Government Engineering College, Sheikhpura Electronics & Communication Engineering

Requirement for Project Lab ECE			
S. No.	**Component**	**Use**	**Quantity**
1	Arduino UNO / Microcontroller	Main controller	10
2	Breadboard	Circuit prototyping	20
3	Jumper Wires (Male & Female)	Connections	20 packet each
4	Resistors (220Ω, 330Ω, 470Ω 1K, 2.2K, 4.7K, 10K 22K, 47K, 100K 220K, 1M)	Current control	5 packet each
5	LEDs (Red, Green, Blue, Yellow)	Indication	5 packet each
6	Capacitors (Ceramic:- 10pF, 100pF, 1nF, 10nF, 100nF), (Electrolytic:- 1µF, 10µF, 47µF, 100µF, 220µF, 1000µF Voltage: 16V / 25V / 50V)	Filtering & timing	5 packet each
7	Transistors (BC547, BC548, 2N2222, BC557, 2N2907, TIP31,TIP122)	Switching/amplification	5 packet each
8	Diodes (1N4007, 1N4148) (Zener diode:- 3.3v, 5v, 9v, 12v)	Protection/rectification	5 packet each
9	Sensors (Temp, IR, Ultrasonic)	Input devices	5 packet each
10	LCD Display (16x2)	Output display	10
11	Relay Module	High voltage control	10
12	Motors (DC/Servo/Stepper)	Motion projects	10 each
13	Power Supply / Battery	Power	50
14	Multimeter	Testing	20
15	Soldering Kit	Permanent circuits	20
16	Project Work Station Specification . Project Work Station Consisting of a. Soldering Station and De-soldering Pump – 2 Nos Voltage 110V,120V,130V,220V,230V,240V AC 50/60Hz Power Consumption 65W Temperature Setting Range 200–480°C Ripple temperature ±5?C (unloaded) Insulation Resistance Over 100MΩ (500V DC) Accessories Soldering Iron Stand ,Soldering Iron Tip Control Unit Output Voltage 24V AC Soldering Unit Voltage / Consumption 24V AC / 60W Ground Resistance Less than 2Ω Leak Voltage Less than 2mV Heater Ceramic heater Desoldering Pump: Should have a self-cleaning Shaft –		05

	When the plunger is pushed, a piston extends out the nozzle. This prevents solder build-up. b. Scope - 5 Nos Bandwidth : 100 MHz Channels : 2 + External Display : 7 inch LCD Colour (320X240 resolution) Acquisition Mode : Sample, Peak detect, Averaging Sample rate (real time) : 1GSa/s Input coupling : DC,AC Probe attenuation factors : 1X, 10X Horizontal system: Time base range : 2ns/div ~ 50s/div Vertical system: Vertical sensitivity : 1mV/div ~ 20V/div Single bandwidth : Full bandwidth Rising time (typical on BNC) : ≤ 3.5 ns Trigger Trigger mode : Edge, Pulse, Video & Alternate Measurement system Automatic measurement : 15 Waveform math : Add, Subtract, Divide,and FFT Voltage : 100 ~ 240 VAC, 50Hz, CAT II Fuse : 1A, T class, 250V ACCESSORIES : 1 pair of 1:1 (10:1) passive probe, USB cable, Power cable, Instruction manual c. Waveform Generator – 5 nos Dual Channel 25 MHz Function Generator Should use DDS Technology No of Channels: 2 Vertical Resolution: 14 Bits Sampling Rate :125 MS/s Frequency range of waveform Sine wave : 1μHz ~ 25MHz Square wave : 1μHz ~ 5MHz Sawtooth wave : 1mHz ~ 1MHz Pulse wave : 500μHz ~ 5MHz Arbitrary wave : 1mHz ~ 5MHz Display :4.3” TFT, LCD Modulation: AM/FM, ASK, FSK, PSK, Burst d. Meter – 5 Nos It should be used to measure voltage current, resistance, capacitance, frequency, temperature, diode and continuity. •Data holding •Range selection automatic and manual •Full function protection •Large LCD & High resolution •Transistor test •Low battery indication & Auto power off •Full overload protection & Shock proof protection Basic Function •DCV Range: Accuracy : ±(0.5%+4) 400mV to 1000V •ACV Range: Accuracy : ±(0.8%+10) 400mV to 750V •DCA Range: Accuracy : ±(1.0%+10) 400μA to 10A •ACA Range : Accuracy : ±(1.5%+10)400μA to 10		

