



**Arab Academy for Science and Technology**

**College Of Engineering and Technology**



**Electrical and Control Engineering Department**

# Laboratories Catalogue

1. **Renewable Energy Systems Lab (042-A).**
2. **Electric Drives Lab (042-B).**
3. **Automation Lab (101).**
4. **Measurements Lab (103-A).**
5. **Automatic Control Lab (103-B).**
6. **Digital Control Lab (105).**
7. **Power System and Protection Lab (142).**
8. **Electrical Circuits Lab (146).**
9. **Electrical Motors Operation and Protection Lab (150-A).**
10. **Power Electronics Lab (150-B).**
11. **Electrical Machines Lab(201).**





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## Lab 042-A

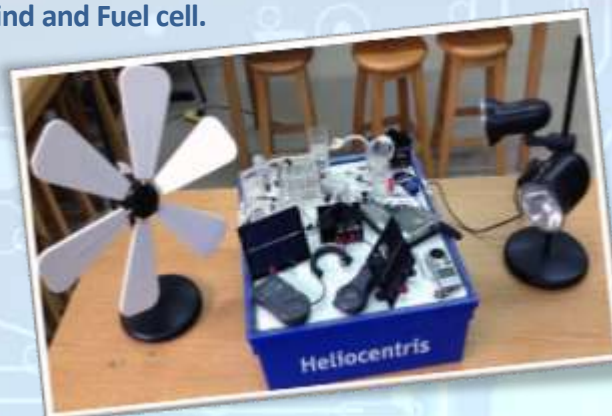
# Renewable Energy Systems

Capacity: 20 Students

It presents the essential need to prepare students with a comprehensive background in renewable energies. These lab experiments help the students understanding the main concepts regarding renewable energy, energy measurement and energy storage. The three main resources are Solar, Wind and Fuel cell.

### LABORATORY EQUIPMENTS

- Fuel Cell/ PV/ Wind Hybrid Systems.
- PV/ Fuel Cell Hybrid Systems.
- PV Trainers.
- Multimeters.
- Oscilloscopes.



### MAJOR EXPERIMENTS

- ✓ Studying the deferent Characteristics of Solar module.
- ✓ Studying the deferent Characteristics of Fuel Cells.
- ✓ Studying the deferent Characteristics of Wind generator.
- ✓ Production of hydrogen from Renewable energy sources.
- ✓ Optimal adaptation of Renewable energy sources.
- ✓ MPPT using clean trainer software.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
NE467	Management of Energy Resources	9,10





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# Lab 042-B

## Electric Drives

Capacity: 20 Students



The electrical drives laboratory offers a great chance for undergraduate as well as postgraduate students to experience and be familiar with conventional electrical drives systems as well as modern advanced drives systems by experimenting AC and DC machine drive systems.



### LABORATORY EQUIPMENTS

- Repulsion start motor with MGB-100-DG.
- Injection Brake with HPT-100.
- Variable Frequency Driver.
- Data Acquisition Motor Interface.
- Universal Laboratory Machine.
- Four Quadrant DC speed Controller.
- Stepper Motor.
- Vector Drive System.
- AC and DC Power supply.
- Series Field Rheostat.
- Dynamometer.
- Digital-Load Cell.
- Digital Taco generator.
- AC Taco generator.
- DC Taco generator.
- LabView Software.



### MAJOR EXPERIMENTS

- ✓ Four-Quadrant DC Speed Controller.
- ✓ Stepper Motor Operation and Characteristics.
- ✓ AC Vector Drive operation and programming.
- ✓ Variable Frequency AC Motor Drive operation.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE424	Electrical Drives 1	8
EE522	Electrical Drives 2	9
EE521	Special Electrical Machines	9



## Lab 101

### Automation

Capacity: 20 Students

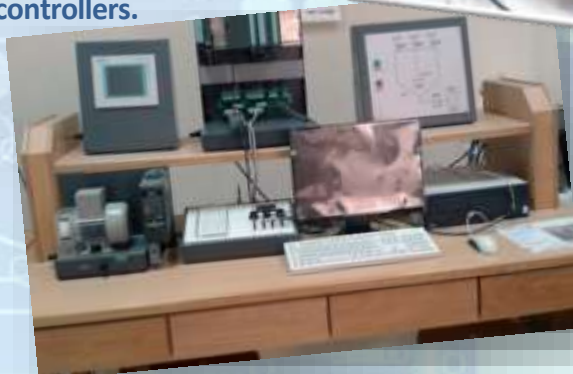


The automation laboratory offers great opportunity to understand the industrial automation systems using high-tech programmable logic controller kits of Siemens available in the market. The laboratory contains most of the equipment required in industrial applications such as pressure, temperature sensors, motors and controllers.



