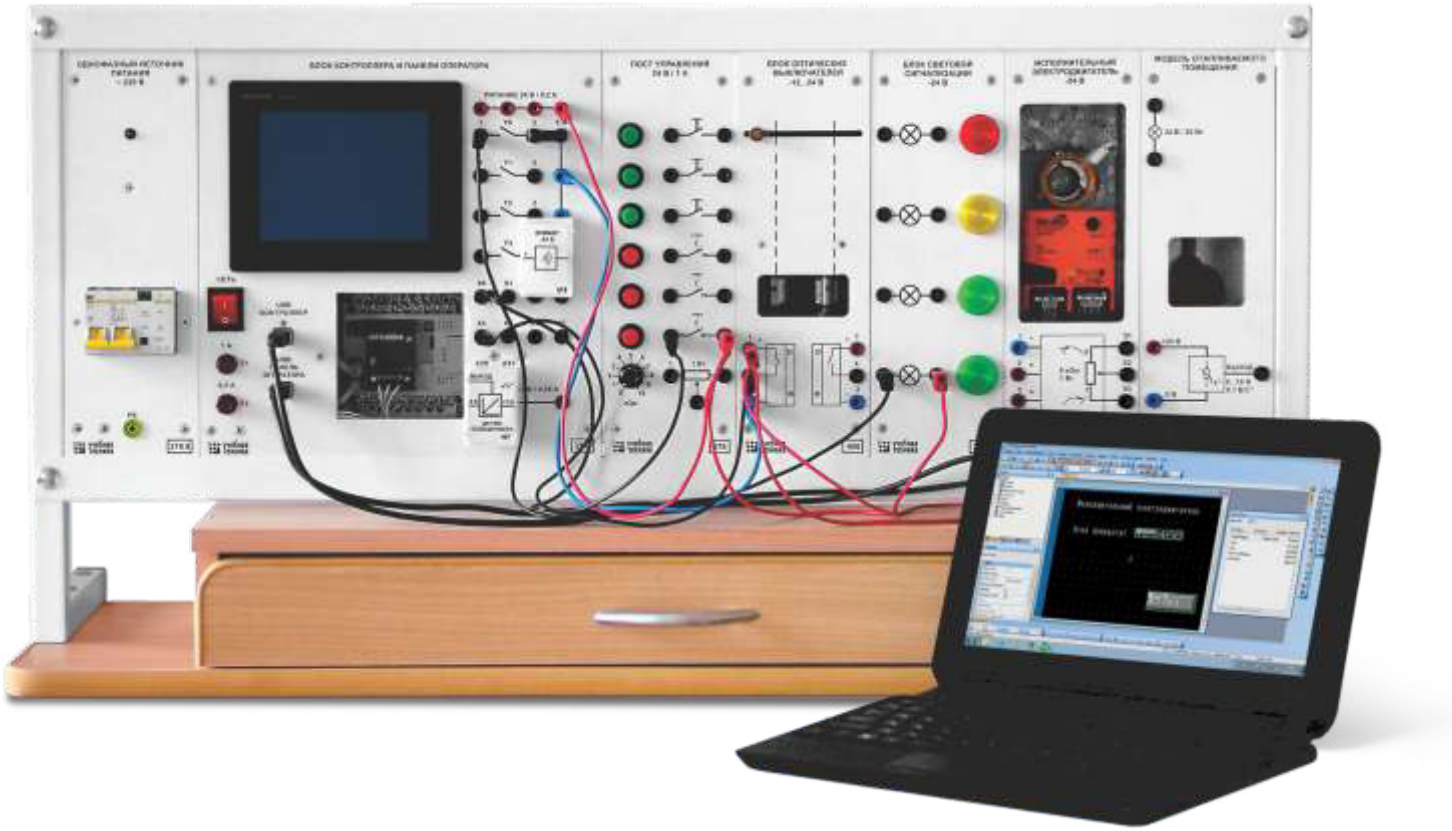
Basic Experiments:

- **Testing basic logical elements**
- **Assembly and test of simple combinational nodes of digital devices** (Combinational node using basic logic elements to implement arbitrary logic function. Combinational nodes using basic logic elements for experimental confirmation of logic algebra laws. Single-digit half-adder and adder. Code converter and decoder. Multiplexer and demultiplexer)
- **Assembly and test of sequential nodes of digital devices** (Triggers. Counters. Registers)
- **Study of basic features of programming environment**
- **Coding of microcontroller timer** (Generation of delay by means of timer. Generation of signal of predetermined frequency. Measuring external signal length by means of timer. Study of counter with programmable division factor based on timer. Using interruptions in microcontroller coding. Coding analog-to-digital microcontroller. Study of digital-to-analog converter on basis of microcontroller pulse-width modulation signals)
- **Signal transfer along sequential transmission channels** (Data transmission using channel SPI. Data transmission using channel USART)
- **Using microcontroller in applications** (Measuring time intervals. Measuring temperature)

Modules / Components:

Single-phase Power Supply
Module Of Testing Digital Devices
“Fundamentals Of Digital Technology” Mini-modules Set
“Microcontrollers” Mini-modules Set
Desktop Container With 1-level Frame
Accessories Kit
Basic Experiments Guide
Multimeter
Notebook With Software

Automation & Robotics



Automation of Technological Processes and Industries Based on Mitsubishi Devices

MODEL: GALSEN® ATPIBMDCD2

Basic Experiments:

- **Studying basic features of the Mitsubishi controller and operator's panel** (Programming the controller; Programming the operator's panel using GT Designer 3 software; Programming timers and counters)
- **Using the Mitsubishi controller and operator's panel in applications** (Automatic control system of traffic lights; Automatic control system of interior lighting; Automatic control of outdoor lighting; Automatic control system sounder; Automatic backup power turn on; Automatic alarm system; Automatic control system of executive motor; Automatic indoor air temperature control system)

Modules / Components:

Single-phase Power Supply
Light Signaling Module
Control Post
Buzzer
Executive Motor
Model of Heated Room
Controller Unit and Operator Panel
Optical Switches Module
Light Sensor
Desktop Containter with 1-Level Frame
Accessories Kit
Basic Experiments Guide
Notebook with Software

Smart Relay

MODEL: GALSEN® SRMP1

Basic Experiments:

- Programmable relay LOGO! control
- Testing basic logic functions
- Testing specific logic functions
- Creating and testing circuit program
- Traffic light automatic control

Modules / Components:

Portable Smart Relay Module
Accessories Kit
Basic Experiments Guide
Tablet (optional)

PID Controller Adjustment

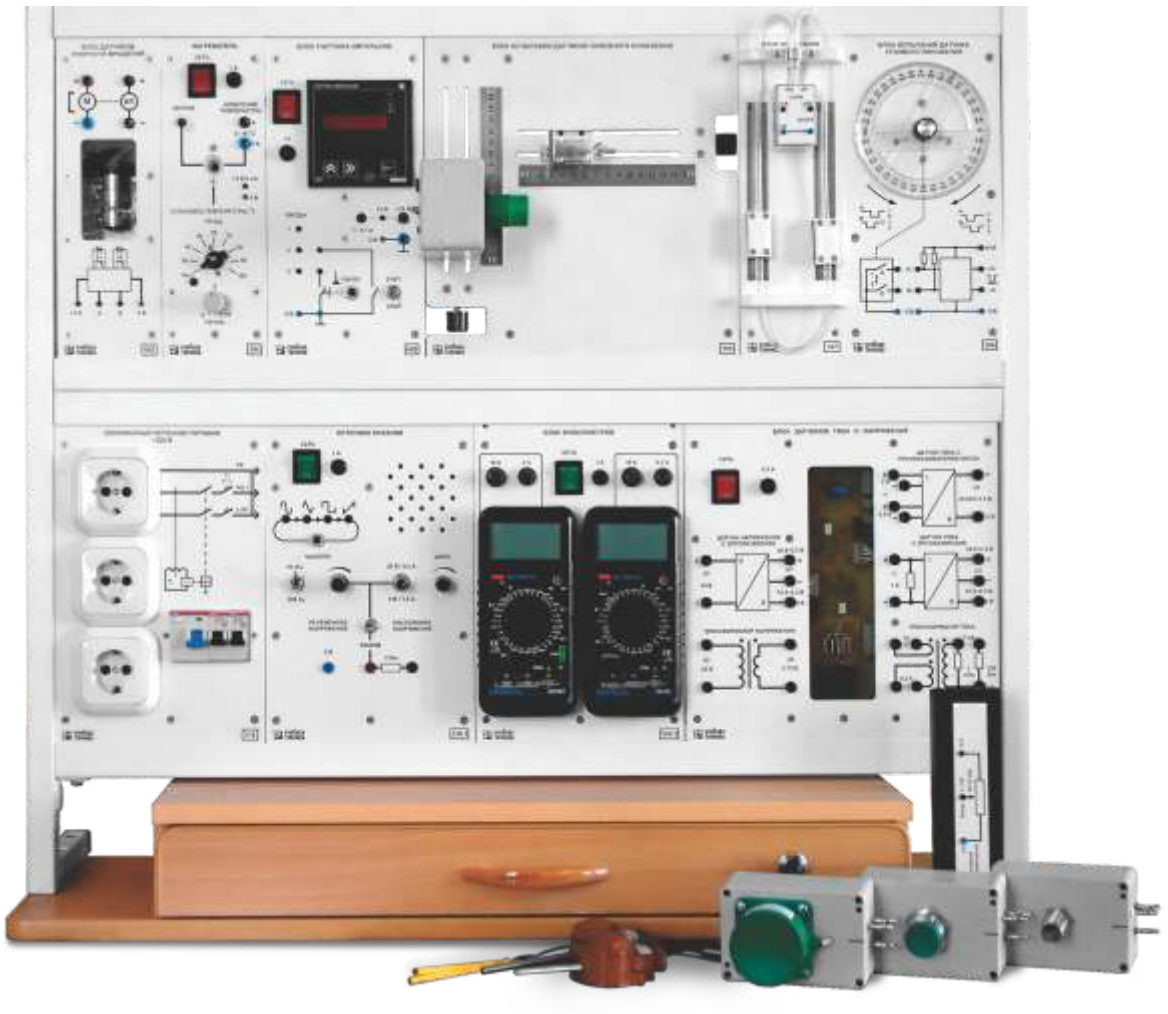
MODEL: GALSEN® PCACD1

Basic Experiments:

- Control object transition function registration
- Determination of direct quality indicators of control process in time domain
- Adjustment of the controller by the frequency method (Zelder-Nichols,Tyreus-Luyben (TLC)
- Adjustment of the controller by single step response method (Zelder-Nichols, Chien-Hrones-Reswick (CHR) and Cohen-Kuhn)
- Manual adjustment of the controller
- Automatic adjustment of the controller

Modules / Components:

Single-phase Power Supply; PID Controller Module; Electric Resistance Furnace Module; USB / RS-485 Converter; Single-level Frame with Container; Notebook with Software; Accessories Kit; Basic Experiments Guide



Technological Parameters Sensors

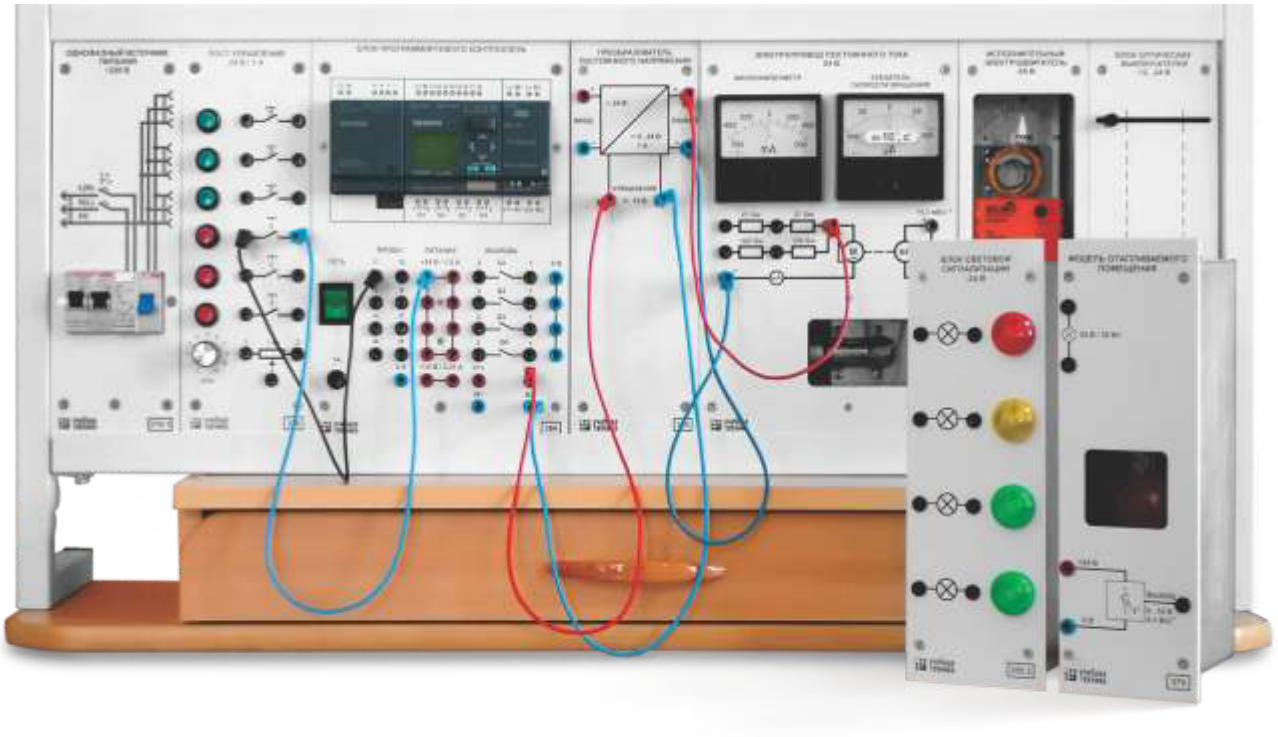
MODEL: GALSEN® TPSMD1

Basic Experiments:

- Static characteristics of current and voltage sensors (5 types)
- Static characteristics of tachometer-generator and optical encoder
- Static and dynamic characteristics of temperature sensors (5 types)
- Static characteristics of linear position sensors (6 types)
- Static characteristics of proximity sensor-switches (3 types)
- Static characteristics of angle position sensors (3 types)
- Static characteristic of pressure sensor

Modules / Components:

Power Supply
Single-phase Power Supply
Electric Heater
Linear Position Sensor Module
Angle Position Sensor Module
Pressure Sensor Module
Current And Voltage Sensors Module
Speed Sensor Module
Impulse Counter Sensor Module
Module Of Two Multimeters
Temperature Sensors Kit
Linear Position Sensors Kit
Desktop Container With 2-level Frame
Accessories Kit
Basic Experiments Guide



Automation Based on Programmable Controller

MODEL: GALSEN® ABPCMD1

Basic Experiments:

- **Programmable controller** (Control of programmable controller; Test of basic logic functions; Test of special logic functions; Creation and test of commutation program)
- **Control systems based on programmable controller** (Traffic light control system; Indoor lighting control system; Outdoor lighting control system; Sounder control system; Automatic switching-on of electric power reserve; Three-pole switching; Automatic alarm system; Control system of executive motor; Pulse control of room air temperature room; Continuous control of room air temperature by proportional-plus-integral regulator; DC motor two-stage startup control as function of time; DC motor dynamic brake control as function of speed; DC motor speed control by proportional-plus-integral regulator)

Modules / Components:

Single-phase Power Supply
Light Signaling Module
Button Control Module
Buzzer
Executive Electric Motor
Model Of Heated Space
Programmable Controller Module
Dc Converter
Electric DC Drive
Optical Switches Module
Light Sensor
Desktop Container With 1-level Frame
Accessories Kit
Basic Experiments Guide

Programmable Mitsubishi Robot

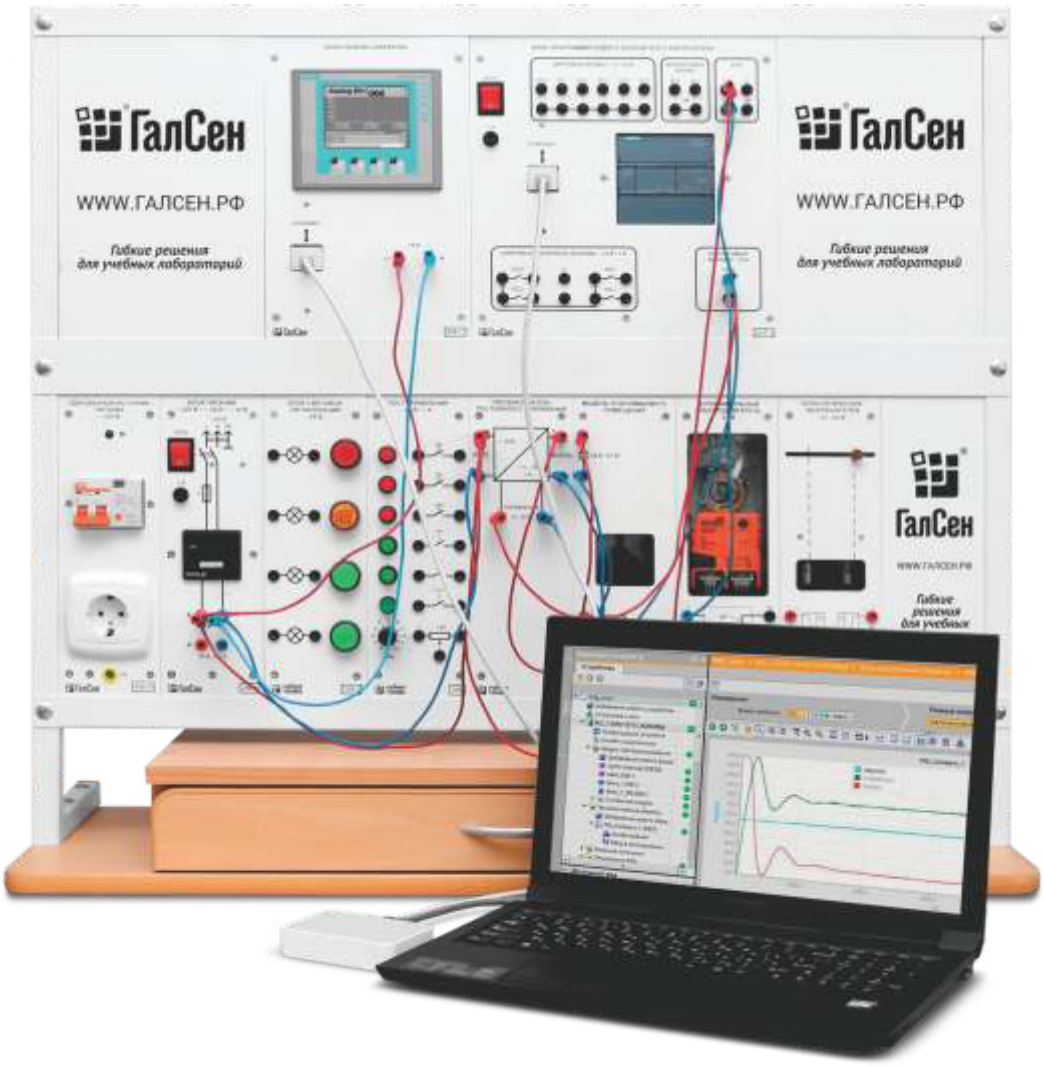
MODEL: GALSEN® PMRCS1

Basic Experiments:

- **Creating and testing a program for controlling a robot using a computer** (Create a project. Set the source coordinates of the robot. Create a program. Testing the control program using a virtual robot. Managing a real robot using the developed program)
- **Creating and testing a program for controlling the robot using the control panel** (Set the source coordinates of the robot. Create a program. Specify the coordinates of the points of the trajectory of motion. Virtual testing of the robot control program. Managing the real robot in the manual mode. Real robot control in automatic mode)
- **Testing examples of application programs for robot control** (Testing the program to move the chess piece. Testing the program for moving chess pieces when setting up Scholar's Mate. Testing the program for the initial placement of pieces on the chessboard. Testing the program to move chess pieces when setting up Scholar's Mate and then restoring the original arrangement of the pieces on the chessboard in a cyclic mode. Testing the program to build a volumetric construction of objects in the form of parallepipeds)

Modules / Components:

Notebook with software
Emergency Shutdown Device
Set of Cubes and Parallelepipeds
Lab Table with a Stand for Compressor
Lab table for the Robot
Sound-proof Cabinet with Compressor
Mitsubishi Robot with Accessories
Accessories Kit
Controller CR750-D
Remote Control Teaching Box R56TB
Set of Chess Pieces with a Field (cell size 30x30 mm)