Electronics & Communication Engineering Laboratory Requirement

VLSI & Embedded Systems Laboratory Requirements

Item	Sprcification	Qty.
FPGA Trainer Boards	Xilinx Artix-7 / Zynq	10
Logic Analyzer	16-channel	2
Dual Regulated Power Supply	±12V / ±15V, 1A	6
Arduino UNO	ATmega328P	15
STM32 Dev Board	ARM Cortex-M	10
PIC Development Kit	PIC16/18 series	5
Raspberry Pi	Model 4 (4 GB)	8
Digital Multimeter	3½ digit	15
DAC Trainer Board	Educational	5
RTOS Trainer	ARM-based	2
Soldering Stations		1
LM35 Analog Temp Sensor	−55°C to +150°C, 10 mV/°C	10
DS18B20 Digital Temp Sensor	−55°C to +125°C, 1-Wire	5
PT100 RTD Resistance Temp Detector	−200°C to +850°C	3
K-Type Thermocouple	−200°C to +1250°C	2
IR Proximity Sensor Reflective IR	2–30 cm range	10
Digital IR Obstacle Sensor	TTL output	8
IR Flame Sensor	760–1100 nm	4
IR Temperature Sensor (MLX90614)	−70°C to +380°C	2
MQ-2, LPG, Smoke	300–10,000 ppm	4
MQ-3 Alcohol	Breath alcohol detection	2
MQ-6 LPG / Butane	High sensitivity	3
MQ-7 Carbon Monoxide	20–2000 ppm	2
MQ-135 Air Quality	NH_3, CO_2, Benzene	3
PIR Motion Sensor (Passive IR)	Human motion detection	6
Ultrasonic Sensor (HC-SR04)	2–400 cm range	6
Accelerometer (ADXL345)	3-axis, ±16 g	3
Gyroscope (MPU6050)	3-axis gyro + accel	3
Solderless Breadboard (Full Size)	830 tie points, ABS body, reusable	20
Mini Breadboard	170 tie points	10
Jumper Wires (Male–Male)	20–30 cm, multicolor	300
Jumper Wires (Male–Female)	20–30 cm, multicolor	200
Jumper Wires (Female–Female)	20–30 cm, multicolor	100
IC Socket (8-pin)	DIP type, tin-plated	100
IC Socket (14-pin)	DIP type, tin-plated	50
IC Socket (16-pin)	DIP type, tin-plated	50

Government Engineering College, Sheikhpura

Semiconductor Physics & Devices and Electrical & Electronics Material Laboratory Requirements

Sl. No.	Item	Specifications	Qty.
1	Solar cell trainer kit	a 4V/T00mA to 5V/500mA solar panel. a high-intensity lamp (100W, 220VAC), and analog or digital meters (0-5V. 0-250mA) for plotting V-I characteristics	2
2	UJT as relaxation oscillator kit	a 2N2646 UJT, regulated power supply (0-15V/30V DC), variable RC timing components (resistor/capacitor), and test points for sawtooth/pulse waveform observation on an	2
3	SCR characteristics kit	DC regulated power supplies (0-30V for anode, 0-3V for gate), analog/digital meters for measuring voltage/current, and uses the 2P4M or TYN604 SCR, powered by 220-240V AC	2
4	LDR,	5mm Cadmium Sulphide (CdS) cell	10
5	Photo Diode		10
6	Phototransistor		10
7	Semiconductor Temperature Coefficient Trainer Kit" or "Thermistor Experimental Setup"	Sensor Types: On-board provision for studying NTC Thermistor (Negative Temperature Coefficient), PT100 RTD, and IC temperature sensors (e.g., LM35).Generally covers er \(-55^{\circ }C\) to (+150^{\circ }C\) (sensor dependent), often featuring a controlled oven/heating system for ranges up to \(100^{\circ }C\)	2

Government Engineering College, Sheikhpura

Digital Circuit Laboratory Requirements

Sl. No.	Item	Specifications	Qty.
1	Logic Gate Trainer Kit (NAND,NOR,NOT gate)	Logic Families: TTL (Transistor-Transistor Logic) compatible, operating at \(+5V\) DC.Integrated Circuits (ICs):NAND Gate: IC 7400 (Quad 2-input NAND).NOR Gate: IC 7402 (Quad 2-input NOR).NOT Gate: IC 7404 (Hex Inverter).Input Section: 4 to 8 toggle switches for providing high (\(+5V\)) or low ((0V\)) logic levels.Output Section: LED indicators (Red/Green) to show output status (1 for ON, 0 for OFF).Breadboard (Optional but recommended): On-board, plug-in breadboard for circuit prototyping.Power Supply: Built-in regulated power supply (\(+5V \pm 5\%\)).Patch Cords: 2mm or 4mm stackable patch cords for connections.	1
2	IC-7483 Trainer Kit	Target IC: 7483 (4-bit binary parallel adder/subtractor).Input Section: 8 Logic Input Switches (4 for Addend \(A_{0}\)-\(A_{3}\), 4 for Augend \(B_{0}\)-\(B_{3}\)) and 1 Logic Input Switch for Carry-in (\(C_{0}\)).Output Section: 5 Logic Output Indicators (LEDs) for 4-bit Sum (\(S_{0}\)-\(S_{3}\)) and 1 Output Carry (\(C_{4}\)).Internal Circuitry: Includes internal connections of four full-adders to perform 4-bit parallel addition. Breadboard Space: Typically includes a Breadboard to integrate additional ICs like 7486 (XOR gates) for subtractor configuration.Power Supply: Fixed \(+5\text{V} \pm 10%%) regulated DC power supply.Indicators: Power ON/OFF toggle switch and LED indicator. Interconnections: 2mm/4mm banana sockets or breadboard area for patch cords.	1