#### LABORATORY EQUIPMENTS

- 10 PLC (Programmable Logic Controllers) Siemens S7 300 family: Basic Demo Units.
- 10 PLC Simulation Demo Units.
- Motor Demo Units/ Micromaster Drive Units.
- 5 Process instrumentation demo units.
- 5 MIMIC demo units.
- 10 HMI (Human machine interface) demo units with TP177 package.
- 1 PCMCIA CP Profibus.
- 5 Compressors.
- Cable and accessories package.
- Software/ Documentation packages.
- 10 computers.
- 10 LCD screen.
- 1 Laptop.



#### MAJOR EXPERIMENTS

- ✓ Operation of Digital input/output Modules.
- ✓ Operation of Analog input/output Modules.
- ✓ Timer/ Counter application included in a simulated process control.
- ✓ Process Automation Systems (PLC + Drive + Compressors + Valves ...).
- ✓ \* Human Machine Interface Experiments:
- ✓ MIMIC based.
- ✓ HMI based.
- ✓ SCADA based.
- ✓ \* Communication Experiments:
- ✓ PLC-PLC.
- ✓ PLC-HMI.
- ✓ PLC-SCADA.
- ✓ PLC-Motor.
- ✓ PLC-Sensor.



#### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE512	Automated Industrial System 1	9
EE518	Automated Industrial System 2	10





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Lab 103-A



# Measurements

Capacity: 20 Students

In this Laboratory, students are introduced to number of sensors and measurement equipment. Characteristics of these sensors are illustrated altogether with experiments covering their operation as well as their application's practice.

## LABORATORY EQUIPMENTS

- Load Cell.
- Semiconductor-Style Pressure Sensor.
- Acceleration Sensor.
- Flow Rate Sensor.
- Thermistor.
- Thermocouple.
- Pt100 (Pt Resistance Temperature Sensor).
- Pyroelectric Sensor.
- Lacteal Gland-Style Proximity Sensor (M18).
- Lacteal Gland-Style Proximity Sensor (M12).
- Capacity-Style Proximity Sensor.
- Heating unit (Temperature Conversion Device).
- Amplifier Module.
- Lamp & Buzzer Module.
- Application Module A (Lighting Control).
- Application Module B (Air Pressure Automatic Door).
- Application Module C (Temperature Control).
- Application Module D (Motor Control).
- Allocator.
- Push Button Valve Switch.
- Low Pressure Regulating Valve.
- Storage Tank Unit.
- Air Service Unit
- Pneumatic Cylinder.
- Slide Unit.
- Test Set.
- DC Power Supply.
- Digital Multimeters.
- Load Set.
- Circuit Connection Cable & Operational Profile.



## MAJOR EXPERIMENTS

- ✓ Load Cell characteristics with Load.
- ✓ Load Cell characteristics with Pressure.
- ✓ Load Cell application Practice.
- ✓ Semi-conductor Pressure Sensor operation.
- ✓ Flow Sensor principles with Flux.
- ✓ Flow Sensor application Practice.
- ✓ Acceleration Sensor operation.
- ✓ Thermistor Sensor operation.
- ✓ Thermistor Sensor application Practices.
- ✓ Thermocouple Sensor operation.
- ✓ Thermocouple application Practice.
- ✓ Resistance Temp. Detector operation.
- ✓ Resistance Temp. Application Practice.
- ✓ Pyroelectric Sensor principles with human body.
- ✓ Capacitive Proximity Sensor operation.
- ✓ Capacitive Proximity Sensor application Practices.
- ✓ Lacteal Gland-Style Proximity Sensor operation.
- ✓ Lacteal Gland-Style Proximity Sensor application Practices.



## The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE211	Electric Measurements & Instrumentation 1	4
EE312	Electric Measurements & Instrumentation 2	5
EE512	Automated Industrial System 1	9



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# Lab 103-B

## Automatic Control

Capacity: 20 Students



In this laboratory students are introduced into the basic principles of mastery of industrial applications. Using instrumentation and measurement equipment's; various areas of analogue automatic control are investigated such as pressure and flow, valve calibration and temperature control. The interfacing of analogue and digital circuit and control principles are also investigated such as computer control of motor speed and transient analysis of control systems using computer interface.