Automation of Technological Processes and Industries Based on Siemens Devices

MODEL: GALSEN® ATPIBSDMD6

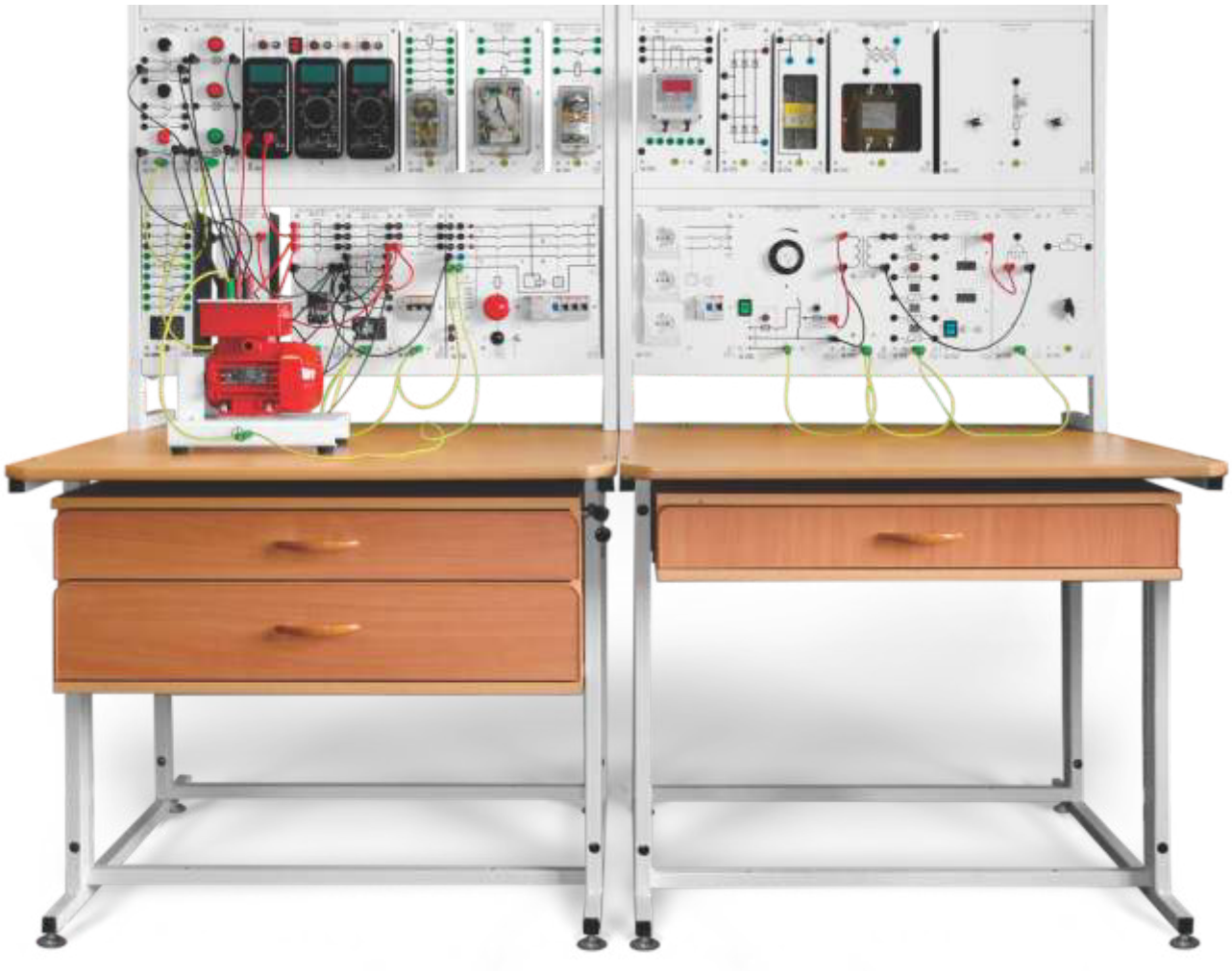
Basic Experiments:

- **Programming the S7-1200 controller in TIA Portal programming environment** (Installing TIA Portal. Purpose of TIA Portal. Running the program and create a new project. Memory data, memory areas and addressing. User program. Functions available in the program. An example of writing a program for multiplying two numbers. Using the operator touch panel)
- **Examples of the development of automatic control systems based on the S7-1200 programmable controller** (Software generator of periodic pulses. Traffic light control. Automatic system of impulse regulation of air temperature in the room. Automatic control system for the executive electric motor. Controlling the lighting in the room. Automatic system P (PD, PI, PID)-regulation of temperature of air in a premise)

Modules / Components:

Light Signaling Module
Control Station
Executive Electric Motor
Heated Room Model
DC Voltage Converter
Optical Switches Model
2-level Desktop Frame with Container
Power Supply Unit
Single-phase Power Supply
Programmable Logic Controller Module
Operator Panel Unit
Accessories Kit
Notebook

Electromechanics



Electric Apparatus

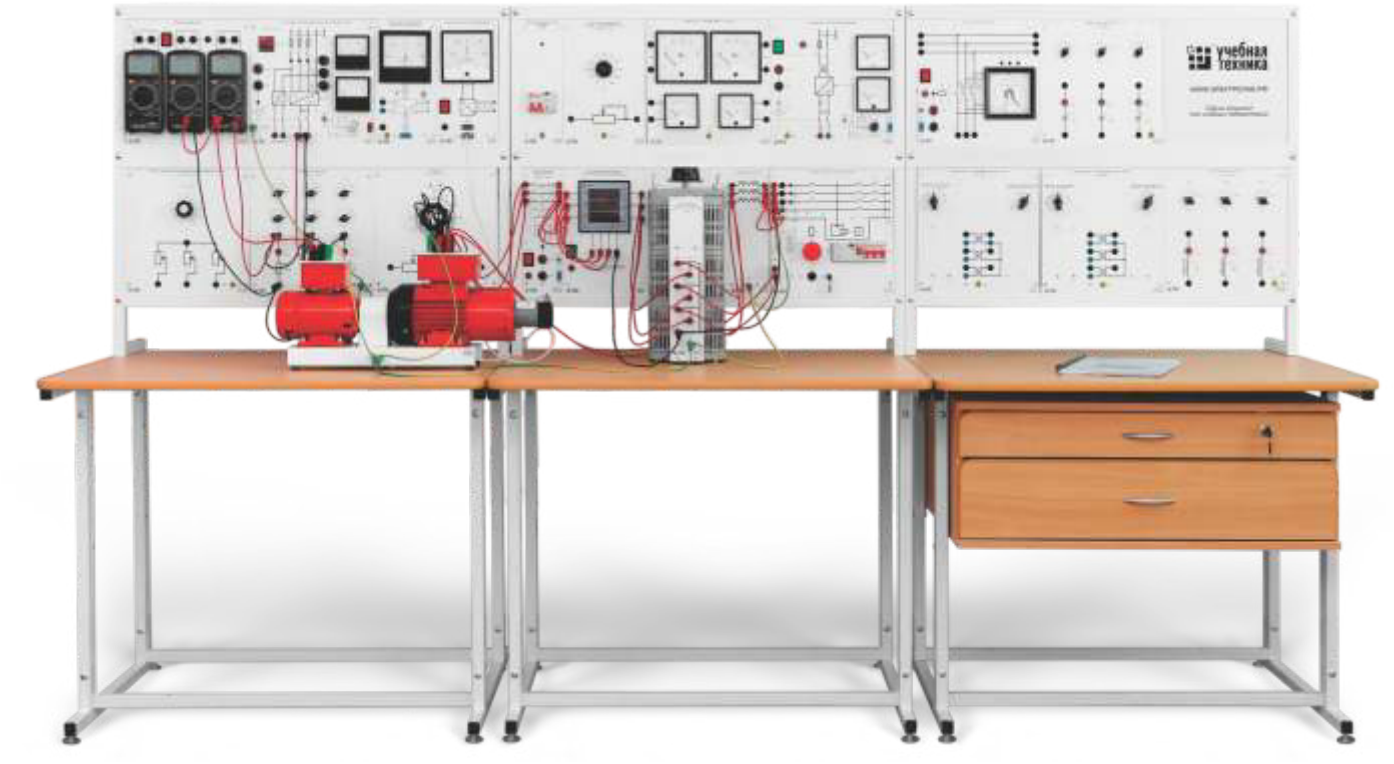
MODEL: GALSEN® EAMS1

Basic Experiments:

- **Operation apparatus** (Electromagnetic contactor returning ratio. Time-current characteristic of thermal electric relay. AC electromagnetic relay returning ratio. AC voltage electromagnetic auxiliary relay returning ratio. Time lag as function of relay pull-in value. Magnetic starter in induction motor nonreversible speed control. Magnetic starter in induction motor reversible speed control. Programming and operating of microprocessor module of induction motor control and current protection)
- **Apparatus of switchgears** (Time-current characteristic of fuse. Time-current characteristic of automatic air circuit-breaker. Time-current characteristic of overvoltage limiter. Inductance of doubled electric reactor. Current transformer measurement error. Voltage transformer measurement error)

Modules / Components:

Induction motor; Three-phase power supply; Single-phase power supply; Active load; Adjustable autotransformer; Rectifier; Rheostat; Module of button control; Module of light signaling; Thermal electric relay; Automatic single-pole breaker; Automatic three-pole breaker Contactor; Current-overload relay; Module of induction motor current protection; Time relay; Auxiliary relay; Single-phase transformer; Doubled electric reactor Module of fuses and overvoltage limiters; Current transformer; Voltage transformer; Module of three multimeters; Current and time meter; Laboratory table with 2-level frame; Laboratory table with 2-section storage and 2-level frame; Accessories Kit; Basic Experiments Guide



Electric Machines

MODEL: GALSEN® EMMS1

Basic Experiments:

- **Single-phase transformer** (Transformation ratio of single-phase transformer. Idling characteristics. Short-circuit characteristics. Characteristic U = f (I) of single-phase transformer with resistive load. Operational characteristics of single-phase transformer with a resistive load. Determination of equalizing current caused by inequality of transformation ratios of parallel single-phase transformers. Effect caused by the inequality of short-circuit voltages of single-phase transformers operating in parallel)
- **Single-phase autotransformer** (Transformation ratio of single-phase autotransformer. Short-circuit characteristics. Characteristic U = f (I) of single-phase during resistive load)

  Three-phase transformer (Idling characteristics. Short-circuit characteristics. Checking vector grouping of three-phase transformer. Confirmation of impossibility of parallel operation of three-phase transformers with different vector grouping)
- **DC generators with separate / shunt excitation** (Idling characteristics of DC generator with separate excitation. Short-circuit characteristics of DC generator with separate excitation. Characteristics U = f (I), If = f (I) and U = f (I_f) of DC generator with separate excitation. Characteristic U = f (I) of DC generator with shunt excitation)
- **DC motors with separate/ parallel / series excitation** (Electromechanical (speed) characteristics. Mechanical characteristics. Operational characteristics. Speed control of DC motor by armature voltage changing. Speed control of a DC motor by changing additional resistance in the armature circuit. Speed control of a DC motor by field current change. Speed control motor with series excitation by shunting field winding)
- **Three-phase squirrel-cage induction motor** (Idling characteristics. Short-circuit characteristics. Electromechanical (speed) characteristic. Mechanical characteristic. Operational characteristics. Speed control of three-phase squirrel-cage induction motor by stator voltage changing)
- **Three-phase wound-rotor induction motor** (Electromechanical (speed) characteristic. Mechanical characteristic. Operational characteristics. Speed control of three-phase wound-rotor induction motor by active rotor resistance changing)
- **Three-phase synchronous generator** (Idling characteristic. Short-circuit characteristic. Characteristics U = f (I), I_f = f (I) and U=f (I_f). Ideal synchronization. Self-synchronization. Angle characteristics. U-curve characteristic)
- **Three-phase synchronous motor** (Asynchronous start. U-curve characteristic. Operational characteristics. Angle characteristics)

Modules / Components:

Electromechanical unit (DC machine, AC motor and angular displacement transducer); Three-phase power supply; DC motor power supply; Synchronous machine exciter; Frequency converter; Single-phase power supply; Three-pole breaker; Active load; Rheostat for AC machine rotor; Excitation rheostat of DC machine; Line reactor; Capacitive load; Module of synchronizing; Rheostat Inductive load; Three-phase transformer group; Adjustable three-phase autotransformer; Voltage and frequency meter; Synchronous machine torque angle meter; Speed indicator; Module of 3 multimeters; Voltmeter; Multifunctional electrical measuring instrument; Laboratory table with 2-level frame; Laboratory table with 2-section storage and 2-level frame; Accessories kit; Basic Experiments Guide

Electric Drives

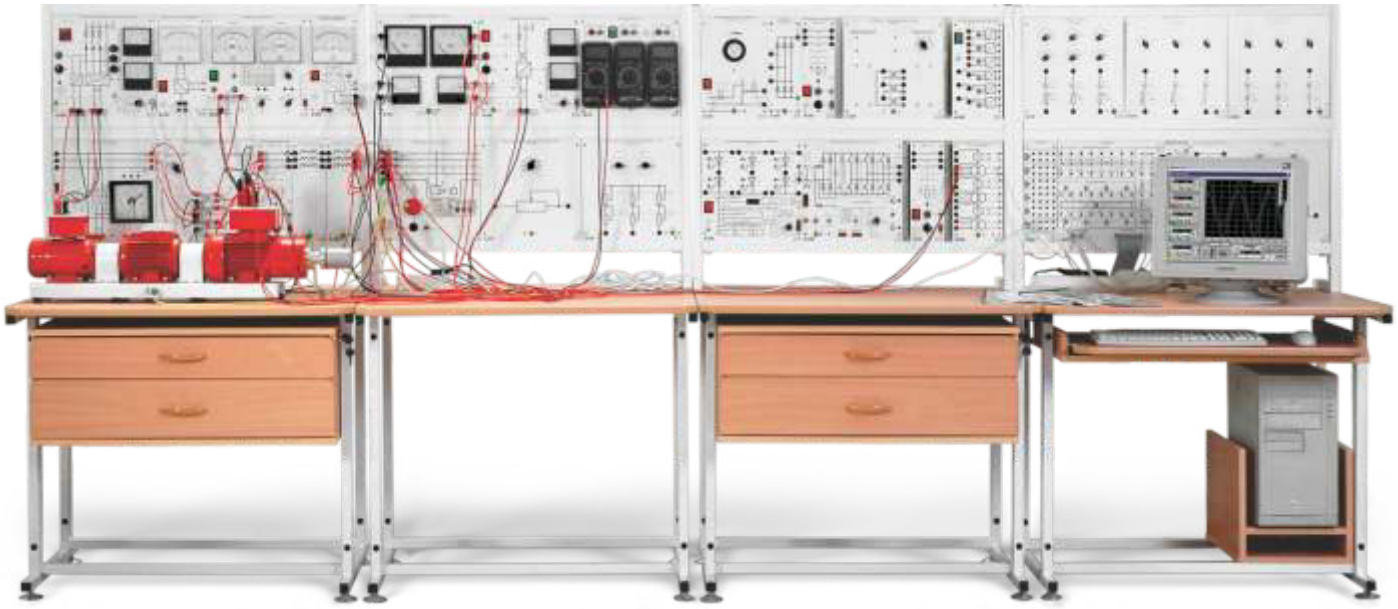
MODEL: GALSEN® EDCS1

Basic Experiments:

- **Mechanics of drives** (Determination of inertia moment of electric drive by method of free run-out. Determination of mechanical characteristic of working mechanism. Drive speed as function of time during transient)
- **Electric drive using DC motor with separate (parallel, series) excitation** (Determination of electromechanical and mechanical characteristics of electric drive in motor, generator, and braking modes. Speed control by changing resistance in armature circuit of DC motor. Speed control by changing excitation current of DC motor. Speed control by shunting field winding of DC motor with series excitation. Speed control by changing armature voltage DC motor. Armature current and speed as function of time during transient. Definition of energy parameters of electric drive with DC motor. Measuring body temperature of DC motor)
- **Electric drive using squirrel-cage induction motor** (Electromechanical and mechanical characteristics of electric drive with induction motor in motor, generator, and braking modes. Speed control by match changing frequency and magnitude of stator voltage. Stator current and speed as function of time during transient. Definition of energy parameters of electric drive with induction motor. Measurement of body temperature of induction motor)
- **Electric drive using wound-rotor induction motor** (Electromechanical and mechanical characteristics of electric drive with induction motor in motor, generator, and braking modes. Speed control by match changing frequency and magnitude of stator voltage. Stator current and speed as function of time during transient. Definition of energy parameters of electric drive with induction motor. Measurement of body temperature of induction motor)
- **Electric drive using synchronous motor** (Electromechanical and mechanical characteristics of electric drive with synchronous motor. Static angle characteristic. Static V-curve characteristic. Reactive power control by changing excitation current. Stator current and speed as function of time during transient. Definition of energy parameters of electric drive with synchronous motor. Measurement of body temperature of synchronous motor)
- **Open-loop control of electric drives** (DC drive startup control in function of time (speed, EMF, armature current) and dynamic braking in function of time (speed, EMF). Induction squirrel-cage motor control during direct-on-line startup, reverse and dynamic braking in function of time (plugging). Induction wound-rotor motor control during direct-on-line startup in function of time (speed, EMF, stator current), reverse and dynamic braking in function of time (speed, EMF). Synchronous motor control of startup and braking)
- **Closed-loop control of electric drives** ("Thyristor converter - DC motor". Control characteristics. Current control contour adjustment. Limiter adjustment. Speed control contour adjustment. Determination of static electromechanical and mechanical characteristics. "Frequency converter - induction motor". Speed control contour adjustment. Control characteristics. Determination of static electromechanical and mechanical characteristics)

Modules / Components:

Electromechanical unit with flywheel (DC machine, AC motor and angular displacement transducer); Three-phase power supply; Synchronous machine exciter; Single-phase thyristor converter; Frequency converter; Single-phase power supply; Three-pole breaker; Terminal; Active load; Rheostat for AC machine rotor; Excitation rheostat of DC machine; Rectifier; Rheostat; Connector; Module of digital signals input/output; Three-phase transformer group; Module of regulators; Module of current-and-voltage sensors; Synchronous machine torque angle meter Speed indicator; Module of two multimeters; Voltammeter; Multifunctional electrical measuring instrument; Laboratory table with 2-section storage and 2-level frame; Laboratory table with computer rack and pullout keyboard shelf and 2-level frame; Laboratory table with storage container for wires and 2-level frame; Accessories Kit; Basic Experiments Guide Personal computer



Electric Machines and Drives

MODEL: GALSEN® EMDCS1

Basic Experiments:

- **Single-phase transformer** (Transformation ratio of single-phase transformer. Idling characteristics. Short-circuit characteristics. Characteristic U = f (I) single-phase transformer with resistive load. Operational characteristics of single-phase transformer with a resistive load. Determination of equalizing current caused by inequality of transformation ratios of parallel single-phase transformers. Effect caused by the inequality of short-circuit voltages of single-phase transformers operating in parallel)
- **Single-phase autotransformer** (Transformation ratio. Short-circuit characteristics. Characteristic U = f (I) under resistive load) Three-phase transformer (Idling characteristics. Short-circuit characteristics. Checking vector grouping of three-phase transformer. Confirmation of impossibility of parallel operation of three-phase transformers with different vector grouping)
- **DC generators with separate / shunt excitation** (Idling of DC generator with separate excitation. Short-circuit characteristics of DC generator with separate excitation. Characteristics U = f (I), If = f (I) and U = f (I_f) of DC generator with separate excitation. Characteristic U=f(I) of DC generator with shunt excitation)
- **DC motors with separate / parallel / series excitation** (Electromechanical (speed) characteristics. Mechanical characteristics. Operational characteristics. Speed control by armature voltage changing. Speed control by changing additional resistance in the armature circuit. Speed control by field current change. Speed control motor with series excitation by shunting field winding. DC motor startup)
- **Three-phase induction generator** (Power characteristics. Ideal idling characteristics. Operational characteristics)
- **Three-phase squirrel-cage induction motor** (Idling characteristics. Short-circuit characteristics. Electromechanical (speed) characteristic. Mechanical characteristic. Operational characteristics. Speed control of three-phase squirrel-cage induction motor by stator voltage changing. Induction motor startup)
- **Mechanics of drives** (Determination of inertia moment of electric drive by method of free run-out. Determination of mechanical characteristic of working mechanism. Drive speed as function of time during transient)
- **Electric drive using DC motor with separate (parallel, series) excitation** (Determination of electromechanical and mechanical characteristics in motor, generator, and braking modes. Speed control by changing resistance in armature circuit of DC motor. Speed control by changing excitation current of DC motor. Speed control by shunting field winding of DC motor with series excitation. Speed control by changing armature voltage DC motor. Armature current and speed as function of time during transient. Definition of energy parameters of electric drive with DC motor. Measuring body temperature of DC motor)
- **Electric drive using squirrel-cage induction motor** (Electromechanical and mechanical characteristics in motor, generator, and braking modes. Speed control by match changing frequency and magnitude of stator voltage. Stator current and speed as function of time during transient. Definition of energy parameters of electric drive with induction motor. Measurement of body temperature of induction motor)
- **Open-loop control of electric drives** (DC drive startup control in function of time (speed, EMF, armature current) and dynamic braking in function of time (speed, EMF). Induction squirrel-cage motor control during direct-on-line startup, reverse and dynamic braking in function of time (plugging). Induction wound-rotor motor control during direct-on-line startup in function of time (speed, EMF, stator current), reverse and dynamic braking in function of time (speed, EMF). Synchronous motor control of startup and braking)
- **Closed-loop control of electric drives** ("Thyristor converter - DC motor". Control characteristics. Current control contour adjustment. Limiter adjustment. Speed control contour adjustment. Determination of static electromechanical and mechanical characteristics. "Frequency converter - induction motor". Speed control contour adjustment. Determination of static electromechanical and mechanical characteristics)