Electrical Engineering Laboratory Requirement

List of deficient equipment and accessories with quantites
Electrical Circuit analysis Lab

<table>
<tr><th>Sl. No</th><th>Name of Experiment</th><th>Specification of Apparatus/Equipment</th><th>Required Qty of Appartus</th></tr>
<tr><td>1.</td><td>Measurement of Steady state & Transient Response of RL, RC& RLC circuits.</td><td>
Measurement of Steady state & Transient Response of RL, RC & RLC circuits.
➢ Regulated & short circuit proof variable DC Voltage source
With built in regulated power supply having following features.
<table>
<tr><td>DC Outputs</td><td>2 x 0 to 30v /3A , 1x5V /3A</td></tr>
<tr><td>Setting</td><td>V: 10mv , 1:5mA</td></tr>
<tr><td colspan="2">Constant Voltage Mode</td></tr>
<tr><td>Load Regulation</td><td>≤± 0.05% ±10mV</td></tr>
<tr><td>Line Regulation</td><td>≤± 0.05% ±10mV</td></tr>
<tr><td>Ripple & noise</td><td>≤1mVrms</td></tr>
<tr><td colspan="2">Constant Current Mode</td></tr>
<tr><td>Load Regulation</td><td>≤±0.2%</td></tr>
<tr><td>Line Regulation</td><td>≤±0.2%</td></tr>
<tr><td>Ripple & noise</td><td>≤±0.4%mVrms</td></tr>
<tr><td>Indication</td><td>CC mode LED</td></tr>
<tr><td>Internal Resistance</td><td>≤10mΩ</td></tr>
<tr><td>Stability</td><td>≤2.5mV at full load</td></tr>
<tr><td>Recovery Time</td><td>≤50μS</td></tr>
<tr><td>Temp coefficient</td><td>≤±(0.05%+10mV/°C)</td></tr>
<tr><td>Current Limit</td><td>100 mA to max</td></tr>
<tr><td>Display</td><td>Switchable 3 digit seven segment LED for Voltage & Current</td></tr>
<tr><td>Display Accuracy</td><td>V: ±(1%+1digit),I ±(1%+3digit)</td></tr>
<tr><td>General Information</td><td>Built in overheat ,over voltage protections</td></tr>
<tr><td>Insulation</td><td>Between chassis & output terminals>10MΩ at 100Vdc chassis & AC Plug >50MΩ at 500Vdc</td></tr>
<tr><td>Supply</td><td>230VAC± 10% ± /50Hz</td></tr>
</table>
➢ Supplied with the digital measuring instruments-
✓ Measuring Method -3 ½ Digit –Dual Slope A/D Conversion
✓ Sampling Rate – 2.5 Samples per second
✓ Display Type - 12.4 mm / 0.48" Digit Height LCD (with Backlight)
✓ Maximum display -- 1999counts for 3 ½ depending on the range
✓ Resolution – 0.001 to 1 count for 3½ depending on the range
</td><td>01</td></tr>
</table>

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		✓ Polarity Indication – "_"is indicated for negative input ✓ Decimal Selection – Field Selectable ➢ On board fitted Different Type Resistance ➢ On board fitted Different Type Capacitor ➢ On board fitted Different Type Inductor ➢ ON / OFF switch and LED for power indication. ➢ Glass fuse for short circuit protection. ➢ Adequate number of other electronic components ➢ Engraved / screen printed block description on Bakelite Sheet ➢ All interconnection are made using 2 mm banana patch cords ➢ Supplied with User manual and patch cords ➢ Enclosed in ABS box ➢ Trainer should be from NSIC registered manufacturing unit. **ADDITIONAL ACCESSORIES COMPULSORY ITEMS (EXTERNALLY CONNECTED) REQUIRE TO CONDUCT EXPERIMENT** **Technical Specifications** Bandwidth: 100MHz Rise Time (at input typical): ≤7nS Power Supply: 100 V to 240 VAC ,50/60 Hz , CATII Power Consumption: <15W Fuse: 2A, T Class ,250V Environmental Conditions: Temperature : 0° C -50° C (operating), -20° C -60° C (Storage) ≤90%RH Display Type: 7"Colour TFTLCD Display Resolution: 800x480 pixels Dimension (W x H x D): 301 x152x70 mm Weight: 1.10kg Accessories: Power Cord ,CD, Manual , USB Cable, Probe	
2.	**Frequency Response of Twin-T Notch Filter & To Study of Active Filter**	**Frequency Response of Twin-T Notch Filter & To Study of Active Filter** ▪ **Low Pass Filter.** ▪ **High Pass Filter.** ➢ Regulated & short circuit proof variable DC Voltage source **With built in regulated power supply having following features.** DC Outputs: 2 x 0 to 30v /3A , 1x5V /3A Setting: V: 10mv , 1:5mA **Constant Voltage Mode** Load Regulation: ≤± 0.05% ±10mV Line Regulation: ≤± 0.05% ±10mV Ripple & noise: ≤1mVrms **Constant Current Mode** Load Regulation: ≤±0.2% Line Regulation: ≤±0.2%	01