### LABORATORY EQUIPMENTS

- Process Control Simulator.
- Temperature Process Trainer T-3.
- Pressure & Flow Process Trainer PF-2.
- Level & Flow Trainer LF-1.
- Computer Control Process Trainer.
- Valve Calibration Trainer.
- Analogue training System.
- F.B Modular Servo System.
- Oscilloscopes.
- Function Generators.
- Programmable Logic Controller "Siemens S-5 100U".
- Digital Multimeters.
- Air Compressors.
- Mini Workshop.



### MAJOR EXPERIMENTS

- ✓ Investigation the characteristics of a Pressure Sensor.
- ✓ Investigation the characteristics of a Level Sensor.
- ✓ Investigation the characteristics of a flow Sensor.
- ✓ Investigation the characteristics of a Resistance Temperature Detector.
- ✓ Open Loop Process control investigation and performance assessment.
- ✓ Closed Loop Process control investigation and performance assessment.
- ✓ PID Controller tuning using process simulator.
- ✓ Disturbance Effect and Disturbance Elimination.
- ✓ Operational Amplifier Amplification & Attenuation Circuits.
- ✓ Operational Amplifier Comparator Circuits.
- ✓ Operational Amplifier Differentiator and Integrator Circuits.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE411	Control System 1	7
EE312	Electrical Measurements 2	5
EE311	Fundamentals of Control	6





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# Lab 105

## Digital Control

**Capacity: 20 Students**



This laboratory attempts to clarify some of the concepts of digital control and digital circuit applications. Using advanced digital design computer software, students gain the knowledge of the various methods of digital circuit integration, circuit analysis and also power system analysis. Practical digital applications are investigated using microcontroller kits, circuit kits, programmable logic controllers and robotic equipment.



### LABORATORY EQUIPMENTS

- Lab-Volt 32 Bit Microprocessor Trainer.
- DC Motor Control Simulator.
- Traffic Control Simulator.
- Washing Machine Simulator.
- Mentor Robot Arm.
- 7 Dell OptiPlex 760, Intel Core2Duo 3.0Ghz desktop computer And LCD 19" monitors.
- Robotic Arm.
- 2 Wheel Drive Robot.
- Omni Directional Wheel Robot.
- Microprocessor Development Boards (microprocessor ATmega- Arduino- Signal Conditioning Circuit-Encoder).



### MAJOR EXPERIMENTS

- ✓ Amplifier Circuits.
- ✓ Flasher Circuits.
- ✓ Microcontroller as input device.
- ✓ Operation of a 7-segements display/ LCD.
- ✓ Analogue to Digital Converter Circuit.
- ✓ AVR Microcontroller Interrupts.
- ✓ Basic robot manipulator arm action and fundamental robotic equipment.
- ✓ Timer and Timer Interrupt.
- ✓ Operation of Keypad/7-segement/LCD Display using Arduino.
- ✓ Load Flow Analysis & Calculations for power system analysis study.
- ✓ Economic dispatch for power system analysis study.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE413	Micro-Processor Based	8
EE514	Robotics	9/10
EE441	Power Systems 1	6



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**Lab 142**

**Power System and Protection**



**Capacity: 20 Students**

The laboratory enables students to demonstrate the principle of power transmission using a model transmission line, electric loads connection such as inductive loads, capacitor banks and resistors to preview their effect on a power system. In addition this laboratory is equipped with facilities that cover all power system protection related topics and achieve experimental verification of principles and practice of protective relaying.

### LABORATORY EQUIPMENTS

- 2× Inductive Load.
- 2× Resistive Load.
- 2× Capacitive Load.
- 2× Transmission Line Model.
- Transmission Line Model- medium.
- Power Factor Meter.
- Reactive Power Controller.
- Differential Transformer Relay.
- 2× Feeder Management Relay.
- Distantimeter (Distance Relay Protection)
- Three- Phase Power Meter.
- Brushless Servo Motor.
- Three- Phase Synchronous generator.
- Electrical Power Digital Measurement Unit.
- AC Machine Excitation Controller.
- LCD SCADA Monitor (Lenovo).
- Brushless controller with motor.
- Three-phase transformer.
- Switchable capacitor battery.
- RS485 communication Module.
- Synchronization indicator.
- Synchronization indicator.
- Double busbar with two, four disconnectors.