Modules / Components:

Electromechanical unit with flywheel (DC machine, induction motor and angular displacement transducer); Three-phase power supply; Single-phase thyristor converter; Frequency converter; Single-phase power supply; Three-pole breaker; Terminal; Active load; Excitation rheostat of DC machine; Linear reactor; Adjustable autotransformer; Rectifier; Rheostat; Connector; Module of digital signals input/output; Three-phase transformer group; Adjustable three-phase autotransformer; Module of regulators; Module of current-and-voltage sensors; Speed indicator; Module of two multimeters; Voltammeter; Multifunctional electrical measuring instrument; Laboratory table with 2-section storage container and 2-level frame; Laboratory table with computer rack and pullout keyboard shelf and 2-level frame; Laboratory table with storage container for wires and 2-level frame; Accessories Kit; Basic Experiments Guide; Personal computer

Slip Ring Induction Motor

MODEL: GALSEN® SRIMMD1

Basic Experiments:

- **Study of Characteristics** (Finding no-load characteristics $I_0=f(U)$, $P_0=f(U)$, $\cos\varphi_0=f(U)$. Finding short circuit characteristics $I_{SC}=f(U)$, $P_{SC}=f(U)$, $\cos\varphi_{SC}=f(U)$. Finding mechanical characteristic $n=f(M)$. Finding operational characteristics $I=f(P_2)$, $P_1=f(P_2)$, $s=f(P_2)$, $\eta=f(P_2)$, $\cos\varphi=f(P_2)$, $M=f(P_2)$
- **Speed control** (Speed control by changing stator voltage. Speed control by changing active resistance of rotor circuit)

Modules / Components:

Electromechanical Unit (DC Machine, AC Motor and Angular Displacement Transducer); Three-phase Power Supply; Single-phase Power Supply; Active Load; AC Machine Rotor Rheostat; Line Reactor; Adjustable Autotransformer; Rectifier; Three-phase Transformer Group; Speed Indicator; Wattmeter; Three Multimeters Module; Desktop Container With Double-level Frame; Desktop Container With Single-level Frame; Accessories Kit; Basic Experiments Guide

Frequency Converter – Induction Motor

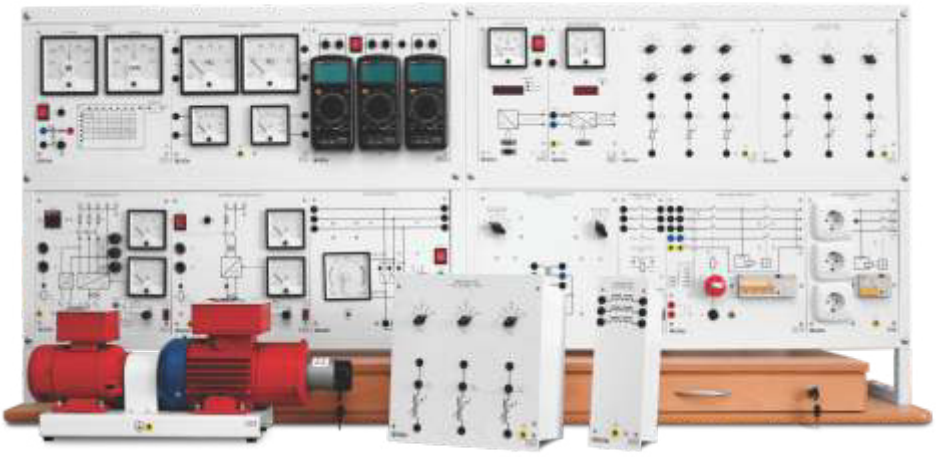
MODEL: GALSEN® FCIMCD1

Basic Experiments:

- Study of “Frequency converter – induction motor” static and dynamic modes during manual control
- Study of “Frequency converter – induction motor” static and dynamic modes during computer control

Modules / Components:

Electromechanical Unit With Flywheel (DC Machine, Induction Motor & Angular Displacement Transducer); DC Voltage Supply; Frequency Converter; Single-phase Power Supply; Terminal; Connector; Current-and-Voltage Sensors Module; Speed Indicator; Laboratory Tables; Accessories Kit; Basic Experiments Guide; Personal Computer With Software



Three-phase Synchronous Generator

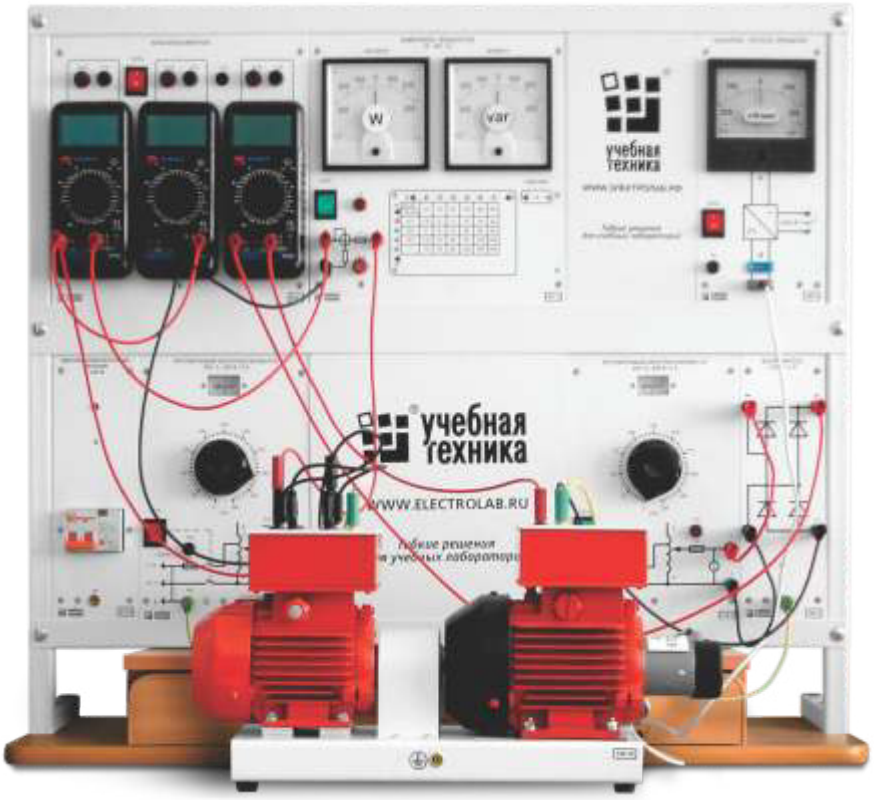
MODEL: GALSEN® TPSGMD1

Basic Experiments:

- **Connection in parallel power network** (Ideal synchronizing. Coarse synchronizing)
- **Study of Characteristics** (Finding no-load characteristic $E_0=f(I_f)$. Finding short-circuit characteristic $I_{sc}=f(I_f)$. Finding output U=f(I), regulation If= f(I) and load $U=f(I_f)$ characteristics. Finding angle characteristics P=f(δ), Q=f(δ), U=f(δ). Finding U-curve characteristic $I=f(I_f)$.

Modules / Components:

Electromechanical Unit (DC Machine, AC Machine and Angular Displacement Transducer); Three-phase Power Supply; DC Machine Power Supply; Synchronous Machine Exciter; Single-phase Power Supply; Three-pole Switch; Active Load; Line Reactor; Capacitive Load; Sychronizing Module; Inductive Load; Three-phase Transformer Group; Voltage and Frequency Meter; Synchronous Machine Torque Angle Indicator; Speed Indicator; Wattmeter; Three Multimeters Module; Desktop Containers; Accessories Kit; Basic Experiments Guide



Single-phase Capacity Motor

MODEL: GALSEN® SPCMMD1

Basic Experiments:

- Idling characteristics of the motor
- Short-circuit characteristics of the motor
- Electromechanical characteristic
- Mechanical characteristic
- Operating characteristics
- Maximum motor torque as function of capacitor size

Modules / Components:

Electromechanical Unit (Single-phase Capacity Motor, Induction Motor and Angular Displacement Transducer); Single-phase Power Supply; Adjustable Auto-transformer; Rectifier; Speed Indicator; Power Meter; Module Of Three Multi-meters; Laboratory Table With 2-section Storage Container and 2-level Frame; Accessories Kit; Basic Experiments Guide

Three-phase Induction Motor With Fault Imitator

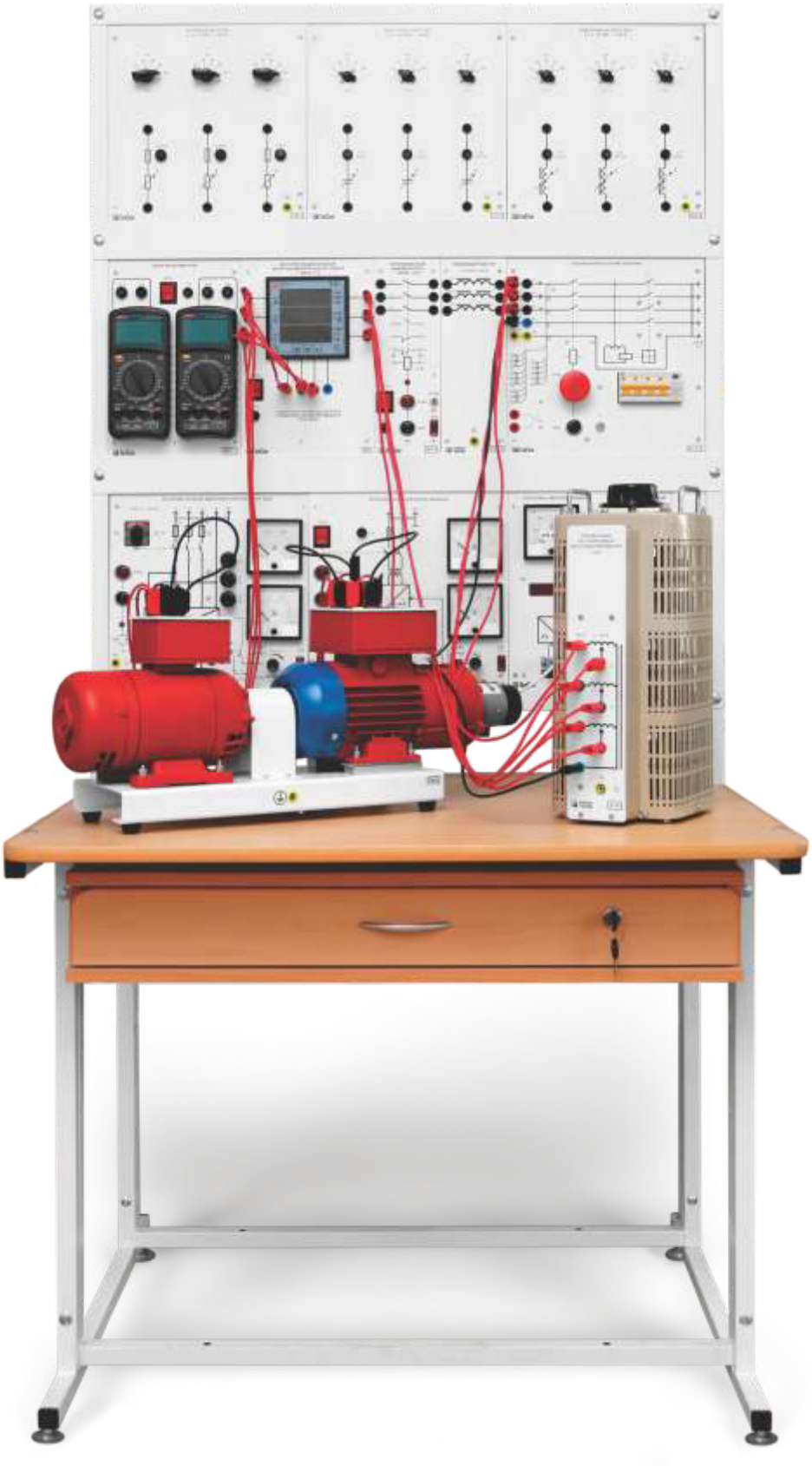
MODEL: GALSEN® TPIMFIMD1

Basic Experiments:

- Modeling and revealing isolation damage (between induction motor stator phase U and body, V and body, W and body)
- Modeling and revealing isolation damage (between induction motor stator phases U and V, U and W, V and W)
- Modeling and revealing loss of induction motor stator phases U, V, W
- Modeling and revealing turn-to-turn faults in induction motor stator phases U, V, W

Modules / Components:

Induction Motor
Fault Imitator
Multimeter
Operation Manual



Three Phase Salient Pole Synchronous Generator

MODEL: GALSEN® TPSPSGMS1

Basic Experiments:

- **Determination of the generator resistance** (Determination of synchronous inductive resistances; Determination of supertransitive resistances; Determination of inductive and active resistance of the reverse sequence; Determination of inductive and active resistance of zero sequence)
- **Readout of the generator characteristics** (Characteristics of the idling performance; Short-circuit characteristic; External characteristics for a given load character; Adjustment characteristic for a given load character; Load characteristics)

Modules / Components:

Three-phase Power Supply
Single-phase Power Supply
DC Motor Power Supply
Synchronous Machine Exciter
Three-pole Switch
Linear Reactor
Capacitive Load
Inductive Load
Active Load
Three-phase Adjustable Autotransformer
Multimeter module (2 multimeters)
Multifunctional Electric Measurement Tool
Speed Indicator
Laboratory Table
Electric Machine Unit (DC Machine, Three-phase Synchronous Salient-pole Generator and Angular Displacement Transducer)
Accessories Kit
Basic Experiments Guide

Power Electronics

Multifunctional Transistor Converter

MODEL: GALSEN® MTCCD1

Basic Experiments:

- **Autonomous voltage inverter** (Determination of the parameters of 1-phase bridge autonomous voltage inverter during steady-state load; Simulation of modulated output voltage of 1-phase bridge autonomous voltage inverter during steady state load; Determination of the harmonic components of 1-phase bridge autonomous voltage inverter during steady-state load; Readout of load and frequency characteristics of 1-phase bridge autonomous voltage inverter during steady-state load; Forming pulse-width modulation signals for 3-phase bridge autonomous voltage inverter; Determination of the parameters of frequency converter with drop DC link and 3-phase bridge autonomous voltage inverter when loaded by motor)
- **Direct voltage pulse-width converter** (Determination of parameters of reversible bridge direct voltage pulse-width converter during steady-state load; Simulation of modulated output voltage of output voltage of direct voltage pulse-width converter in accordance with the given control mode; Determination the harmonic components of output voltage and current of direct voltage pulse-width converter; Determination of parameters of reversible bridge direct voltage pulse-width converter when loaded by motor)

Module / Components:

Motor-Generator Set (DC machine + Induction Motor + Angular Displacement Transducer); Single-phase Power Supply; Terminal; Adjustable-ratio Autotransformer; Connector; Multifunctional Transistor Converter; Loading Resistor; Choke; Single-phase Transformer; Unit of Current and Voltage Sensors; Speed of Rotation Indicator; Two Multimeters Unit; Voltmeters; Ampermeters;Laboratory Tables; Accessories Kit; Basic Experiments Guide; I/O Board; Double-Channel Oscilloscope; Personal Computer

DC Voltage Pulse-Width Converters

MODEL: GALSEN® DCVPWCCS1

Basic Experiments:

- Unreversible pulse-width converters with reduced output voltage, controllable operating R- L- load with counterEMF (series key and series-shunt key schemes).
- Unreversible pulse-width converter with incrised output voltage, controllable operating R- L- load with counterEMF (shunt key scheme).
- Unreversible pulse-width converter with output voltage regulated higher or lower than input voltage, controllable operating R- L- load with counterEMF
- Reversible pulse-width converter, controllable operating R- L- load with counterEMF (key control, symmetric and asymmetrical).
- Transients in pulse-width converters.
- Pulse-width converters output voltage automatic control.

Modules / Components:

Power Supply; Single-phase Power Supply; Terminal; Active Load; Connector; Module Of Digital Signals I/O; Pulse-width DC Converter; Pull-up Resistor; Choke; Module Of Switching Capacitors; Module Of Current-and-voltage Sensors; Laboratory Table With 2-section Storage And 2-level Frame; Laboratory Table With Computer Rack And Pullout Keyboard Shelf And 2-level Frame; Accessories Kit; Basic Experiments Guide; Data Acquisition Board; Personal Computer

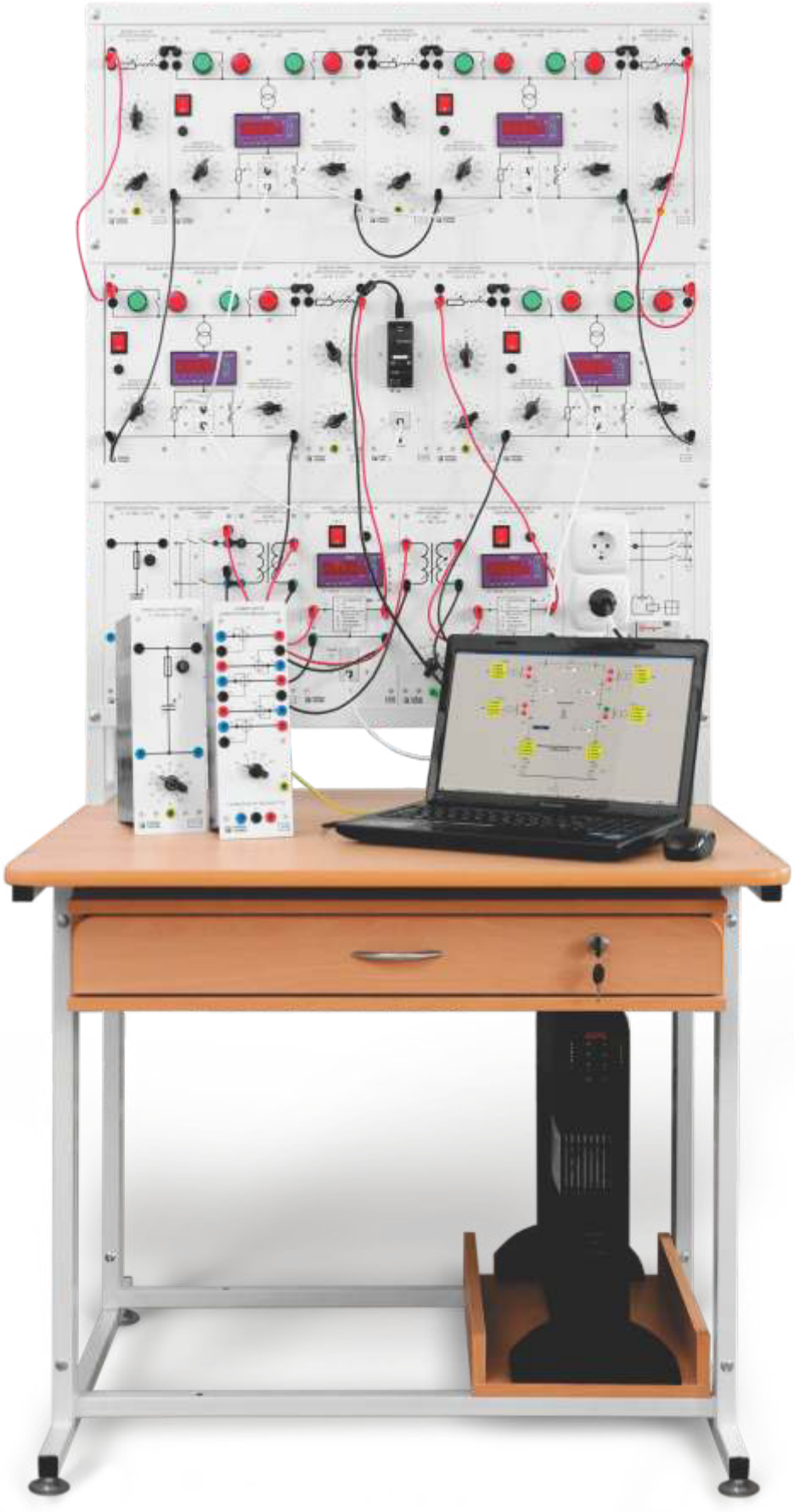
Power Supply

Distributional Power Supply Grid with Mode Optimization

MODEL: GALSEN® DPSGWMOCS1

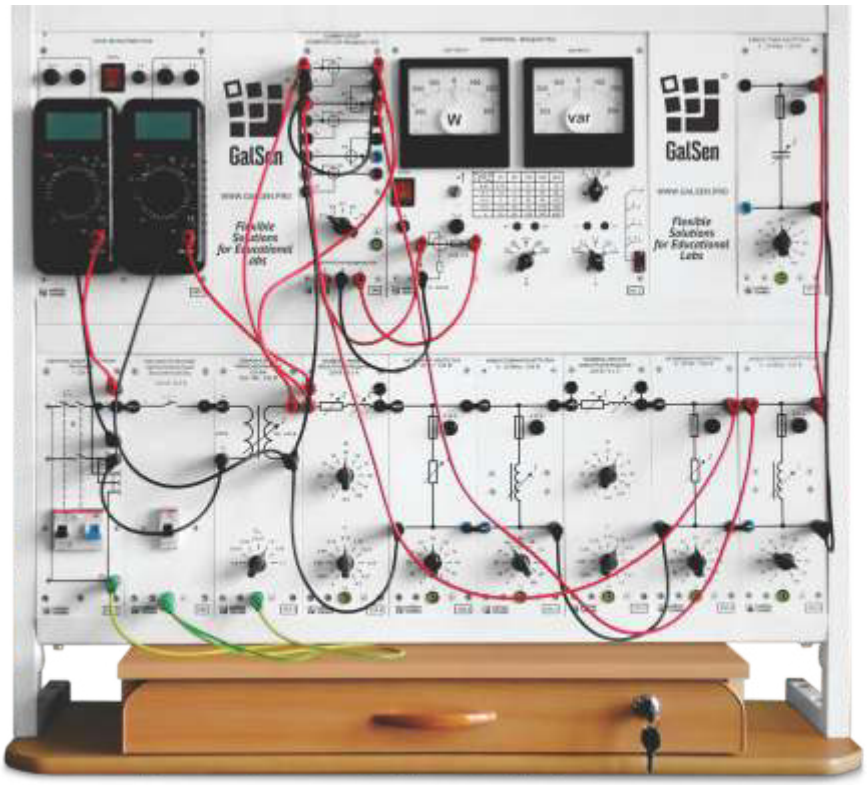
Basic Experiments:

- **Steady-state modes of elements of electric distribution network** (Full-scale simulation of steady-state mode of single-phase transformer; Full-scale simulation of steady-state mode of one phase of network; Readout of static characteristics of the power for static load)
- **Steady-state modes of the power distribution network** (Full-scale simulation of steady-state mode of one phase of network with single-sided supply / two-sided supply)
- **Voltage regulation in electric distribution network** (Counter voltage regulation; Voltage regulation by cross compensation of reactive power with capacitor banks)
- **Optimization of the local electricity distribution network modes** (Detecting active power losses in local power distribution network composed by loop scheme; Evaluation of effect of difference in the voltages at busbars of power centers on loss of active power in local electric distribution network, composed by loop scheme, when it operates in closed mode; Evaluation of effect of rupture of local electric distribution network, composed by loop scheme, on loss of active power; Finding point of normal (optimal) rupture in local electric distribution network, composed by loop scheme, according to the criterion of minimum active power losses; Operation of local electric distribution network, made by loop scheme, in mode of automatic point selection of normal (optimal) rupture according to the criterion of minimum active power losses)
- **Optimization of the regional electricity distribution network modes** (Measurement and calculation of closed (circular) regional electric distribution network mode parameters; Finding optimal power of the compensating capacitors in closed (circular) regional electric distribution network according to the criterion of minimum active power losses)



Modules / Components:

Single-Phase Power Supply; Electric Transmission Line Model; Capacitive Load; Single-Phase Transformer; Transformer Substation and Load Model; Electric Network Parameters Measurement Tool; Laboratory Table With 3-Level Frame, Container and Rack; Accessories Kit; Basic Experiments Guide; Software CD-ROM; Uninterruptible Power Supply; Notebook



Power Distribution Grid

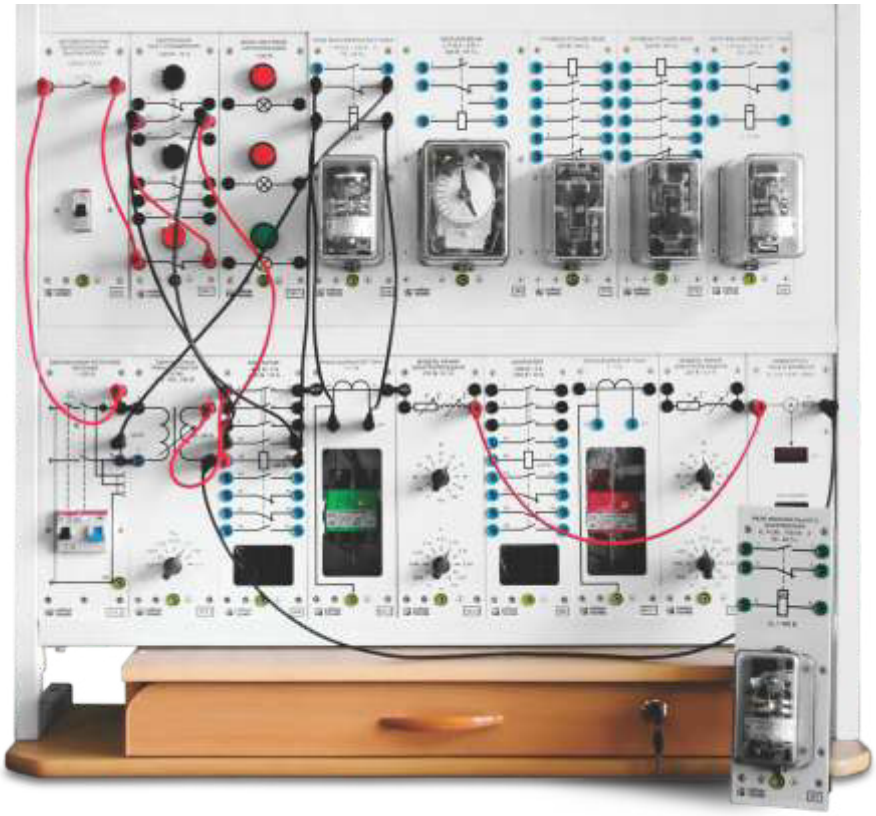
MODEL: GALSEN® PDGMD1

Basic Experiments:

- **Electric loads modes** (Power vs Voltage static characteristic of resistive load, reactor, capacitive load)
- **Distribution grid modes** (Modeling steady state operation of: single-phase transformer, a transmission line phase, .a phase of open-loop grid phase single feed. Voltage regulation of open-loop power distribution grid by shunt reactive power compensation using capasitor package)

Modules / Components:

Single-phase Power Supply; Active Load; Model Of Transmission Line; Capacitive Load; Adjustable Autotransformer; Inductive Load; Power Meter Commutater; Automatic Single-pole Switch; Single-phase Transformer; Module Of Two Multimeters; Single-phase Grid; Parameters Meter; Desktop Containe; Accessories Kit; Basic Experiments Guide



Relay Protection and Automation

MODEL: GALSEN® RPAMD1

Basic Experiments:

- **Relay protection** (Transmission line high-set overcurrent protection. Transmission line instant current cutoff. High-set overcurrent protection of radial electrical grid with single supply. Transmission line differential protection. Transformer differential protection. Transmission line circuit breaker high-set overcurrent protection. Thermal electrical relay thermal protection of electrical grid)
- **Automation** (Automatic activation of backup of electrical load supply. Transmission line autoreclosing)

Modules / Components:

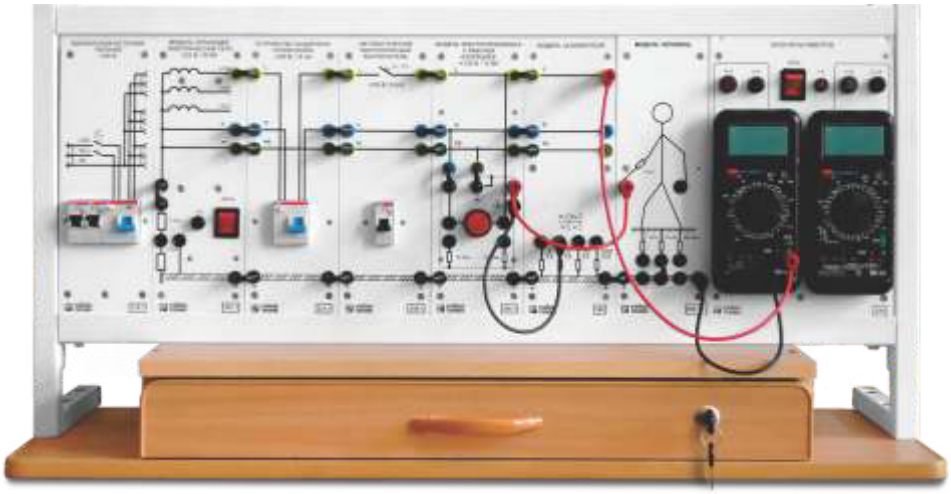
Single-phase Power Supply; Electrical Transmission Line Model; Push-button Control Station; Light Signaling Module; Electrothermal Relay; Automatic Single-pole Switch; Contactor; Overcurrent Relay; Undervoltage Relay; Time Relay; Interposing Relay; Single-phase Transformer; Current Transformer; Current & Time Meter; Desktop Frame; Accessories Kit; Experiments Guide

Electric Safety in Power Supply Systems

MODEL: GALSEN® ESPSSMD2

Basic Experiments:

- **Effect of electric current on human being** (Determination of electric current through human body at direct touch to parts under voltage. Determination of electric current through human body at indirect touch to parts under voltage. Determination of human body resistance)
- **Measures to protect humans from electric shock** (Action of protective neutral grounding. Protective effect of automatic power-off when overcurrent. Protective effect of appliance double insulation. Operation of protective switching device. Operation of protective grounding. Phase insulation monitoring in grid with insulated neutral)
- **Protection from electric shock in installations** (with grounding TN-C, TN-S, TN-C-S , TT, TI, IT: Protection operating at direct human touch to parts under voltage, Protection operating at damage of appliance system insulation, Protection operating at mistaken joining neutral, system and protective conductors, etc)



Modules / Components:

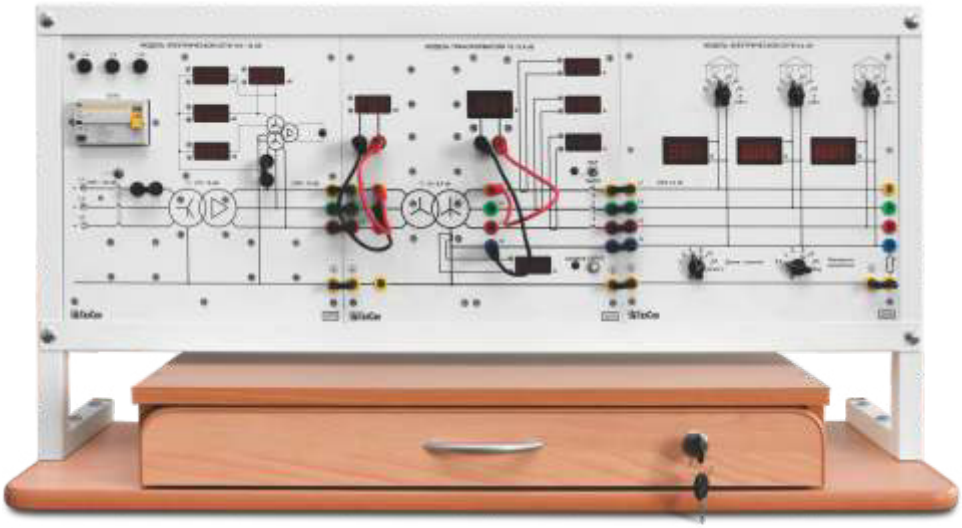
Single-phase Power Supply; Model Of Grid Section; Human Being Simulator; Protective Switching Device; Automatic Single-pole Breaker; Model Of Supply Grid; Model Of Appliance With Working Insulation; Model Of Grounding; Module Of Two Multimeters; Desktop Container With Single Level Frame; Accessories Kit; Basic Experiments Guide

Emergency Regimes of 110/10/0,4 kV Distribution Network

MODEL: GALSEN® ERDN1MD1

Basic Experiments:

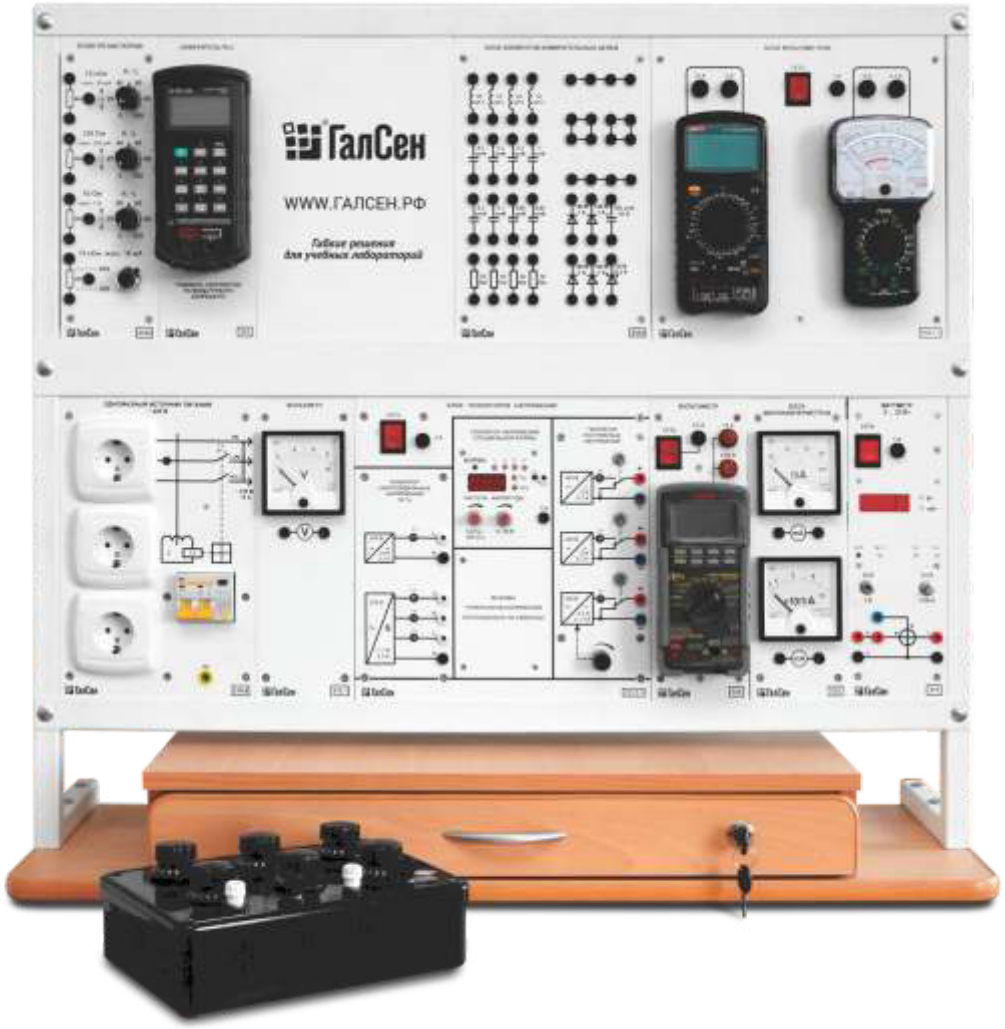
- Study of emergency modes occuring on one of the following conditions: a) when wire breaks in 110 kV network, b) when one wire of 10 kV line is grounded, c) when one wire is broken in 10 kV network, d) when wire breaks in 10 kV network and falls to the ground on the load side, e) when the phase wire is broken in 0.4 kV network, f) when a zero wire is cut off in 0.4 kV network with asymmetric load, g) when there is a single-phase short-circuit in the 0.4 kV network.
- Study of influence of re-grounding on the voltage of contact with the housings of electrical apparatus and on the operation of protection.
- Examination of emergency mode when one phase of measurement voltage transformer fails.



Modules / Components:

Single-level Desktop Frame with Container; Model of 110/10 kV Electric Network; Model of 10 / 0,4 kV Transformer; Model of 0,4 kV Electric network; Accessories Kit; Basic Experiments Guide

Electrical Measurements



Electrical Measurements and Metrology Fundamentals

MODEL: GALSEN® EMMFMD1

Basic Experiments:

- **Measurements in DC circuits** (Direct measurements of voltage and current by analog and digital devices. Determination of voltage polarity of voltage and current direction according to instrument readings. Indirect measurements of voltage and current. Expansion of the limits of measurement of ammeters and voltmeters by means of shunts and additional resistances. Calibration of analog ammeter and voltmeter. Determination of the methodical error of measurements due to the influence of instruments. Estimation of resistance value of analog and digital devices. Measurement of the EMF Source with a high internal resistance compensation method)
- **Measurements in AC circuits** (Direct measurements of sinusoidal and non-sinusoidal voltage and current. Evaluation of influence of shape and constant component of voltage and current on the instrument readings. Estimation of upper limit of frequency range of measuring instruments. Expansion of limits of measurement of ammeters and voltmeters using current and voltage transformers. Estimation of load influence on the error of current and voltage transformers)
- **Power measurement in DC and AC circuits** (Indirect and direct methods)
- **Measurement of electrical resistance in DC circuits** (Direct and indirect methods. IDetermination of methodological error due to the influence of instruments. Assembling, testing and calibration of an analog ohmmeter. Assembly and testing of bridge circuit. Measurement by substitution)
- **Measurement of parameters of elements of electrical circuits with a sinusoidal voltage**

Modules / Components:

Voltage Generators Module; Single-phase Power Supply; Power Supply Unit; Resistors Module; Measuring Circuits Elements Module; Multimeter Module (2 multimeters); Wattmeter; Voltmeter; Milliammeters Module; R-L-C Measuring Instrument; Multimeter; Double-level desktop frame with Container; Accessories Kit; Resistance Boxes; Basic Experiments Guide

Electric Power Engineering

Electric Power System Model

MODEL: GALSEN® EPSMMS2

Basic Experiments:

Production of electric energy

- **Synchronous generators** (Manual control of switching of the generator in parallel operation according to the method of mode self- synchronization. Manual control of switching of the generator in parallel operation according to the method of exact synchronization. Manual control of mode of free-running generator. Manual control of generator mode operating in parallel with the electric system of infinite power)
- **Synchronous compensators** (Start-up and regulation of reactive power of the synchronous compensator)
- **Own needs of power plants** (Self-starting of three-phase asynchronous motor)
- **Transmission of electric power** (Regimes of electric grid elements. Full-scale simulation of steady operation of the transformer. Full-scale simulation of the steady-state operation of transmission lines)
- **Power System Modes** (Determination of influence of power system mode consumed active / reactive power. Determination of influence of the mode of the electricity system generated in active / reactive power. Full-scale modeling regime of steady-state three-phase (two-phase, single-phase, two-phase to ground) short circuits in an electrical network powered by a source of almost infinite power)
- **Steady modes of distribution grids** (Full-scale simulation of the steady-state mode of operation of the electrical distribution network with one-way power. Full-scale simulation of the steady-state operation of electrical power distribution system with dual supply)
- **Voltage regulation in distribution networks** (Counter voltage regulation. Voltage regulation by cross-reactive power compensation using capacitor bank. Voltage regulation by longitudinal compensation of reactive power with capacitor banks)
- **Consumption of electrical energy** (Static characteristics of the voltage power of resistive loads. Readout of static characteristics of power by voltage: of inductive load (reactor), of capacitor, of lighting load, of rectifier loads, of asynchronous loads. Experimental determination of power capacitor bank to compensate for reactive power of the asynchronous load)
- **Quality of electrical energy** (Measurement of parameters and indicators of quality of electric energy. Quality control of electrical energy by a counter voltage regulation, by regulating the voltage cross reactive power compensation, by regulating the voltage of the longitudinal compensation of reactive power. Decrease in the level of generation of higher harmonics current by replacing three-pulse rectifier for manufacturing of power load with direct current)
- **Electromagnetic transients in power systems** (Transient process of transformer without load. Transient during quenching field synchronous generator. Transient in case of sudden three-phase short circuit at terminals of the synchronous generator. Transient in case of sudden three-phase short circuit in an electrical network powered by a source of almost infinite power)
- **Electromechanical transients in power systems** (Transient process when you connect synchronous generator to the mains. Readout of the angular characteristics and the definition of the power limit of the synchronous generator. Determination of the influence of the power limit of the synchronous generator in a single-machine power system the length and voltage of transmission lines, excitation current and power factor of the generator. Determination of the influence of the power limit of the synchronous generator in a single-machine power system device longitudinal capacitive compensation. Determination of the influence of the power limit of the synchronous generator in a single-machine power system intermediate reactive power generation, and other experiments)