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Ripple & noise	≤±0.4%mVrms
Indication	CC mode LED
Internal Resistance	≤10mΩ
Stability	≤2.5mV at full load
Recovery Time	≤50μS
Temp coefficient	≤±(0.05%+10mV/°C)
Current Limit	100 mA to max
Display	Switchable 3 digit seven segment LED for Voltage & Current
Display Accuracy	V: ±(1%+1digit),I: ±(1%+3digit)
General Information	Built in overheat ,over voltage protections
Insulation	Between chassis & output terminals>10MΩ at 100Vdc chassis & AC Plug >50MΩ at 500Vdc
Supply	230VAC± 10% ± /50Hz

- Supplied with the digital measuring instruments-
  - ✓ Measuring Method -3 ½ Digit –Dual Slope A/D Conversion
  - ✓ Sampling Rate – 2.5 Samples per second
  - ✓ Display Type - 12.4 mm / 0.48" Digit Height LCD (with Backlight)
  - ✓ Maximum display – 1999 counts for 3 ½ depending on the range
  - ✓ Resolution – 0.001 to 1 count for 3½ depending on the range
  - ✓ Polarity Indication – "_"is indicated for negative input
  - ✓ Decimal Selection – Field Selectable
- Fixed resistances of different values.
- Fixed capacitor of different values.
- Op-amp IC (741).
- ON / OFF switch indication light.
- Glass fuse for short circuit protection.
- Patch cords suitable to the terminals with board for easy interconnection.
- Enclosed in ABS box
- Trainer should be from NSIC registered manufacturing unit.

DIGITAL STORAGE OSCILLOSCOPE WITH NABL CALIBRATION CERTIFICATE

Technical Specifications	
Bandwidth	50MHz
Rise Time (at input typical)	≤7nS
Acquisition	
Sample Rate	1 GSa/s
Mode	Normal, Peak detect, Averaging
Vertical System	
Channel	2
Input Coupling	DC, AC & GND

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Input Impedance		1MΩ±2%, in parallel with 20pF±5pF
Max Input Voltage		400 V (PK - PK) (DC +AC, PK – PK)
Vertical Resolution (A/D)		8 bits (2 channels simultaneously)
Vertical Sensitivity		5 mV/div - 5 V/div (at input)
DC Gain Accuracy		± 3%
Channel Isolation		50 Hz: 100: 1, 10 MHz: 40 : 1
Probe Attenuation Factor		1X, 10 X, 100 X, 1000 X
Horizontal System		
Horizontal Scale (s/div)		2 ns/div to 1000 s/div, step by 1-2-5
DC Accuracy (Average)		Averages ≥ 16: ± (3% reading + 0.05 div) for ΔV
LF Response (AC, -3dB)		≥ 10 Hz (at input, AC coupling. -3dB)
Accuracy		± 100 ppm
Record Length		10K
Interpolation		sin (x) / x
X-Y Mode	Bandwidth	Full Bandwidth
	Phase Difference	±3 degrees

- **DIGITAL MEASURING INSTRUMENT (Function Generator)**

1) Maximum Output Frequency- 10Mhz
2) Number of channels: 2
3) Sampling Rate: ≥ 125 MSa/s
4) Arbitrary Waveform Length: ≥ 8kpts
5) Frequency Resolution: 1µHz or better
6) Vertical Resolution: ≥ 14 bit
7) Waveform : Sine, Square, Ramp, Pulse & Noise
8) Modulation: AM, FM, PM, FSK, PWM, ASK, PSK, Sweep, Burst
9) Sine
   a) Frequency Range 1µHz to 25MHz
   b) Total Harmonic Distortion 0.2% (10Hz-20kHz)
10) Square wave
   a) Frequency Range 1µHz to 5 MHz
   b) Rise / Fall time ≤ 12ns (10%-90%)
   c) Overshoot ≤ 5%
11) Ramp
   a) Frequency Range 1µHz to 1 MHz
   b) Linearity 0.1% of peak output, 10% to 90% of amplitude range
   c) Symmetry 0-100%
12) Pulse
   a) Frequency Range 1µHz to 5 MHz
   b) Rise / Fall time ≤ 12ns
   c) Jitter ≤ 1ns
   d) Pulse width 40ns to 1000 ks
   e) Pulse width accuracy ≤ 10ns
13) Arbitrary

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		a) Frequency Range 1µHz to 10 MHz b) Waveform Length 8kpts c) Rise / Fall time ≤ 10ns d) Sampling Rate 125 MSa/s 14) Amplitude a) Range 1 mVpp - 20 Vpp (High Impedance) 1 mVpp to 10 Vpp (50Ω) 15) Frequency Counter a) Frequency Range 100mHz-200MHz b) Resolution 6 digit c) Measurement Frequency, Period, Positive Pulse, Width, Duty cycle d) Coupling Modes AC, DC 16) Display 4" LCD Display 17) Power Supply 220 -240 VAC, 50/60 Hz 18) Operating Condition 0 to 40°C 19) Standard Interfaces USB		