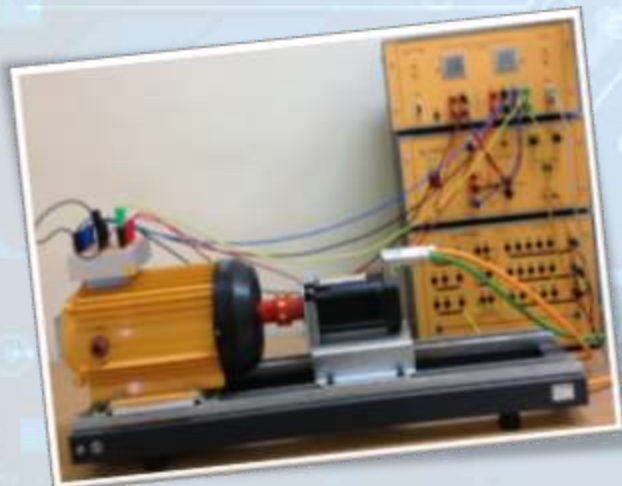
### MAJOR EXPERIMENTS

#### Power System Experiments

- ✓ No-Load / Matched load performances
- ✓ Measurement of Ohmic Inductive load investigation of a transmission line.
- ✓ Measurement of Ohmic Capacitive load investigation of a transmission line.
- ✓ Measurement of current and voltage ratios during three phase short circuits.
- ✓ Measurement of current and voltage ratios during Asymmetrical short circuits.
- ✓ Measurement of a zero sequence impedance.

#### Power system Protection Experiments

- ✓ Distance Protection.
- ✓ Differential protection for (Generator/Transformer)
- ✓ Over current/Voltage/Frequency Protection.
- ✓ Under Voltage/Frequency Protection.



### The Laboratory Serves the Following Courses

<b>Course No.</b>	<b>Course Title</b>	<b>Semester</b>
EE341	Introduction to Power	5
EE441	Power System 2	7
EE449T	Electrical Power	8
EE442	Power System Protection 1	8





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# Lab 146

## Electrical Circuits

Capacity: 20 Students



It provides the essential Knowledge for the student to understand and validate the AC and DC electric circuit's concepts. And it also familiarizes the student with measurements devices, power supplies and other different circuit elements.



### LABORATORY EQUIPMENTS

- Dual Digital DC power Supplies.
- Dual Digital function generators.
- Spectrum analyzers.
- Digital oscilloscopes.
- Multiplexer.
- Digital LCR meters.
- Digital Multimeters.
- Training Boards.

### MAJOR EXPERIMENTS

- ✓ Ohm's Law.
- ✓ Kirchoff's Laws.
- ✓ Resistance in series and parallel.
- ✓ Node voltage method.
- ✓ Loop current method.
- ✓ Superposition theory.
- ✓ Thevenin's equivalent circuit.
- ✓ Maximum power transfer.
- ✓ R, L, C identification.
- ✓ Series and parallel resonance.
- ✓ Star Delta transformation.
- ✓ AC circuit analysis.
- ✓ Oscilloscope identification.
- ✓ Natural response for RL and RC circuits.
- ✓ Step response for RL and RC circuits.
- ✓ Multisim v12.0.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE238	Electrical Eng. Fundamentals	3
EE231	Electrical Circuits 1	3
EE236	Electrical Engineering 1	4
EE232	Electrical Circuits 2	4
EE239	Electrical Eng. Fundamentals for Marine Technology	3



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## Lab 150-A

# Electrical Motors Operation and Protection

Capacity: 20 Students

The laboratory provides the essential knowledge for relay logic control of a three phase induction motor with the main switches and protection elements. Besides that, a smart relay is used for motor control and to simulate a process with inputs/outputs simulator panel. Also, the necessary measurements of current and voltage are provided. The laboratory consists of three identical

### LABORATORY EQUIPMENTS

- Direct online motor starter.
- Star/Delta motor starter.
- Forward/Reverse motor operation.
- Forward/Reverse motor operation using timer.
- Remote/Local motor operation.
- Phase sequence detection.
- Motor Overload and Short Circuit Protection.
- Star/Delta motor starter using smart relay.
- Two motors sequential operation.
- Remote/Local motors controlled operation.
- Filling Bottles plant simulator.
- Motor operations using Zelio PLC.
- Logic, Timer, Counter operation using Zelio PLC.



### MAJOR EXPERIMENTS

- ✓ Direct online motor starter.
- ✓ Star/Delta motor starter.
- ✓ Forward/Reverse motor operation.
- ✓ Forward/Reverse motor operation using timer.
- ✓ Remote/Local motor operation.
- ✓ Phase sequence detection.
- ✓ Motor Overload and Short Circuit Protection.
- ✓ Star/Delta motor starter using smart relay.
- ✓ Two motors sequential operation.
- ✓ Remote/Local motors controlled operation.
- ✓ Filling Bottles plant simulator.
- ✓ Motor operations using Zelio PLC.
- ✓ Logic, Timer, Counter operation using Zelio PLC.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE442	Power System Protection 1	5
EE512	Automated Industrial System 1	6
EE518	Automated Industrial System 2	10





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# Lab 150-B



## Power Electronics

Capacity: 20 Students

The laboratory offers various equipment and tools for investigating power electronics related experiments. In addition the laboratory provides voltage and current measurement probes, Digital storage oscilloscope and a three-phase harmonic analyzer.