Modules / Components

Electric machine with flywheel (with asynchronous motor, AC machine, angular displacement transducer); Exciter of the synchronous machine; Single-phase power supply; Three-pole switch (3); Model of transmission line (2); Linear reactor; Longitudinal capacitive compensation device; Capacitive load; Inductive load; Diodes Module; Lighting load; Three-phase transformer group; Three-phase transformer group; Power Meter Switchboard (2); Varistors Module; Three phase adjustable auto-transformer; Voltages & frequencies measurement Module; Multifunction electric measuring device (2); Lab tables; Module of current sensors and voltage; Resistive load; Indicator of load angle of the synchronous machine; Speed indicator; Module of Measuring of quality indicators of electric power; Three-phase power supply; Synchronization unit; Turbine model power supply; Digital oscilloscope; Accessories kit

Electric System Model with Asynchronized Synchronous Generator

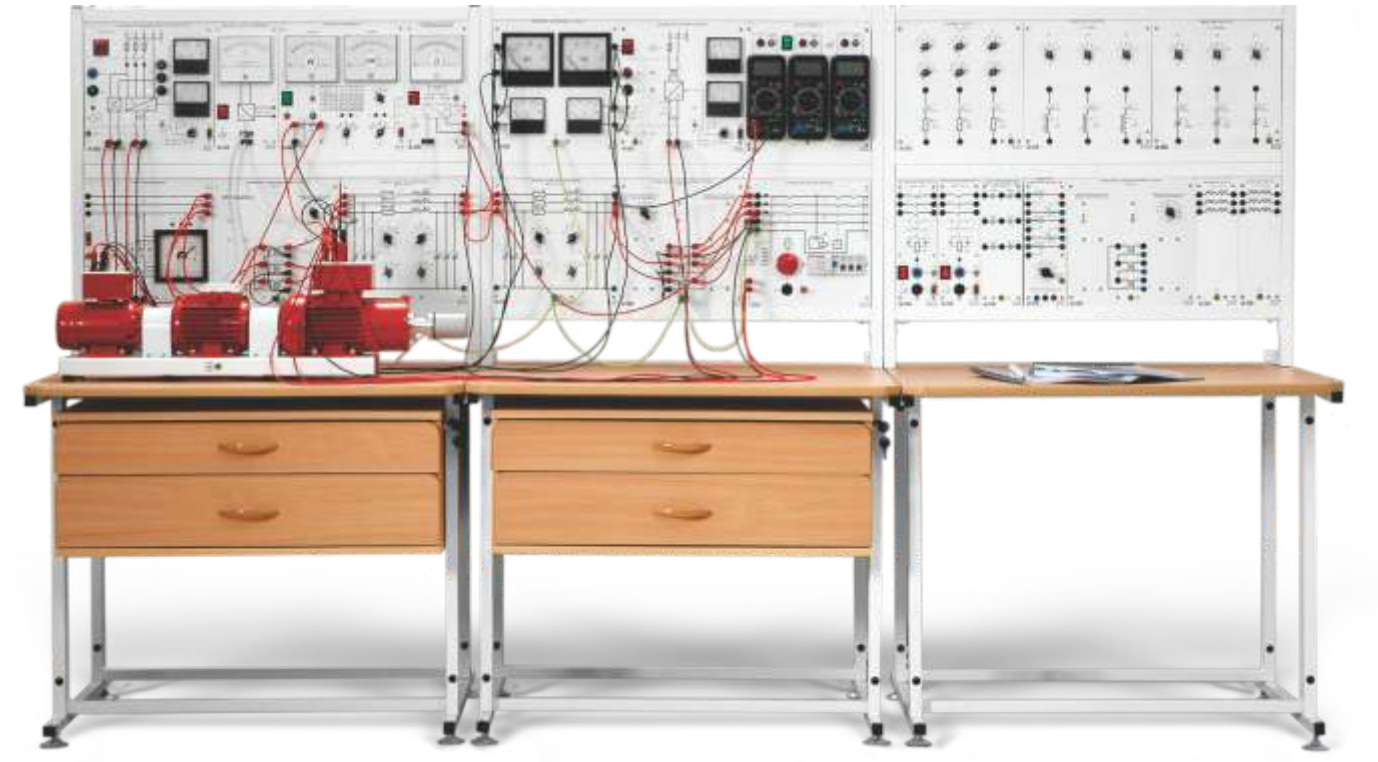
MODEL: GALSEN® ESMASGCS1

Basic Experiments:

- **Main equipment of electric power stations and substations** (Synchronous generators. Power transformers. Synchronous compensators)
- **Auxiliary needs of electric power stations and substations** (Direct-on-line / reactor start of induction motor. Self-running of induction motor)
- **Electric power systems and grid** (Steady states of electric grid elements. Steady states of electric grid. Steady states of electric power system. Voltage regulation in grid)
- **Transients in electric power systems** (Electromagnetic transients. Electromechanical transients)
- **Relay protection of electric power systems** (Protection of transmission lines. Busbar protection. Power transformer protection. Relay protection and breakers back-up. Synchronous generator protection. Generator-transformer unit protection. Induction motor protection.)
- **Automation of electric power systems normal modes** (Automatic switching-in synchronous generator in parallel. Frequency and active power automatic control. Voltage and reactive power automatic control. Automatic control of electric power system mode)
- **Emergency automation of electric power systems** (Automation of fault clearing, reclosing and back-up. Automatic stability control. Automatic asynchronous mode prevention. Automatic prevention of unacceptable changes of regime parameters)
- **Steady states of asynchronized synchronous generator in electric power system** (Idling characteristics of asynchronized synchronous generator. Switching-in asynchronized synchronous generator on parallel operation by ideal synchronization. Regulating characteristics of asynchronized synchronous generator at parallel operation)

Modules / Components:

Electromechanical unit with flywheel (induction motor, AC machine, and angular displacement transducer); Three-phase power supply; Synchronous machine exciter; Single-phase power supply; Turbine model power supply; Three-pole breaker; Terminal; Active load; Model of transmission line; Line reactor; Series capacitive compensating device; Capacitive load; Module of synchronizing Inductive load; Connector; Module of digital signals I/O; Module of diodes;Three-phase transformer group; Power meter commutater; Module of varistors; Module of current-and-voltage transformers; Module of current-and-voltage sensors; Voltage-and-frequency meter; Synchronous machine torque angle meter; Speed indicator; Power meter; Module of three multimeters; Multifunctional electrical measuring instrument; Laboratory tables; Accessories Kit; Basic Experiments Guide; Personal computer with Software



Electric Power Systems & Grid

MODEL: GALSEN® EPSGMS2

Basic Experiments:

- **Steady states of electric grid elements** (Modeling steady state of three-phase transformer. Modeling steady state of three-phase transmission line)
- **Steady states of electric grid** (Modeling steady state of an electric grid phase with single supply. Modeling steady state of an electric grid phase with duplicate supply. Modeling steady state of three-phase electric grid with single supply)
- **Steady states of electric power system** (Consumed active/reactive power effect on electric power system mode. Generated active/reactive power effect on electric power system mode)
- **Voltage regulation in grid** (Counter voltage regulation. Voltage regulation by shunt reactive power compensation using capacitor package. Voltage regulation by series reactive power compensation using capacitor package)

Modules / Components:

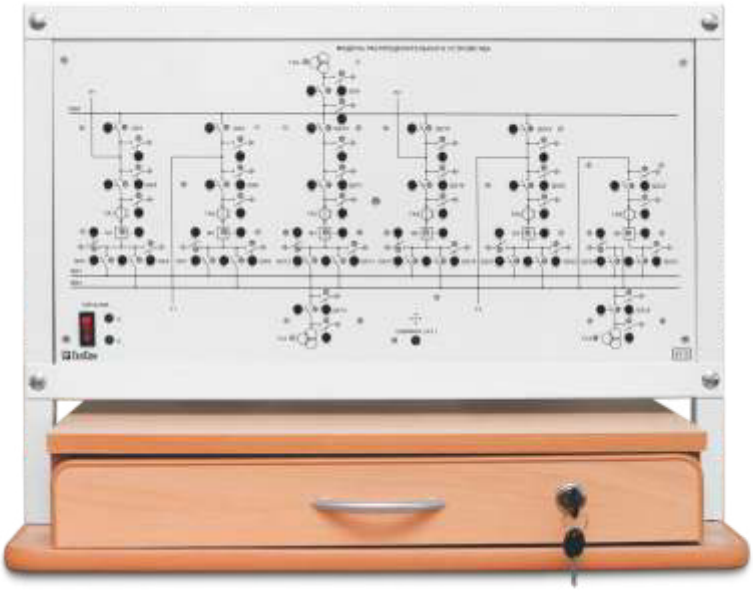
Electromechanical Unit with Flywheel (induction motor, AC machine, angular displacement transducer); 3-phase power supply; Synchronous Machine Exciter; 1-phase Power Supply; Turbine Model Power Supply; 3-pole breaker; Active Load; Transmission Line Model; Series Capacitive Compensating Device; Capacitive load; Inductive load; 3-phase transformer group; Power Meter Commutater; Speed indicator; Multifunctional Eelectrical Measuring Device; Lab tables; Accessories Kit; Experiments Guide

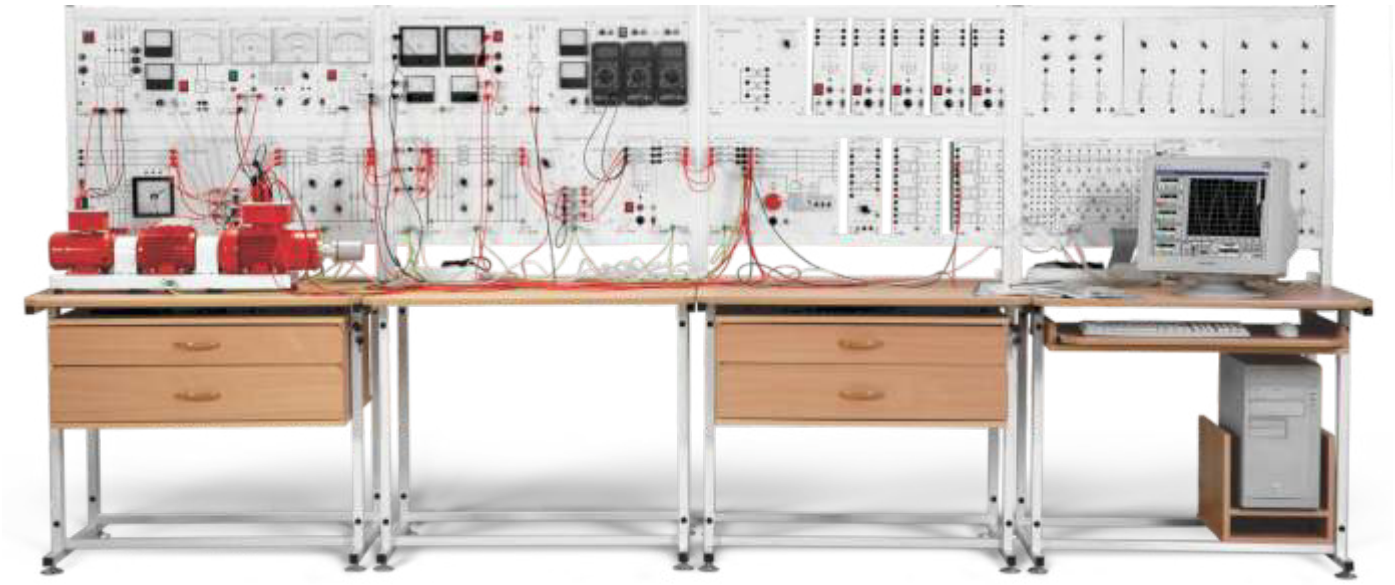
Operative Switching in Switchgears of Power Stations & Substations

MODEL: GALSEN® OSSPSSMD1

Basic Experiments:

- **Switching while connecting and disconnecting connections** (Enable/disable power line connection, connection of transformer line).
- **Switching while transferring connections from one bus system to another** (Transfer of all connections from the bus system to the backup bus system using the bus coupler, to the standby bus system without the use of a busbar switch, using a bus coupler with a fixed distribution of busbar connections)
- **Switching on withdrawal of equipment for repair and putting it back into operation**





Relay Protection and Automation of Electric Power Systems

MODEL: GALSEN® RPFEPSCS2

Basic Experiments:

Relay protection of electric power systems

- **Schemes of measuring transformers connection** (Schemes of current transformers connection.Schemes of voltage transformers connection)
- **Protection of transmission lines** (Overcurrent protection / cutoff of two transmission lines with single supply. Directional current protection of transmission lines in ring grid. Ground fault protection of grid with big ground fault current. Nonselective alarm of ground fault in grid with small ground fault current. Longitudinal differential protection of transmission line. Transverse differential protection of parallel transmission lines. Distance protection of transmission lines in grid with duplicate supply)
- **Busbar protection** (Differential protection. Current busbar cutoff. Distance busbar protection)
- **Power transformer protection** (Differential protection. Overcurrent protection. Negative phase-sequence transformer protection. Zero-sequence current transformer protection)
- **Relay protection and breakers back-up** (Circuit-breaker failure protection)
- **Synchronous generator protection** (Differential protection. Overload protection)
- **Generator-transformer unit protection** (Differential protection)
- **Induction motor protection** (Overcurrent protection. Differential protection. Low-voltage protection)

Automation of electric power systems normal modes

- **Automatic switching-in synchronous generator in parallel** (by coarse synchronization; by ideal synchronization)
- **Frequency and active power automatic control** (Autonomous electric power system frequency automatic regulation. Active power automatic control of synchronous generator working in parallel to infinite bus)
- **Voltage and reactive power automatic control** (Voltage automatic regulation by synchronous generator field changing. Voltage automatic regulation by static thyristor compensator reactive power changing)
- **Automatic control of electric power system mode** (Automatic control of autonomous single-machine electric power system mode. Automatic control of mode of single-machine electric power system operating in parallel to infinite bus)

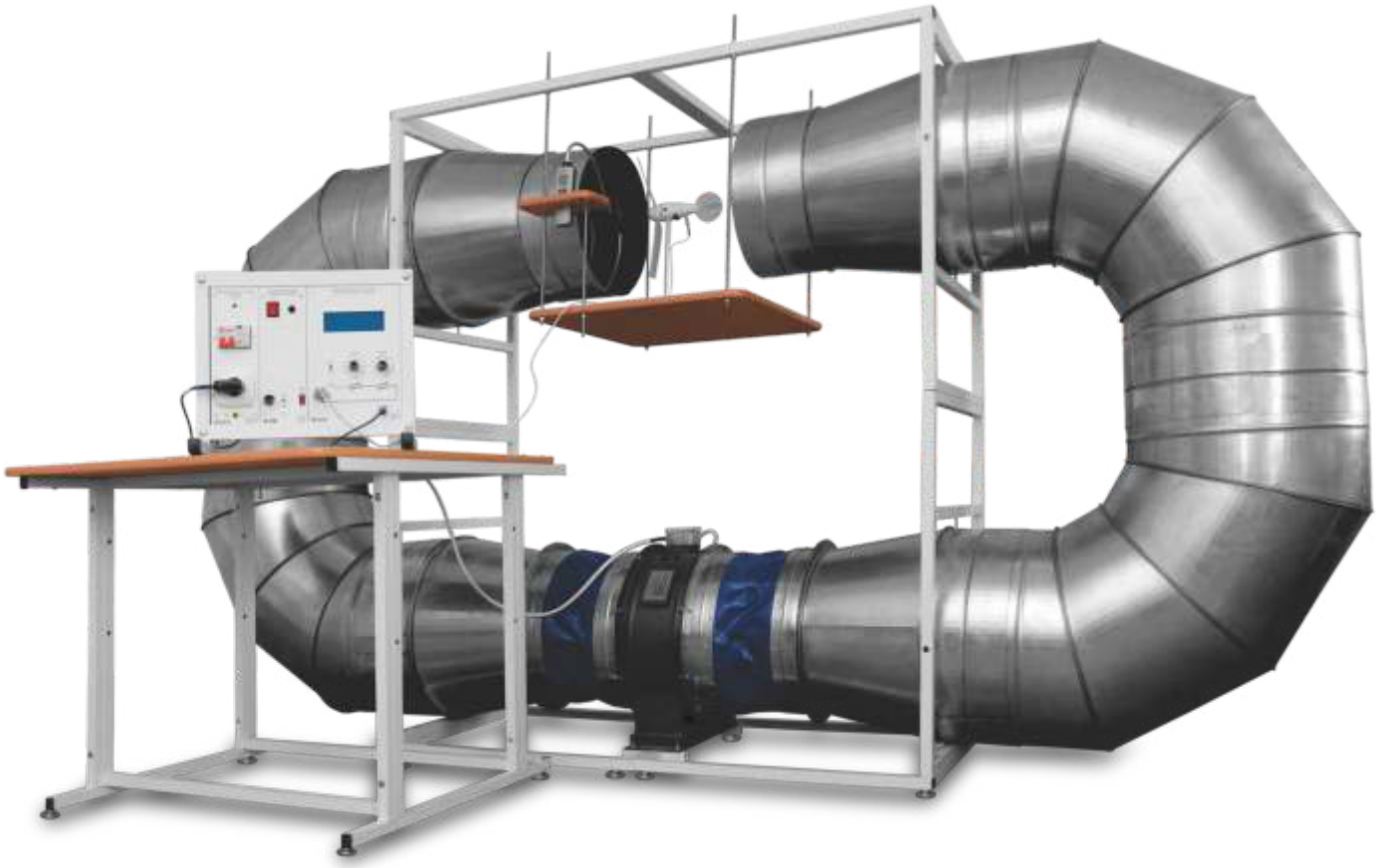
Emergency automation in electric power systems

- **Automation of fault clearing, reclosing and back-up** (Automatic fault clearing on transmission line with single supply. Automatic reclosing transmission line with single supply. Automatic reclosing transmission line with duplicate supply. Automatic switching-in step-down substation section switch)
- **Automatic stability control** (Automatic control of dynamic stability by synchronous generator field forcing, by quick short-time synchronous generator prime mover power reduction, by synchronous generator electric braking)
- **Automatic asynchronous mode prevention** (Automatic prevention of asynchronous mode caused by transmission line overload. Automatic prevention of asynchronous mode caused by synchronous generator field loss)
- **Automatic prevention of unacceptable changes of regime parameters** (Automatic voltage drop limitation by series capacitive compensation of transmission line. Automatic voltage rise limitation by shunt reactor at transmission line end. Automatic frequency drop limitation by electric power system load switching-off)

Modules / Components:

Electromechanical unit with flywheel (induction motor, AC machine, and angular displacement transducer); Electromechanical unit (electromagnetic brake, induction motor, and angular displacement transducer); Three-phase power supply; Thyrister converter/regulator; Synchronous machine exciter; DC voltage source; Single-phase power supply; Turbine model power supply; Three-pole breaker; Terminal; Active load; Model of transmission line; Line reactor; Series capacitive compensating device; Capacitive load; Module of synchronizing; Inductive load; Connector; Module of digital signals input/output; Module of diodes; Three-phase transformer group; Module of current-and-voltage transformers; Module of current-and-voltage sensors; Voltage-and-frequency meter; Synchronous machine torque angle meter; Speed indicator; Power meter; Laboratory tables; Accessories Kit; Basic Experiments Guide; Personal computer

Renewable Energy



Wind Power Plant Model in Aerodynamic Tube

MODEL: GALSEN® WPPMATM3

Basic Experiments:

- **Characteristics of synchronous generator with permanent magnets** (Readout of idling characteristics of synchronous generator. Readout of characteristics of short circuit of synchronous generator. Readout of external characteristics of synchronous generator at constant wind speed. The lifting speed characteristics of synchronous generator at a constant load resistance)
- **Characteristics of the wind turbine** (Measurement of the starting wind speed of the wind generator. Readout of power of synchronous generator and determination of the dependence of the moment of the wind turbine the rotational speed at a constant wind speed. Readout of dependence of frequency of rotation of the wind turbine from the wind speed at a constant load resistance of a synchronous generator. Read-out of synchronous generator power from wind speeds at a constant frequen-cy of rotation of the wind turbine. Read-out of dependence of frequency of rotation of the wind turbine from the wind speed at the maximum value of the po-wer synchronous generator. Readout of a maximum output power of the synchronous generator depending from wind speed. Readout of a maximum output power of the synchronous generator depending from the angle of attack of the blades of the wind turbine. Readout of a maximum output power of the synchronous generator depending on the number of blades of the wind turbine. Determination of the ratio of the maximum values of power of the synchronous generator, the respective different shapes of the profile of the blades of the wind turbine)

Modules / Components:

Single-phase Power Supply; Turbine Power Supply Model; Measurement and Load Mo-dule; Wind Tunnel; Two-level frame with container; Accessories Kit; Basic Experi-ments Guide; Wind Power Generator; Anemometer

Wind Power Plant Model

MODEL: GALSEN® WPPMCS3

Basic Experiments:

- Checking the wind turbine integrity.
- Readout of voltage, current, power and speed of wind turbines depending on the wind speed.
- Simulation of autonomous mode of wind power plant.
- Determination of amount of electrical energy produced during the experiment (which can be generated for a month, or a year) of a wind power plant with a priori defined mean wind speed and the shape parameter of the distribution function of wind speed.