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Power Electronics Lab

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus
1.	**STUDY OF SINGLE-PHASE INVERTER TRAINER (DC-AC)**	**The kit includes:** • Power circuit for single phase inverter half-bridge configuration • Power circuit for single phase inverter full-bridge configuration • Different types of loads: R Load and R-L Load • Microcontroller based control circuit • Different control circuits: Square Wave, Sine PWM • Current waveform observation. **Specifications:** • Popularly used basic controlling methods like square wave mode, quasi square wave mode and sinusoidal PWM is experimented. • Trainer should include step down power supply, control circuit, power circuit and different types of load internally. • The kit should work directly with 230V, 50Hz AC supply and other low power supplies required for the operation should be derived internally. • Proper isolation between control and power circuit with DC link fuse should be provided. • Step down supply voltage of 24 V DC, Load resistance of 100 E, Load inductance 100 mH is provided • Loading arrangements should be a part of trainer and experiment with R Load and R-L Load should be provided. • Microcontroller based control circuit with LCD and keyboard interfacing should be provided for selecting different operating modes. **The setup will consist of following cards:** • Controller card: • MOSFET based inverter card: • 40 V DC supply **List of Experiments:** I) Study of single-phase half bridge inverter. II) Study of single-phase full bridge inverter. III) Study of square wave inverter. IV) Study of Sinusoidal inverter. V) Study of Gate pulses for MOSFET 's in different types of Modes. **Digital measuring and display instruments having following features–** **Technical Specifications** Bandwidth: 50 MHz RiseTime (at input, typical): ≤ 7 ns Power Supply: 100 V to 240 VAC, 50/60 Hz, CATII	01

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Power Consumption	< 15 W
Fuse	2A,Tclass, 250 V
Environmental Conditions	Temperature, : 0°C ~ 50°C (Operating), -20°C ~ 60°C (Storage), ≤ 90% RH
Display Type	7" Colour TFTLCD
Display Resolution	800 X 480 pixels
Dimensions (W X H X D)	301 X 152 X 70 mm
Weight	1.10 Kg
Accessories	Power Cord, CD, Manual, USB Cable, Probe

Testing panel modules mounted on **sturdy aluminium profile flat demo system**, consisting of colourful vinyl printed overlays circuit diagram, various high voltage components fixed on sturdy Bakelite sheet, fixed to modular aluminium profile structure foot mounted **with extended control desk** made of 19mm ply board with sunmica fitted top. The back of testing panel modules should have protective cover.

Power scope:

Accessory for any lab CRO for of ground differential measurement upto 1000Volt DC to facilitate checking inverter/ converter wave form.

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Control System Lab

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus
1.	To study the behaviour of d.c. separated excited motor at open loop and closed loop conditions with variation of load.	DC SPEED CONTROL SYSTEM **(a) To study D.C. speed control system on open loop and close loop.** (b) To study of Transient performance, another time signal is added at the input ofcontrol Circuit. **(c) To study how eddy current breaking is being disturbance rejected by close andopen loop.** **Features and Specifications** • Speed control of a 12V, 4W permanent magnet dc. Motor • Speed range: 0 to 3000 rpm (typical) • Opto-interrupter based speed sensing • 4-digit speed display in rpm • Electronic tachogenerator for feedback Separate unit for motor in a see-through cabinet • Essential accessory — a CR0 • Smooth, non-contact eddy current brake for loading • Built-in 3½ digit DVM for signal measurements • Built-in IC regulated internal power supply • Supporting literature and patch cords included All the above accessories must be fitted on top of the box fixed to sturdy ABS Box. (Shook proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab). Test report from NABL certified lab to be enclosed.	01
2.	**DETERMINE THE TRANSIENT RESPONSE OF A 2ND ORDER SYSTEM WITH STEP/ SQUARE INPUT**	LINEAR SYSTEM SIMULATOR **Suggested Experiments** □ Step response of open loop systems – 1st, 2nd or 3rd order. □ Step response of closed loop system as above for various values of forward path gain. □ Verification of experimental results from theoretical calculations. □ Study of steady state performance through built-in triangular wave generator. Features and Specifications □ Simulated blocks – configurable as 1st, 2nd and 3rd order systems with negative feedback. □ Forward gain adjustable through a calibrated 10 turn potentiometer (Resolution 1 in 1000). □ Three built-in signal sources. □ Square wave : 1 V p-p (min). □ Triangular waye : ± 0.5 V p-p (min).	01

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		▯ Trigger pulses : ± 10 V (min). ▯ Frequency adjustable : 40 Hz – 90 Hz. ▯ Provision for disturbance inputs at input and load. ▯ I.C. regulation in all internal power supplies. ▯ Power requirement less than 10W at 220 V, 50 Hz operation. ▯ Supporting literature and patch cords included. ▯ Complete with Measuring Device as given below :- **Technical Specifications** Bandwidth: 50 MHz Rise Time (at input, typical): ≤ 7 ns Power Supply: 100 V to 240 V AC, 50/60 Hz, CAT II Power Consumption: < 15 W Fuse: 2 A, T class, 250 V Environmental Conditions: Temperature, : 0°C ~ 50°C (Operating), -20°C ~ 60°C (Storage), ≤ 90% RH Display Type: 7" Colour TFT LCD Display Resolution: 800 X 480 pixels Dimensions (W X H X D): 301 X 152 X 70 mm Weight: 1.10 Kg Accessories: Power Cord, CD, Manual, USB Cable, Probe All the above accessories must be fitted on top of the box fixed to sturdy ABS Box. (Shook proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab). Test report from NABL certified lab to be enclosed.	
3.	TO STUDY OF PID CONTROLLER FOR SIMULLATION PROCESS LIKE TRANSPORTATION LAG	PID CONTROLLER Suggested Experiments ➢ Open loop response of various process configurations. ➢ Study of closed loop response with P, PI & PID controller. ➢ Study of open loop response of P, I & D controller. Features and Specifications ➢ Simulated block-dead time (transportation leg), integrator, Time constants, error detector and gain. ➢ PID Controller (configurable as P, PI, PD or PID) ➢ Proportional Band : 5% to 50% (Gain 2-20)	01