### LABORATORY EQUIPMENTS

- 2 Battery Stack.
- 4 Silicon Diode.
- 2 Group of Diodes.
- 1 Group of SCR.
- 2 Triac.
- 2 MOSFET.
- 2 Group of igbt.
- 4 Bridge Three-Phase Rectifier.
- 2 DC Power Supply.
- 2 Scr with turn Off Circuit.
- 2 Voltage Reference Generator.
- 2 Trigger Point Limiter.
- 2 Two Pulse Control Unit.
- 2 Matching Amplifier.
- 1 Six Pulse Control Unit.
- 1 Pwm/pfm/tpc Control Unit.
- 4 Mains Transformer.
- 4 LCR Load.
- 2 Emi Filter.
- 2 Function Generator.
- 2 Current Transformer.
- 2 Capacitors Unit.
- 4 Super- Fast Fuses Unit.
- 4 Digital Oscilloscope.
- 4 Digital Multimeter.
- Support with 3 Shunt 1 ohm.
- Adapter with 3 Shunt 0.1 ohm.
- 2 UPS Units.



### MAJOR EXPERIMENTS

- ✓ Single-Phase Uncontrolled rectifiers supplying variable loads.
- ✓ Single-Phase Controlled rectifiers supplying variable loads.
- ✓ Three-Phase Uncontrolled rectifier.
- ✓ Three-Phase half controlled/fully controlled rectifier.
- ✓ DC/DC Converters (Buck, Boost and Buck Boost).
- ✓ Single-Phase (PWM) Inverter.
- ✓ Single-phase AC Voltage controlled converter with R and RL Loads.
- ✓ Three-Phase AC Voltage controller with related applications.
- ✓ Commutated (SCR) circuits (UPS) Uninterruptable Power Supply.

### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE323	Power Electronics 1	6
EE423	Power Electronics 2	7
EE424	Electrical Drives 1	8



## Lab 201

# Electrical Machines

Capacity: 20 Students

The electric machines laboratory provides the opportunity to understand and examine the behavior of converting electrical energy to mechanical energy and vice versa and understand the classical electrical machines to drive several mechanical loads as well as synchronizing generators to be connected on a single local network. Also it includes modules of power electronic devices and scopes suitable to build power electronic circuits and demonstrate device control and performance. Furthermore, basic converter and inverter drive sets are available to be applied with different machine types.

### LABORATORY EQUIPMENTS

- D.C. machine with measurement unit.
- DC compound motor
- 3Φ Slip ring induction motor
- 3Φ Induction motor squirrel cage induction motor
- 1Φ Induction motor capacitor start
- 3Φ Synchronous machine
- Transformer.
- Power pack.
- DC power supply.
- Synchronizing device.
- Synchronizing unit.
- Power electronics components and panels.
- 3Φ Passive loads (Capacitive Loads, Inductive Loads and Resistive Loads).
- 3Φ Load switch.
- Wye/Delta Switch.
- Shunt regulator.
- Revolution counter.
- Tachometer generator.
- Power factor meter.
- Multimeters.
- Wattmeters.



### MAJOR EXPERIMENTS

- ✓ Obtaining different characteristics of the DC separately excited generator.
- ✓ Observing the load sharing between two DC separately excited generators when connecting in parallel to supply a common load.
- ✓ Obtaining the external characteristics of the DC compound generator.
- ✓ Studying different characteristics of the DC shunt motor.
- ✓ Studying different characteristics of the DC series motor.
- ✓ Understanding different methods of DC motors speed control.
- ✓ Determining the equivalent circuit parameters of a transformer by short circuit and open circuit tests.
- ✓ Studying different characteristics of 3Φ squirrel cage induction motor.
- ✓ Studying different characteristics of 3Φ slip ring wound rotor induction motor.
- ✓ Demonstrating the open circuit, short circuit and loading characteristics of synchronous alternator.
- ✓ Performing parallel operation of Synchronous Generators.
- ✓ Studying different characteristics of synchronous motor.



### The Laboratory Serves the Following Courses

Course No.	Course Title	Semester
EE321	Electrical Machine 1	5
EE322	Electrical Machine 2	6
EE328	Electrical Power & Machines	6
EE328	Electrical Machines	7
EE422	Electrical Machine 3	7
EE521	Special Electrical Machines	9