Modules / Components:

Wind Power Generator Module
Single-phase Power Supply
Rechargeable Battery Module
Electrical Load
Wind Power Generator Terminal
Laboratory Table
Accessories Kit
Basic Experiments Guide
Notebook

PV Solar Power Plant Model

MODEL: GALSEN® PVSPPMCD3

Basic Experiments:

- **PV Module Characteristics** (Finding volt-ampere characteristic, energy characteristics, dependence of short circuit current from irradiance, dependence of short circuit current from angle of light rays inclination toward surface of PV module, dependence of short circuit current from the temperature of PV module, dependence of open-circuit voltage from the temperature of PV module, dependence of maximum power from the PV module temperature)
- **Autonomous PV Solar Power Plant Model** (Finding time dependence of PV module output power during 24 hours any given day of the year. Finding electric energy, which PV module can produce of specified nominal power within a given day and within an year, broken down by month. Comparison of electric energy amounts generated within a day and a year when PV module is installed at two different geographical latitudes. Comparison of electric energy amounts generated by PV module daily and yearly when its plane is installed with two different azimuths. Comparison of electric energy amounts produced by PV module daily and yearly when its plane is installed at two different inclination angles to horizon. Comparison of electric energy amounts generated daily and yearly when photovoltaic module is mounted stationary on single- and two-coordinate tracker.

Modules / Components:

Active Load; Charge-discharge Controller; PV Module; Light Source; PV Module Terminal; Two Multimeters Module; Two-level Frame with Container; Accessories Kit; Basic Experiments Guide; Notebook with Software

Comparison of electric energy amounts generated by of PV module daily and yearly when loading it on constant resistor and loading on battery and constant resistor through controller with maximum power demand function. Finding operating characteristics of rechargeable battery controller with maximum power demand function. Simulation of modes of autonomous PV solar power plant)

Heat Pump

MODEL: GALSEN® HPCS1

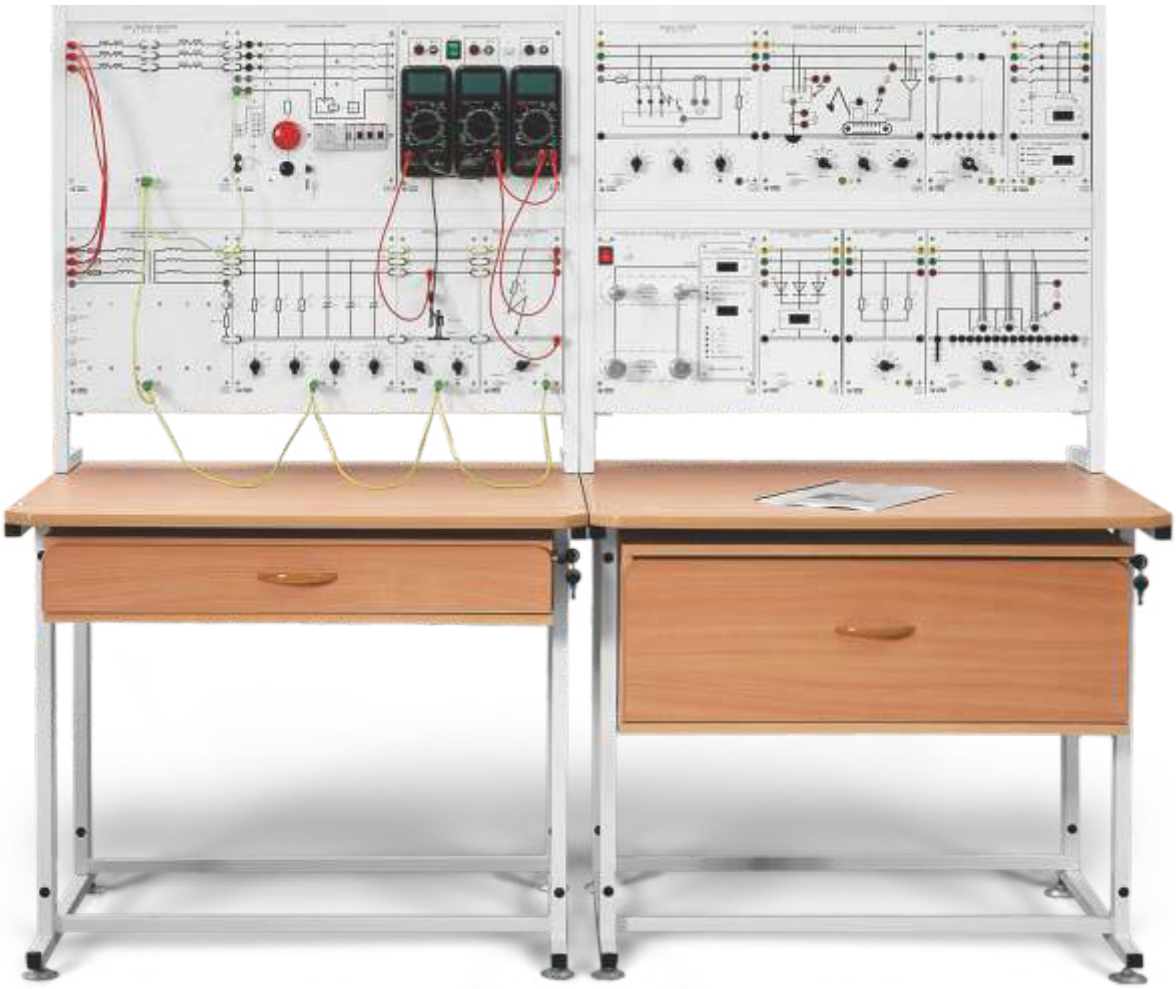
Basic Experiments:

- Heat pump operating parameters (coolant temperature and pressure in different points, electrical energy consumed, output thermal energy, conversion factor)
- Heat pump conversion factor VS medium temperature of low-level heat source
- Heat pump conversion factor VS medium temperature of high-level heat source
- Heat pump productivity control
- Measurement, determination and display of heat pump operating parameters by computer

Modules / Components:

Water Source Model (Water Tank, Stand)
Heat Pump Module
Accessories Kit
Basic Experiments Guide
Notebook With Software

Electric Safety



Electric Safety Fundamentals

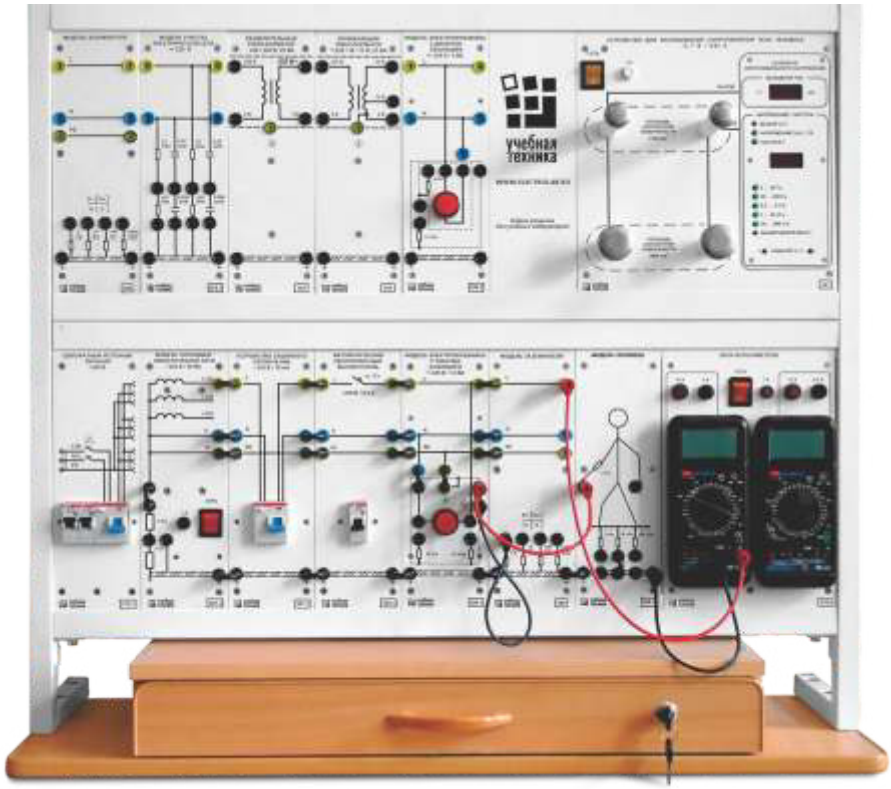
MODEL: GALSEN® ESFMS1

Basic Experiments:

- **Factors determining conditions of electrical safety** (Study of shoes and floor resistance influence on the electric safety conditions; Study of neutral mode influence on electric safety conditions; Study of electric network parameters (insulation resistance and capacity admittance) influence on the electric safety conditions; Study of the ground fault resistance influence on electric safety conditions in network with isolated neutral)
- **Phenomena of leaking current into ground through protective earthing electrode**
- **Electrical resistance of human body**
- **Simulation of protective neutral earthing of electrical equipment**
- **Isolation control in electric network with isolated neutral** (Isolation control using method of 3 voltmeters; Isolation control by means of specialized device)
- **Measurement of grounding resistance by ampermeter and voltmeter for 4 different types of earth**
- **Simulation of protective grounding / autogrounding of electrical equipment** (Performance of cutout device in electric network; Performance of cutout device in electric network with dead grounded neutral; Performance of cutout device in electric network with isolated neutral)

Modules / Components:

Three-phase Power Supply; Single-phase Power Supply; Three-phase Transformer; Electric Network Section Model; Human Being Simulator; Ground Fault Model; Insulation Resistance Simulator; Model of Grounding Measurements Insulation Monitor; Protective Switching Device; Ground w/Hemispherical Electrode Simulator; Ground w/Vertical Tubular Electrode Simulator; Ground w/Long Tubular Electrode on Surface Simulator; Model of Protective Grounding / Autogrounding; Model of Neutral Grounding; Line Chokes Unit; Resistance of Human Body Study Device; Three Multimeters Unit; Laboratory Tables; Accessories Kit; Basic Experiments Guide



Electric Safety in Installations up to 1000V

MODEL: GALSEN® ESIMD1

Basic Experiments:

- **Effect of electric current on human being** (Determination of electric current through human body at direct touch to parts under voltage. Determination of electric current through human body at indirect touch to parts under voltage. Determination of human body resistance)
- **Measures to protect human being from electric shock** (Action of protective neutral grounding. Protective effect of automatic power-off when overcurrent. Protective effect of appliance double insulation. Operation of protective switching device. Operation of protective grounding. Protective effect of neutral protective conductor re-grounding. Protective effect of lower voltage. Protective effect of electric circuits separation. Phase insulation monitoring in grid with insulated neutral)
- **Protection from electric shock in installations with grounding TN-C and grounded installations bodies** (Confirmation of inappropriate use of protective switching devices. Confirmation of protection absence at direct human body touch to parts under voltage. Protection operating at damage of appliance system insulation, class I)
- **Protection from electric shock in installations with grounding TN-C and ground-insulated installations bodies** (Protection operating at direct human touch to parts under voltage. Protection operating at damage of appliance system insulation, class I)
- **Protection from electric shock in installations with grounding TN-S** (Protection operating at direct human touch to parts under voltage. Protection operating at damage of appliance system insulation, class I. Protection operating at mistaken joining neutral, system and protective, conductors. Protection operating at breakage of neutral protective conductor)
- **Protection from electric shock in installations with grounding TN-C-S** (Protection operating at direct human touch to parts under voltage, at damage of appliance system insulation, class I. Protection operating at wrong joining neutral, system and protective, conductors. Protection operating at breakage of neutral protective conductor)
- **Protection from electric shock in installations with grounding TT** (Protection operating at direct human touch to parts under voltage, at damage of appliance system insulation, class 01)

Modules / Components:

Single-phase Power Supply; Model Of Grid Section; Human Being Simulator; Protective Switching Device; Device For Human Body Resistance Test; Automatic Single-pole Breaker; Model Of Supply Grid; Model Of Appliance With Working Insulation; Model Of Appliance With Double Insulation; Reducing Transformer; Model Of Grounding; Insulating Transformer; Module Of Two Multimeters; Desktop Container With 2-level Frame; Accessories Kit; Basic Experiments Guide

- **Protection from electric shock in installations with grounding TI** (Protection operating at direct human touch to parts under voltage. Protection operating at damage of appliance system insulation, class 0. Protection operating at damage of appliance system insulation, class II)
- **Protection from electric shock in installations with grounding IT** (Confirmation of inappropriate use of protective switching devices. Grid insulation monitoring. Protection operating at damage of appliance system insulation, class 0)

Energy Saving

Energy Saving in Electric Lighting Systems

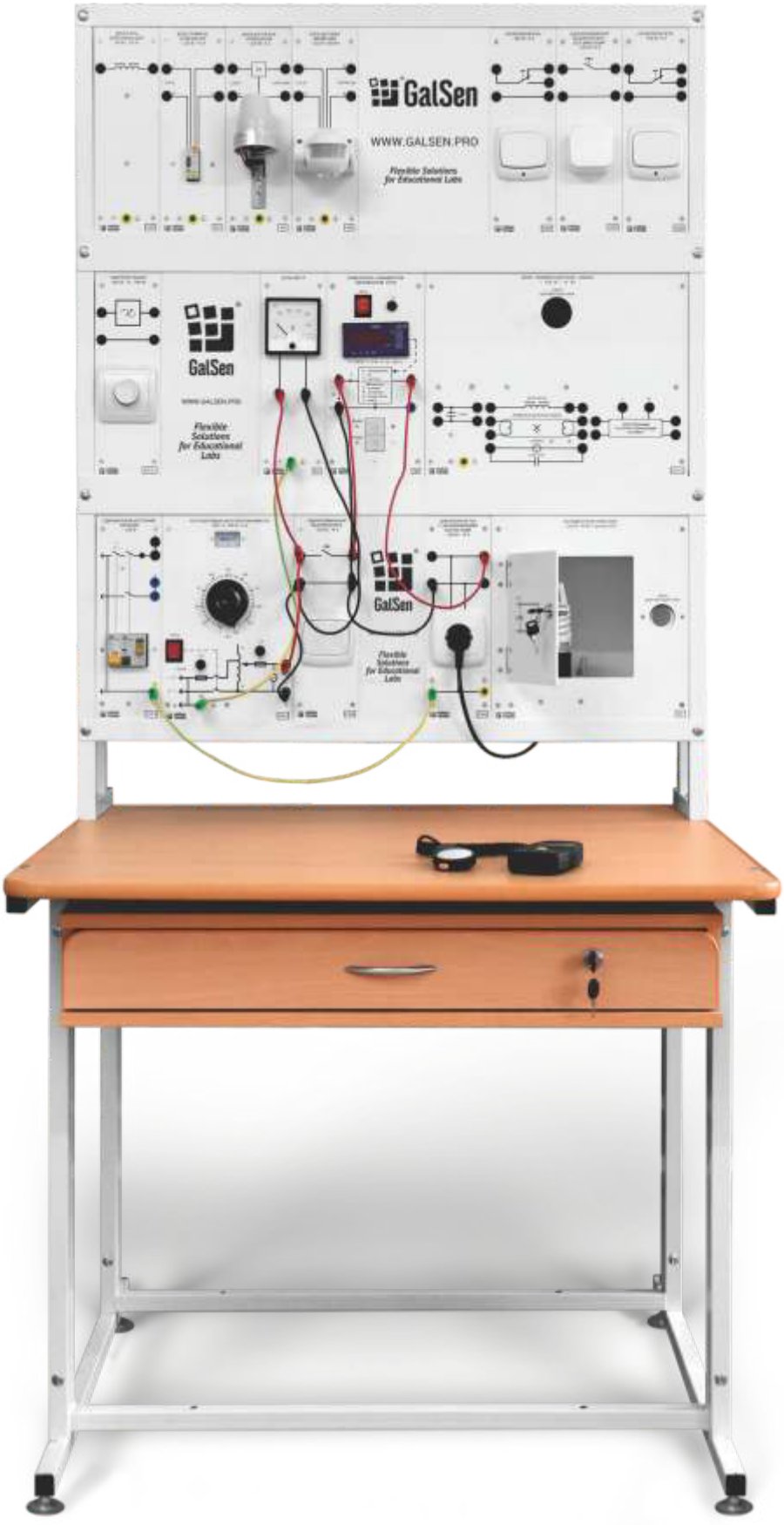
MODEL: GALSEN® ESELSMS2

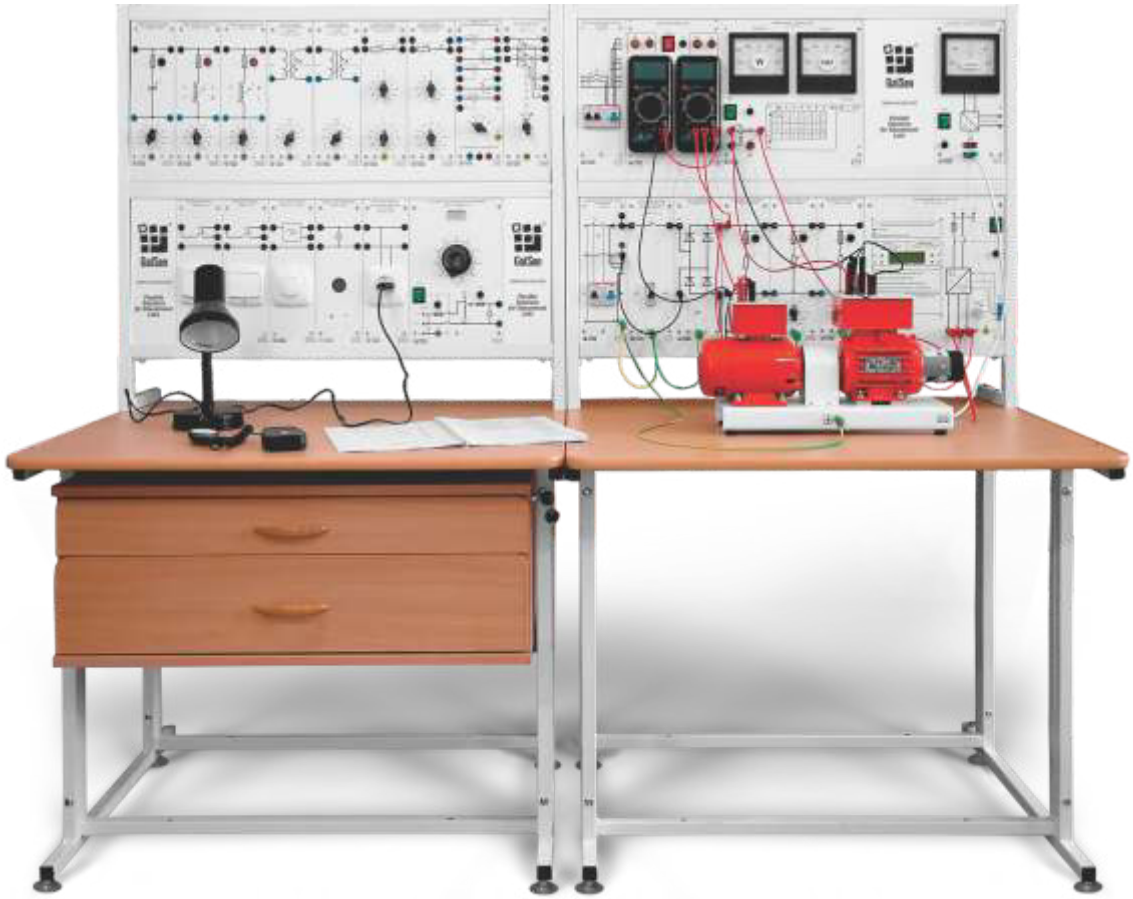
Basic Experiments:

- **Energy efficiency of light sources** (Comparison of light efficiency of halogen lamps, compact fluorescent lamps of low pressure, and LED lamps with incandescent lamps; Comparison of light efficiency of fluorescent lamps, high-pressure mercury-vapor and incandescent lamps; Comparison of light efficiency linear fluorescent lamps of low pressure from the starter and electronic control gear)
- **Devices for energy savings in electric lighting systems** (Reactive power compensation by means of capacitor in case of linear fluorescent low-pressure lamp with starter; Diminishing power consumption by means of electric lighting zonal off; Diminishing power consumption by means of light intensity regulation; Diminishing power consumption by means of on/off lighting by motion sensor; Diminishing power consumption by means of on/off lighting by photo relay; Diminishing power consumption by means of on/off lighting by timer)