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		➢ Integral Time : 10 ms – 100 ms ➢ Derivative time : 2-20 ms ➢ Built in IC regulated power supply. ➢ Built in 3½ digit DVM ➢ Built in signal sources. ➢ Set value : -1V to + 1V ➢ Square wave 1 V p-p (min) at 40 Hz (typical) ➢ Triangular wave : 1 V p-p (min) at 40 Hz (typical) ➢ Detailed literature and patch chords included ➢ 220 V, 50 Hz mains operations ➢ Complete in all respects except a measuring CRO. All the above accessories must be fitted on top of the box fixed to sturdy ABS Box. (Shook proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab). Test report from NABL certified lab to be enclosed	

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Basic Electrical Engineering LAB

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus
1.	**TO STUDY BASIC ELECTRICAL TRAINER (MODULAR PANAL)**	List of experiments which can be performed 1) To understand Series & parallel Circuit for R,L,C for DC Circuit 2) Verification of Kirchoff's Law 3) Verification of superposition Theorem 4) Verification of Thevenin's and Norton's theorem 5) Verification of maximum power transfer theorem 6) Study of phenomenon of resonance in RLC series circuit & obtain resonant frequency 7) To study Ohms Law Testing panel modules mounted on sturdy aluminum profile flat demo system, consisting of colorful vinyl printed overlays circuit diagram, metering section and power supply section fixed on sturdy bakelite sheet, fixed to modular aluminium section profile section. The back of modular panel should be covered with detachable protective cover. Entire system should be arranged on 40X40 aluminum profile (Heavy duty) Anodized Silver Table frame having good quality treated plyboard white / silver gray with smooth finish veneer finish table top (25mm thickness) provided with Four sturdy castor wheels with locking mechanism or level foot so that table can be positioned conveniently. The Control panel should be provided to fit the following instruments mentioned below: i) On board AC voltage source 12-0-12V -01No. ii) Provision for connecting AC voltage source 0-230V-01No. iii) On board DC Voltmeter 0-50V-02Nos. iv) On board DC Ammeter 0-100mAmp -02Nos. v) On board Digital AC Voltmeter 0-50V-02Nos. vi) On board Digital AC Ammeter 0-100mAmp - 02Nos. vii) On board fitted Single Phase auto transformer 2Amp. viii) On board fitted Potentiometer-03Noss. ix) On board printed resistor colour code scheme. x) On board fitted different type of resistors. xi) On board fitted different type of capacitors. xii) On board fitted different type of inductors. xiii) On board fitted DP MCB for ON/OFF switch and LED for power indication. xiv) Glass fuse for short circuit protection xv) Screen printed block description on Bakelite Sheet. xvi) All interconnections should made using 2mm banana patch code. User manual as per the experiment and patch cords.	01

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2.	**TO STUDY SINGLE PHASE TRANSFORMER** List of Possible Experiments:- 1) Observation of the No-Load Current Waveform (Non-Sinusoidal Wave-shape due B-H Curve) 2) Measurement of Primary & Secondary Voltages & Currents, & Power & Efficiency using OC & SC Test Loading of a Transformer	Single Phase Transformer I KVA 230/230V with Tappings at 50% & 86.6% Naturally Air Cooled Copper Double wound, Core type. The transformer Will housed in MS sheet box enclosure with top sheet and one side of MS Box should have window provision and having transparent acrylic sheet to see the internal parts. All the terminals Of primary & secondary shall be brought over to transparent sheet on top of the box through insulated banana Jack terminals (BS-10). The Control panel should be provided to fit the instruments mentioned below: I) Digital AC' Voltmeter Micro-controller based. NABL Certified- 2nos. II) Digital AC Ammeter Micro-controller based. NABL Certified. 0-5A- 2 nos. III) Digital Wattmeter Micro-controller based, NABL Certified 5 Amp having following specification: • TRMS Measurement. • 128 x 64 Graphical Display with White Backlight. • RS485 Port IV) DP MCB 6 Amp -01 No V) Indicating Lamps LED type 16 mm dia- 1 No VI) Single Phase Variac. 6 Amp - 1No VII) Insulating Terminals. VIII) Patch chords. IX) Instruction manuals per experiment **X) ELECTRICAL LOAD HAVING FOLLOWING SPECIFICATION** ➢ Three Phase/Single Phase Resistive Load (Trolley Mounted with caster wheels enclosed in perforated MS Box) ➢ Single Phase Operation ➢ Voltage : 240V AC ±10%, 50HZ, Current: 15A ; Power : 3.5 Kw ; Loading steps : 15 ➢ MCBs; Current rating : 10A (SP); No. of MCBs : 15 ➢ Three Phase Star operation – Voltage : 415V AC ±10%, 50 Hz, Current : 5A (Per Phase), Power : 3.5kW, Loading steps : 5 (per phase), MCBs (act as switch) : 10A (SP) ➢ Three Phase Delta Operation – Voltage : 415V AC ±10%, 50 Hz, Current : 15A (Per Phase), Power : 10.5kW, Loading steps : 5 (per phase), MCBs : 10A (SP) No. of MCBs : 15 ➢ Auxiliary Supply for in built fan : 230V AC, 50 Hz ➢ Star/Delta Switch : 415V, 25A; MCB : 16A (TPN)	01	

		The Control panel should be provided to fit the instruments mentioned below of Size L - 1220mm x H-610mm x D - 230mm. The control panel should be mounted on M.S. Angle frame of size 35mrn x 35mm x 4mm of height 760 mm with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm ply-board with sun-mica fitted top of sin 1220mm x 305mm..	
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Machine-I

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus
1.	**(a)TO OBTAIN EFFICIENCY OF A DC SHUNT MACHINE USING SWINBURN'S TEST** **(b) TO OBTAIN SPEED CONTROL OF DC SHUNT MOTOR USING ARMATURE RESISTANCE CONTROL& FIELD RESISTANCE CONTRO**	**DC SHUNT MOTOR** DC Shunt motor 220V, 2.5 kW, 1500rpm Horizontal foot mounted internally fan cooled, with 4-point starter, class B insulation. The front and rear end cover should be covered with acrylic sheet with detachable hook clamp type for showing the internal parts of machine to student. Type : DC Motor, shunt wound, self excited, screen protected, horizontal foot mounted, fan cooled. Capacity : 2.5 kW Winding : Shunt wound. R.P.M. : 1500 to be displayed on Panel Board using Proximity Sensor fitted on shaft Volts. : 230 Insulation : Class 'B' Connections : All the terminals of armature and shunt field shall be brought over to a bakelite sheet, fixed to C.I. terminal box, fitted on top of Motor. **Base Plate** Motor will be mounted on fabricated base plate of MS channel base. **Machines should be from ISO Certified Company.** **Control Board :- Rust free powder coated control board made up of high grade Fibre moulded body (FRP) of minimum thickness 4 mm for better safety and in compliance with IS3021/IEC60335-1, tested from NABL accredited Lab. Shock proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab. The Enclosure is open from front side for fitting of Engraved diagram Bakelite plate. Back side door is with hinges & lock for open the door from back side suitable for table mounting.** The Control panel should be provided to fit the instruments mentioned below of Size L-1220mmxH-610mmxD-230mm. The control panel should be mounted on M.S. Angle frame of size35mmx35mmx4mm of height 760 mm with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm ply-board with sun mica fitted top ofsize1220mmx 305mm. (i) Digital DC Voltmeter Micro-controller based, NABL Certified, 0-300V – 2 Nos. (ii) Digital DC Ammeter Micro-controller based, NABL Certified, 0-10A – 2 Nos. (iii) Digital RPM Meter with Proximity Sensor – 01 No. (iv) DP MCB suitable for DC operation 220V – 01 No.	01

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		(v) 4 Point DC Starter 2.5 kW, suitable for above motor – 01 No. (vi) Insulated banana Jack terminals (BS-10) (vii) Patch chords. (viii) Instruction manual. **ADDITIONAL ACCESSORIES COMPULSORY ITEMS (EXTERNALLY CONNECTED) REQUIRE TO CONDUCT EXPERIMENT** (i) Three Phase/Single Phase Resistive Load Single Phase Operation Voltage : 240V AC ±10%, 50 Hz ; Current: 15A ; Power : 3.5 Kw ; Loading steps : 15 MCBs; Current rating: 10A (SP), No. of MCBs : 15 Three Phase Star Operation - Voltage: 415V AC ±10%, 50 Hz, Current : 5A (Per Phase); Power : 3.5kW; Loading steps : 5 (per phase); MCBs (act as switch) : 10A (SP) Three Phase Delta Operation - Voltage: 415V AC ±10%, 50 Hz, Current : 15A (Per Phase) Power : 10.5kW; Loading steps : 5 (per phase); MCBs : Current rating : 10A (SP); No. of MCBs : 15 Auxiliary Supply for in built fan: 230V AC, 50 Hz Star/Delta Switch: 415V, 25A; MCB : 16A (TPN) (ii) Tubular Rheostat 1.4 Amp 260 Ohms Tubular Rheostat 5 Amp 45 Ohms	
2	**TO OBTAIN EFFICIENCY AND VOLTAGE REGULATION OF A SINGLE PHASE TRANSFORMER BY SUMPNER'S TEST** **PERFORMANCE OF PARALLEL OPERATION OF TWO SINGLE PHASE TRANSFORMER**	*TRANSFORMER* 2 Nos. Single Phase Transformer 1 KVA 230/230V with Tappings at 50% & 86.6% Naturally Air Cooled Copper Double wound, Core type. The transformer will be housed in MS sheet box enclosure with top sheet and one side of MS Box should have window provision and having transparent acrylic sheet to see the internal parts. All the terminals of primary & secondary shall be brought over to transparent sheet fitted on top of the box through insulated banana Jack terminals (BS-10). **Transformer should be from ISO Certified Company.** **Control Board :- Rust free powder coated control board made up of high grade Fibre moulded body (FRP) of minimum thickness 4 mm for better safety and in compliance with IS3021/IEC60335-1, tested from NABL accredited Lab. Shock proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab. The Enclosure is open from front side for fitting of Engraved diagram Bakelite plate. Back side door is with hinges & lock for open the door from back side suitable for table mounting.** The Control panel should be provided to fit the instruments mentioned below of Size L-1220mmxH-610mmxD-230mm. The control panel should be mounted on M.S. Angle frame of size 35mmx35mmx4mm of height 760 mm with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm ply-board with sun-mica fitted top of size1220mmx 305mm. (i) Digital AC Voltmeter Micro-controller based, NABL Certified, 0-300V – 2 Nos.	01