Modules / Components:

Single-phase Power Supply
Adjustable Autotransformer
Rocker Switch
Switch Plug with Earthing Contacts
Dimmer
Fluorescent Lamp Unit
Mercury-Vapor Lamp Choke
Rocker Switch (non-fixing)
Motion Sensor Unit
Photocell Lighting Unit
Lighting Timer Unit
Voltmeter
Photometric Unit
Single-phase Network Parameters Meter
Laboratory Table with 3-Level Frame
Illuminometer
Acessories Kit
Basic Experiments Guide





Energy Saving in Power Supply Systems and Electricity Consumption Systems

MODEL: GALSEN® ESPSSECSMD1

Basic Experiments:

- **Energy Saving Indicators** (Transformer efficiency. The specific active power losses in transmission line. Induction motor efficiency. Light output of incandescent lamp (low pressure compact fluorescent lamp, LED lamp).
- **Technical means of energy saving in electric power systems** (Reduction of active power losses in distribution network with unilateral supply by compensating load reactive power. Reduction of active power losses in distribution network with dual supply by voltage control. Reduction of active power losses in distribution network with dual supply by implementing cut therein. Ensuring high efficiency of low loaded transformer by switching off parallel working transformer)
- **Technical means of energy saving in electricity consumption systems** (Ensuring high efficiency and power factor of low loaded induction motor by switching stator winding from "delta" to "star". Reducing electric power consumed by induction motor of pump or ventilation system by replacing fluid flow throttle control by frequency speed control. Reducing specific energy consumption of electric lighting system by replacing incandescent lamp by fluorescent or LED lamps. Reducing lighting power consumption by zonal lighting switching off. Reducing lighting power consumption by light intensity regulating. Reducing lighting power consumption by light on / off with motion sensor. Reducing lighting power consumption by light on / off with photorelay. Reducing lighting power consumption by light on / off with timer)

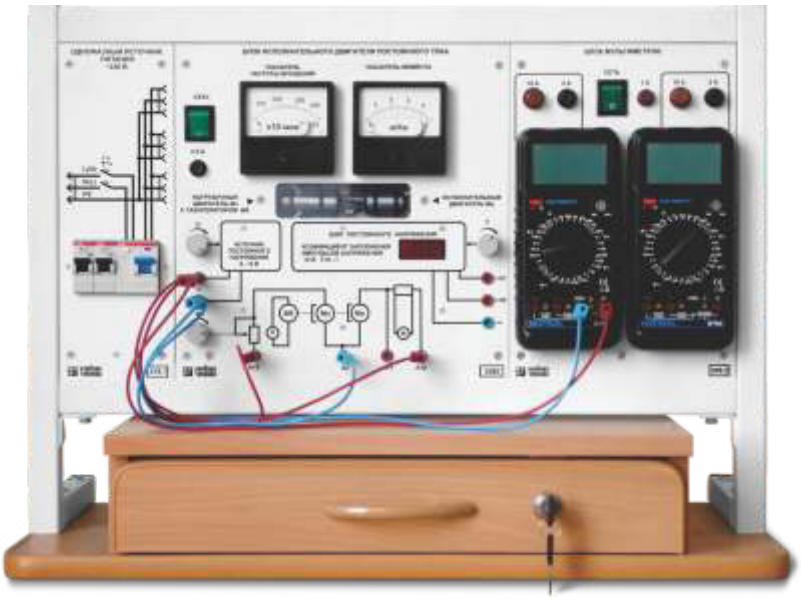
Modules / Components:

Electromechanical Unit (DC Machine, Induction Motor And Angle-to-digit Converter); Frequency Converter; Single-phase Power Supply; Active Load; Transmission Line Model; Capacitive Load; Adjustable Autotransformer; Rectifier; Inductive Load; Power Meter Commutator; Automatic Single-pole Switch; Single-phase Transformer; One-button Switch Switch; Electric Socket With Grounding Contacts; Incandescent Lamp; Dimmer Switch Y/A; One-button Switch Without Fixing; Motion Sensor Module; Lighting Photorelay Module; Lighting Timer Module Speed Indicator; Power Meter; Two-Multimeters Module; Photometric Module; Two-level Frame With Container; Luxmeter; Accessories Kit; Basic Experiments Guide

Mechatronics Elements

Actuating DC Motor

MODEL: GALSEN® ADCMMD1



Basic Experiments:

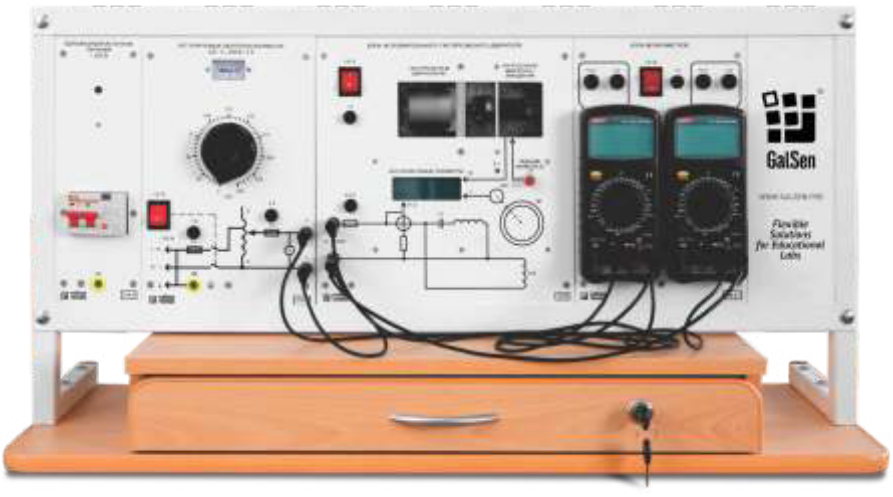
- **Actuating DC motor with armature control** (Readout of mechanical and control characteristics; Determining characteristics of mechanical power)
- **Actuating DC motor with pulse control** (Readout of mechanical and control characteristics; Determining characteristics of mechanical power)

Modules / Components:

Single-phase Power Supply; Actuating DC Motor Unit; Two Multimeters Unit; Desktop Containter with 1-Level Frame; Accessories Kit; Basic Experiments Guide

Actuating Hysteresis Motor

MODEL: GALSEN® AHMMD1



Basic Experiments:

- External characteristics of the motor
- Operating characteristics of the motor

Modules / Components:

Single-phase Power Supply; Adjustable Autotransformer; Module Of Actuating Hysteresis Motor; 2 Multimeters; Desktop Container Accessories Kit; Basic Experiments Guide

Actuating Brushless DC Motor

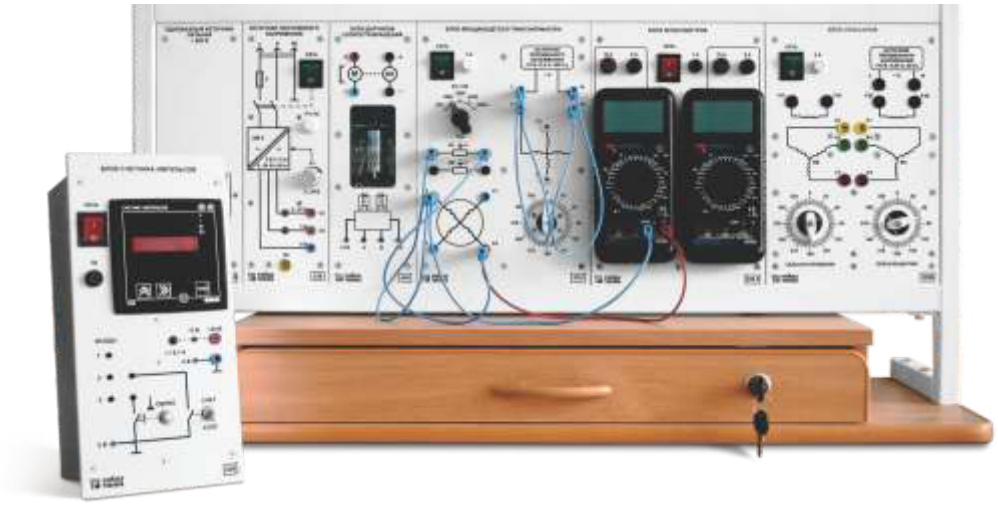
MODEL: GALSEN® ABDCMCD1

Basic Experiments:

- Operating parameters of the motor with Hall sensors
- External characteristic and regulating characteristic of the motor with Hall sensors.
- Determination of switching sequence of the motor switches
- Operating parameters of the motor w/o Hall sensors
- External characteristic of the motor w/o Hall sensors

Modules / Components:

Single-phase Power Supply; Module Of Actuating Brushless Dc Motor; Desktop Container With 1-level Frame; Basic Experiments Guide; Accessories Kit; USB Oscilloscope; Notebook With Software



Informational Electric Machines

MODEL: GALSEN® IEMMD1

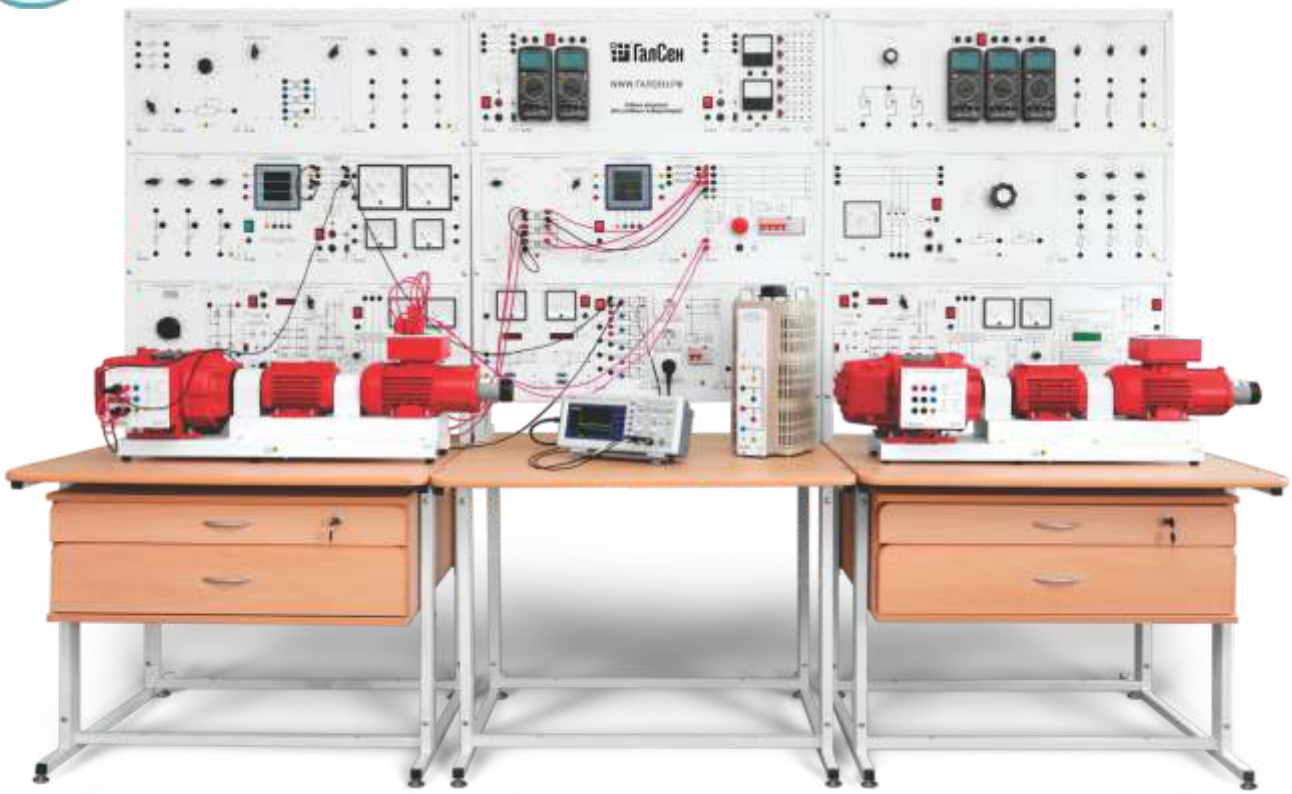
Basic Experiments:

- Operation of sine-cosine rotary transformer in sine mode, in sine-cosine mode, in linear mode
- Operation of selsyns in indicator mode, in transformer mode
- Adjusting digital speed sensor (optical encoder)
- Readout of DC tachogenerator output voltage vs speed curve and determination of its output characteristics slope

Modules / Components:

Single-phase Power Supply; DC voltage Power Supply; Selsyns Unit; Rotary Transformers Unit; Speed Sensors Unit; Pulse Counter Unit; Two Multimeters Unit; Desktop Containter with 1-Level Frame; Accessories Kit; Basic Experiments Guide

Marine Electrical Equipment



Marine Vessel Electric Machines

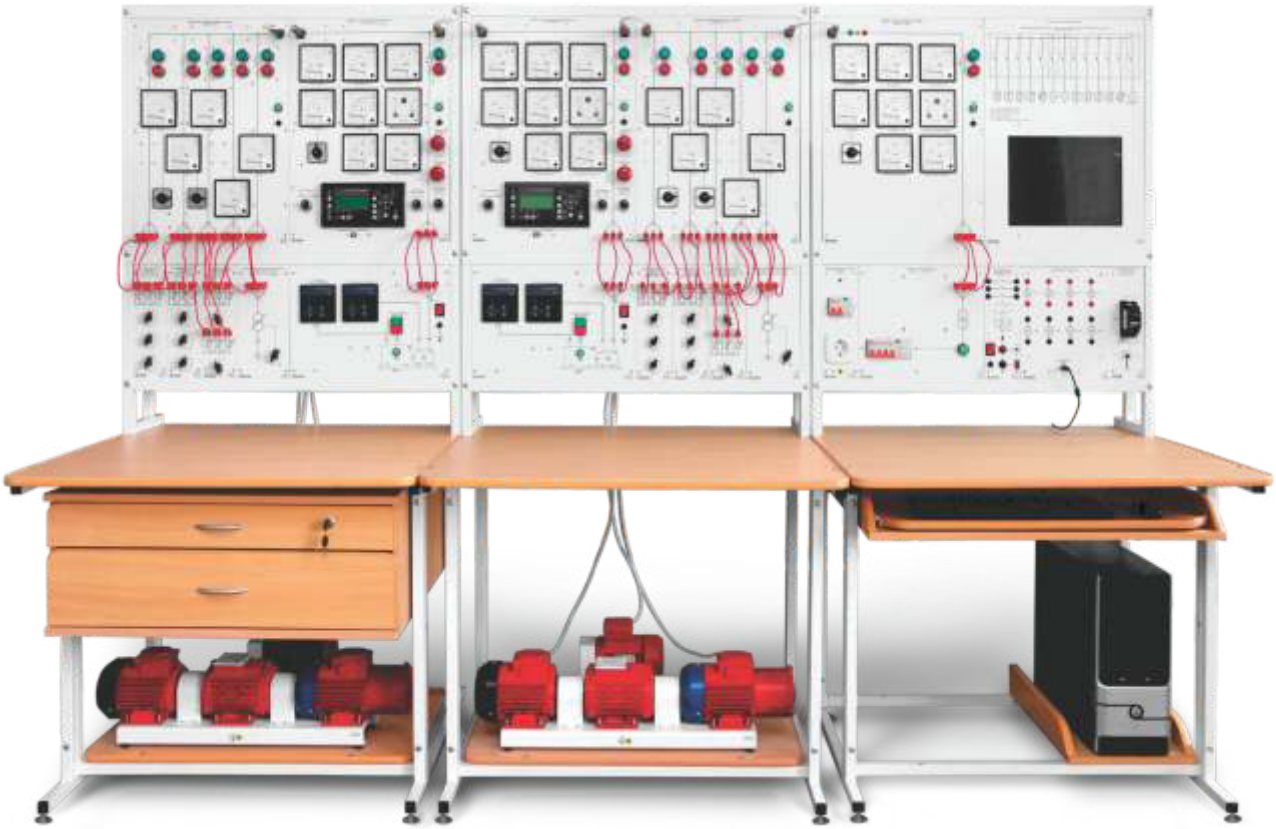
MODEL: GALSEN® MVEMMS1

Basic Experiments:

- **Single-phase transformer** (Determination of transformer ratio. Readout of idling characteristics, short-circuit characteristics, external and performance characteristics of the transformer with active load. Determination of equalizing current caused by the inequality of transformation coefficients of parallel-connected single-phase transformers. Determinati-on of the unbalance of the currents of parallel-connected single-phase transfor-mers caused by the inequality of their short-circuit voltages)
- **Single-phase autotransformer** (Determination of the coefficient of transformation. Readout of the external characteristic of the autotransformer with active load)
- **Three-phase transformer** (Readout of idling characteristics, short-circuit characteristics. Checking the group of winding connections of a three-phase transformer. Confirmation of inadmissibility of parallel operation of three-phase transformers with different groups of winding connections)
- **DC current generators** (Readout of characteristics of the generator with independent excitation: idling characte-ristics, short-circuit, external, adjustment, load characteristics. Determination of the effect of resistance of excitation circuit of the generator with parallel excitation on the possibility of self-excitation. Determination of the effect of rotational speed of the generator with parallel excitation on the possibility of its self-excitation. Readout of external characteristics of the generator with parallel excitation. Readout of external, adjustment, load characteristics of the generator with mixed excitation)
- **Parallel operation of DC generators** (with parallel or mixed excitation)
- **DC motors** (Readout of characteristics of with independent / parallel / series / mixed excitation. Determination of the motor performance. Regulation of the motor speed)
- **Three-phase asynchronous generator with squirrel-cage rotor, with phase rotor** (Readout of the characteristics of the generator during its autonomous operation: idling characteristic, external, load, power characteristics)
- **Three-phase asynchronous motor with squirrel-cage rotor, wirh phase rotor** (Readout of characteristics. Determination of performance. Regulation of speed)
- **Synchronous generator. Synchronous motor**
- **Transients in electric machines**

Modules / Components:

Frequency converter; Single-phase power supply; Three-pole switch (3); The rheostat for the rotor circuit of an AC machine; Rheostat excitation of DC machine (2); Linear reactor; Capacitive load; Adjustable autotra-nsformer; Rectifier; Rheostat; Inductive load; Three-phase transformer group (2); Three-phase adjustable autotransformer; Voltage and frequency meter; Multimeter block (3 multimeters); Voltammeter; Multifunctional electrical measuring device (2); Lab tables; Terminal; Module of current and voltage sensors; Multimeters module (2 multime-ters); Active load (2); Indicator of the load angle of the synchronous machine; Speed indicator; Three-phase power supply; Synchronization module; Synchronous machine excitation unit (2); Capacitors module; Electromachine unit with flywheel (with DC machine, AC machine and angular displacement transducer) (2); Digital oscilloscope; Single-phase thyristor converter (2); Accessories Kit



Marine Vessel Power Station Trainer (with two diesel-generators)

MODEL: GALSEN® MVPSTCS1

Basic Experiments:

- **Simulation of ship power plant modes** (Continuous supply of the main switch-board (MSB) busbars by one or both diesel-generators. Continuous supply of the main switchboard (MSB) busbars by one or both diesel-generators with active and reactive power distribution between generators. Short-term parallel operation of one or two diesel-generators with shore network at a time of load transfer to shore network and back. Continuous supply of the main switchboard (MSB) busbars from shore power feeder)
- **Generator protection testing** (Against: generator reverse power, generator over- and undervoltage, generator over- and underfrequency, generator overpower, generator overload (total current, including voltage-dependent operation curve), gene-rator unbalanced currents and voltages, generator over- and underexcitation, busbar over- and undervoltage, short-circuit)
- **Diesel-generator control** (Selection of generator control mode: manual or automatic. Manual or automatic generator start-up with above-synchronous speed crossing. Manual or automatic generator shut-down. Manual or automatic generator frequency and voltage control. Manual or automatic generator ideal synchronizing to busbars. Active and reactive power distribution during parallel operation with other generator. Smooth generator unloading before generator circuit breaker turning-off when regular (non-emergency) stop)
- **Ship power plant automatic control** (Automatic priority selection for each diesel-generator, which provides uniform yield of all diesel-generators service life. Blocking all functions of complex power plant control when circuit-breaker from the shore is on, and other experiments)
- **Ship power plant semi-automatic control** (Initiating operations: generators start / stop, connect to or disconnect from busbars by pressing appropriate buttons on controller displays or with control panel of digital interface).
- **Ship power plant manual control** (Providing operations: generators start / stop, connect to or disconnect from busbars using means of manual controls of main switchboard)
- **Monitoring and recording ship power plant modes electrical parameters** (Monitoring voltages, currents, frequency, active and reactive power using panel-mounted meters. Monitoring voltages, currents, frequency, active and reactive power using controllers. Monitoring voltages, currents, frequency, active and reactive power using computer)

Modules / Components:

Diesel-generator model (2), Induction motor (2) Single-phase power supply, Shore power network model, Three-pole breaker, Active load of powerful consumers (4), Active loads of irresponsible consumers module (2), Interface converter USB/RS-485, Diesel-generator sections models, Distribution sections models, Induction load regulation module (2), Shore supply section model, Data acquisition module, Lab tables, Accessories Kit, Basic Experiments Guide, Computer system unit

Electric Installation Work

Altivar Frequency Converter Adjustment

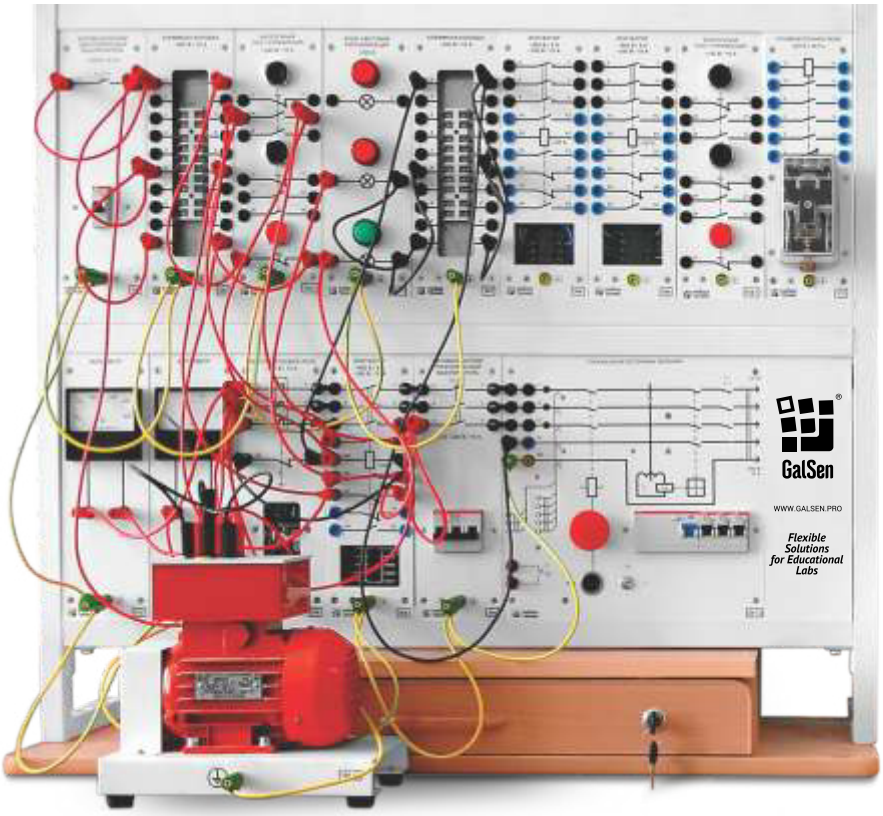
MODEL: GALSEN® AFCAMS1

Basic Experiments:

- **Introduction to frequency converter** (Programming frequency converter. Switching on frequency converter and setting factory default values. Preparing frequency converter to work)
- **Adjustment of an open system of electric drive "Frequency converter - induction motor"** (Determining electric drive coordinates static dependencies from induction motor shaft torque. Determining electric drive coordinates static dependencies from converter control voltage. Plotting electric drive power diagram)
- **Adjustment of electric drive "Frequency converter - induction motor" in compensation mode** (Determining electric drive coordinates static dependencies from induction motor shaft torque in slip compensation mode. Determining electric drive coordinates static dependencies from induction motor shaft torque in IR-compensation mode. Plotting electric drive power diagrams at different compensation mode)
- **Reproducing braking methods in electric drive "Frequency converter - induction motor"** (Braking with timed ramp. Rapid breaking. Braking a freewheel. Dynamic breaking)
- **Adjustment of an open system of electric drive "Frequency converter - induction motor" in energy saving mode** (Determining electric drive coordinates static dependencies from induction motor shaft torque in energy saving mode. Plotting electric drive power diagram in energy saving mode)
- **Adjustment of a closed system of electric drive "Frequency converter - induction motor"** (Preparing frequency converter. Setting speed loop proportional controller. Determining electric drive coordinates static dependencies from induction motor shaft torque since using proportional-plus-integral controller. Plotting closed type electric drive power diagram)

Modules / Components:

Electromechanical Unit with Flywheel (DC Machine, AC Machine and Angle-to-Digit Converter)
DC Voltage Power Supply
Frequency Converter
Single-phase Power Supply
Speed Indicator
Laboratory Table
Basic Experiments Guide
Accessories Kit
Two-Channel Oscilloscope



Magnetic Starter Wiring and Adjustment

MODEL: GALSEN® MSWAMD1

Basic Experiments:

- Assembling and checking induction motor control circuit providing its direct start (non-reversing magnetic starter circuit)
- Assembling and checking induction motor control circuit providing its direct start and reverse (reversing magnetic starter circuit)
- Adjusting and checking induction motor thermal protection based on electrothermal relay (non-reversing magnetic starter circuit with electrothermal relay
- Assembling and checking induction motor overcurrent protection based on automatic switch

Modules / Components:

Induction Motor
Three-phase Power Supply
Push-button Control Station
Light Signaling Module
Electrothermal Relay
Automatic Single-pole Switch
Automatic Three-pole Switch
Terminal Board
Contactor
Voltmeter
Ammeter
Desktop Container with 2-Level Frame
Basic Experiments Guide
Accessories Kit

Open & Buried Wiring Technology

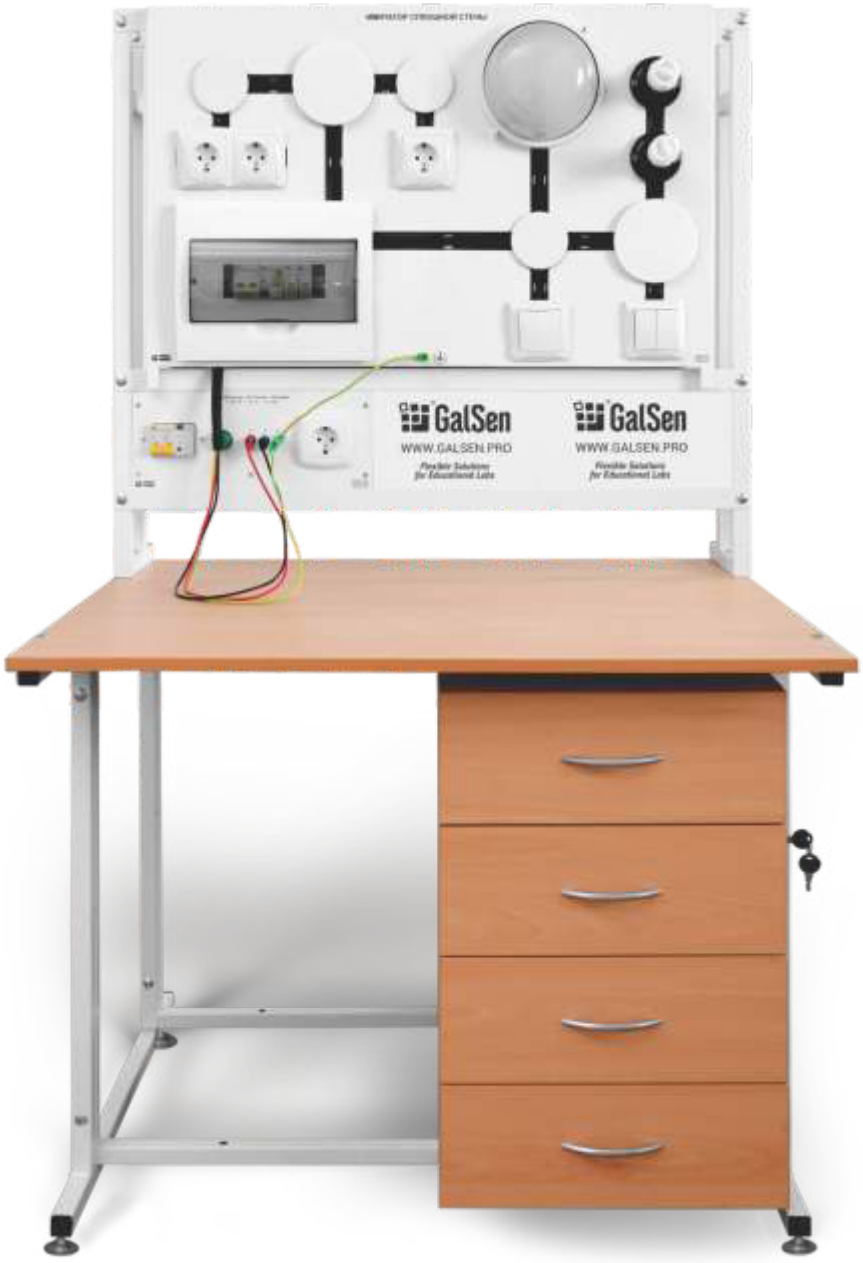
MODEL: GALSEN® OBWTMS1

Basic Experiments:

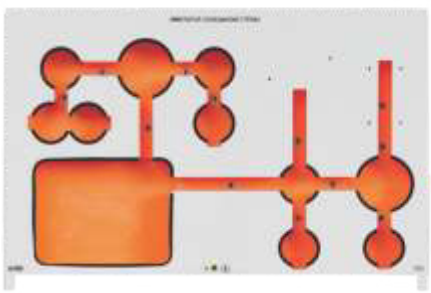
- **Technology of open wiring** (Open wiring of group electric two-wire lighting and sockets network. Open wiring of group electric two-wire lighting and sockets network with TN-C-S type of grounding)
- **Technology of buried wiring** (Buried wiring in solid wall of group two-wire electric lighting and sockets network. Buried wiring in solid wall of group two-wire electric lighting and sockets network with TN-C-S grounding. Buried wiring in hollow wall of group two-wire electric lighting and sockets network. Buried wiring in hollow wall of group two-wire electric lighting and sockets network with TN-C-S type of grounding)

Modules / Components:

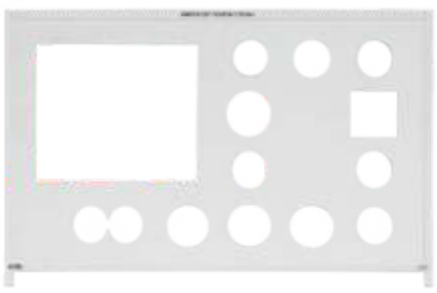
Single-phase Power Supply
Wiring Panel (Board)
Imitator of Hollow Wall
Imitator of Solid Wall
Laboratory Table
Accessories Kit
Basic Experiments Guide
Multimeter
Optional Open and Buried Wiring Components Set (wires, sockets, switches, lamps, etc)



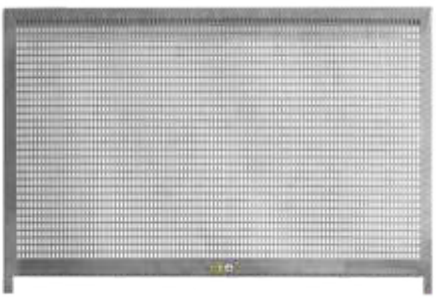
Solid Wall Imitator



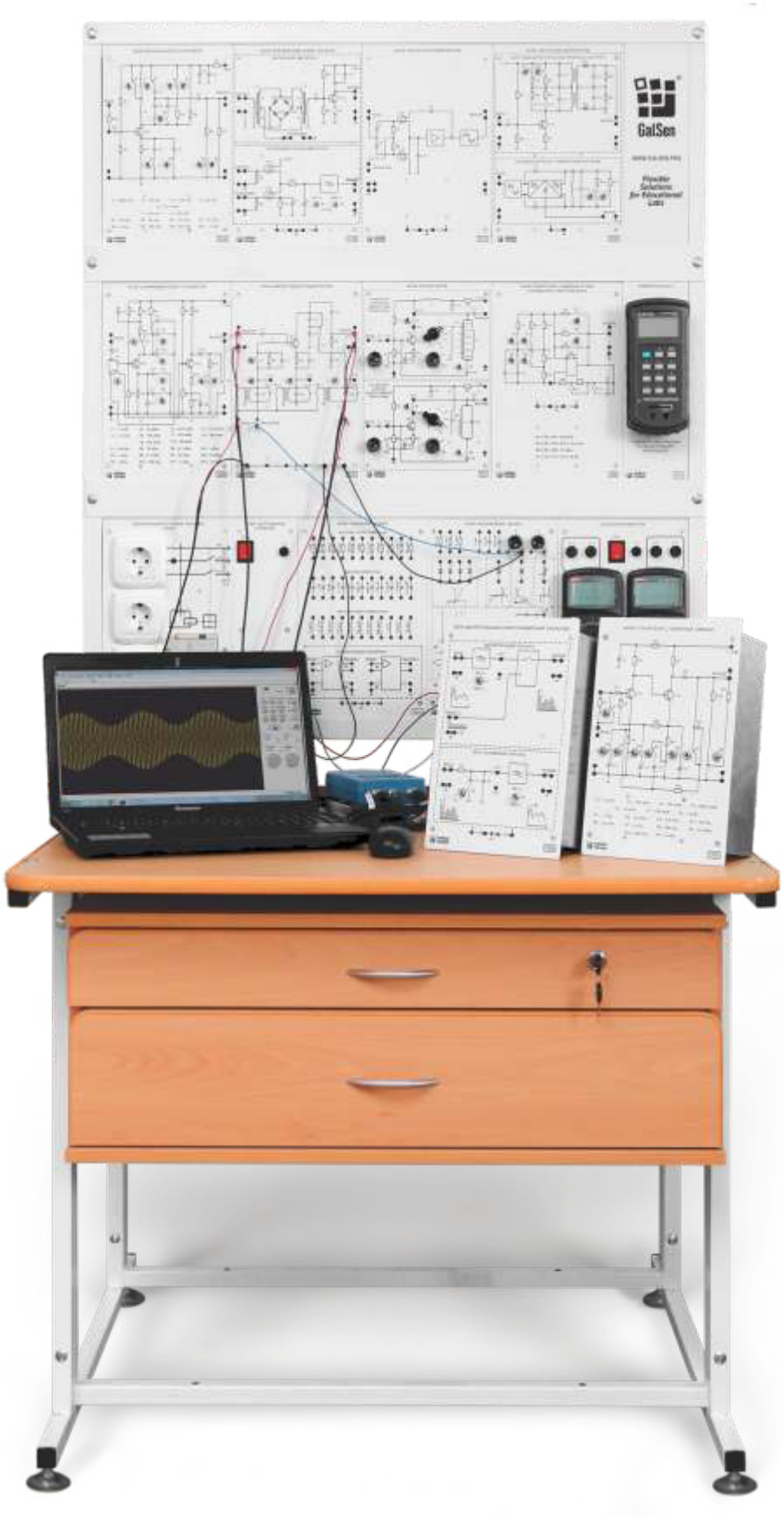
Hollow Wall Imitator



Wiring Panel (Board)



Radio Engineering



Radio Circuits & Signals

MODEL: GALSEN® RCSCS2

Basic Experiments:

- Linear circuits of first order
- Linear circuits of second order
- Frequency characteristics of linear circuits
- Nonlinear circuits
- Transistor resistive amplifier
- Amplifier with feedback
- Generators of oscillators
- Study of oscillator with Wien bridge
- Amplitude modulator
- Study of frequency modulator
- Frequency detector
- Resonance amplifier of high frequency
- Quantization of signals and their synthesis on discrete samples
- Frequency conversion

Modules / Components:

Single-phase Power Supply
Power Supply Unit
Generator Unit Based on Oscillator
Harmonic Oscillations with
Wien Bridge Generator
Aperiodic Amplifier Unit
Feedback Amplifier Unit
Resonance Amplifier Unit
Linear Circuits Unit
Nonlinear Circuits Unit
Signal Sampling and Reconstruction Unit
Frequency Converters Unit
Frequency Detectors Unit
Amplitude Modulator Unit
Frequency Modulator Unit
Two Multimeters Unit
R-L-C Gauge
Laboratory table
USB oscilloscope with Software
Notebook
Signal Generator
Accessories Kit
Basic Experiments Guide

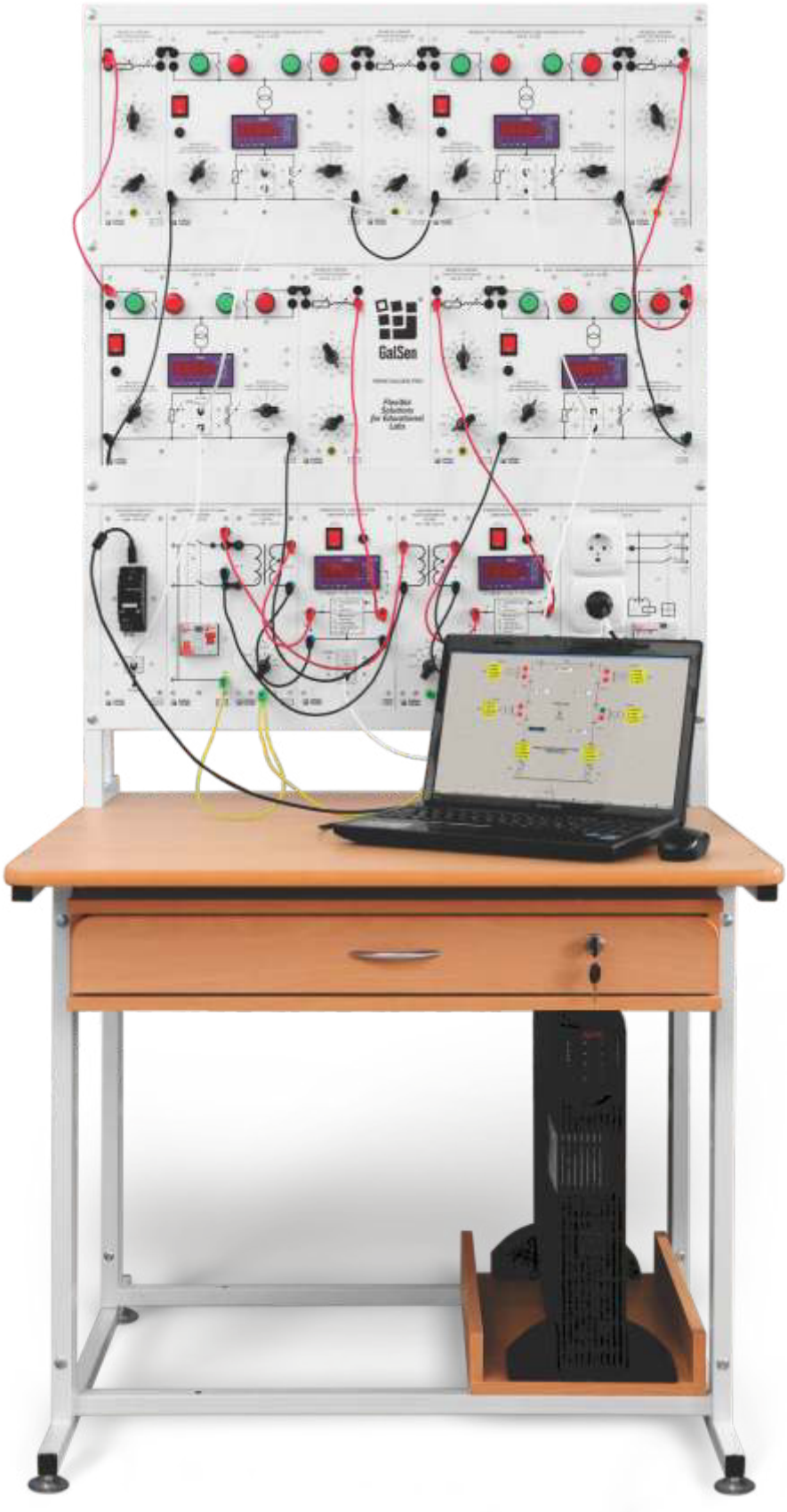
Smart Grids

Smart Electric Distribution Grid

MODEL: GALSEN® SEDGCS1

Basic Experiments:

- Detecting active power losses in local power distribution grid composed by loop scheme
- Evaluation of effect of difference in the voltages at the busbars of the power centers on loss of active power in local electric distribution grid, composed by loop scheme, when it operates in closed mode
- Evaluation of effect of rupture of local electric distribution grid, composed by loop scheme, on loss of active power
- Finding point of normal (optimal) rupture in local electric distribution grid, composed by loop scheme, according to the criterion of minimum active power losses
- Operation of local electric distribution grid, made by loop scheme, in the mode of automatic point selection of normal (optimal) rupture according to the criterion of minimum active power losses



Modules / Components:

Single-phase Power Supply
Electric Transmission Line Model
Single-phase Transformer
Transformer Substation and Load Model
Single-phase Network Parameters Meter
Laboratory Table with 3-Level Frame
Notebook
Uninterruptible Power Supply
Accessories Kit
Basic Experiments Guide
Software

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