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		(ii) Digital AC Voltmeter Micro-controller based, NABL Certified, 0-500V – 1 No. (iii) Digital AC Ammeter Micro-controller based, NABL Certified, 0-5A – 2 Nos. (iv) Digital Wattmeter Micro-controller based, NABL Certified 5 Amp, 250V – 1 No. (v) DP MCB 6 Amp – 01 No. (vi) Indicating Lamps LED type 16 mm dia – 1 No. (vii) Single Phase Variac, 6 Amp – 1 No. (viii) Insulating banana Jack terminals (BS-10). (ix) Patch chords. (x) Instruction manual. **ADDITIONAL ACCESSORIES COMPULSORY ITEMS (EXTERNALLY CONNECTED) REQUIRE TO CONDUCT EXPERIMENT** (i) Three Phase/Single Phase Resistive Load Single Phase Operation Voltage : 240V AC ±10%, 50 Hz ; Current: 15A ; Power : 3.5 Kw ; Loading steps : 15 MCBs; Current rating : 10A (SP); No. of MCBs : 15 Three Phase Star Operation - Voltage : 415V AC ±10%, 50 Hz, Current : 5A (Per Phase); Power : 3.5kW; Loading steps : 5 (per phase); MCBs (act as switch) : 10A (SP) Three Phase Delta Operation - Voltage : 415V AC ±10%, 50 Hz, Current : 15A (Per Phase) Power : 10.5kW; Loading steps : 5 (per phase); MCBs : Current rating : 10A (SP); No. of MCBs : 15 Auxiliary Supply for in built fan : 230V AC, 50 Hz Star/Delta Switch : 415V, 25A; MCB : 16A (TPN)	

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Machine1

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus/ Equipment
3.	**TO STUDY LOAD TEST ON DC SERIES MOTOR**	**DC SERIES MOTOR** DC Series motor 220V, 2.5 kW, 1500 rpm Horizontal foot mounted internally fan cooled, with 2-point starter, class B insulation. The front and rear end cover should be covered with acrylic sheet with detachable hook clamp type for showing the internal parts of machine to student. Type : DC Motor, series wound, self excited, screen protected, horizontal foot mounted, fan cooled. Capacity : 2.5 kW Winding : Series wound. R.P.M. : 1500 to be displayed on Panel Board using Proximity Sensor fitted on shaft Volts. : 230 Insulation : Class 'B' Connections : All the terminals of armature and series field shall be brought over to a bakelite sheet, fixed to C.I. terminal box, fitted on top of Motor. Mechanical Loading : Loading of the Motor shall be made through Pronney brake arrangement, consisting of a C.I. drum pulley, suitable for water cooling, **Calibrated Digital**	01

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			Linear Sensor with LCD Display for torque, weight in kg and diameter of the pulley, canvas belt with hooks, C.P. wheels with threaded studs for tightening the belt, frame. The pronney brake loading arrangement should be flexibly coupled (through Love-Joy coupling) to shaft of the motor so that motor is easily detachable from the mechanical loading arrangement as and when required. **Machines should be from ISO Certified Company.** **<u>Control Board</u> :- Rust free powder coated control board made up of high grade Fibre moulded body (FRP) of minimum thickness 4 mm for better safety and in compliance with IS3021/IEC60335-1, tested from NABL accredited Lab. Shock proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab. The Enclosure is open from front side for fitting of Engraved diagram Bakelite plate. Back side door is with hinges & lock for open the door from back side suitable for table mounting.** The Control panel should be provided to fit the instruments mentioned below of Size L-1220mmxH-610mmxD-230mm. The control panel should be mounted on M.S. Angle frame of size35mmx35mmx4mm of height 760 mm	

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		with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm ply board with sun mica fitted top of size1220mmx 305mm. (i) Digital DC Voltmeter Micro-controller based, NABL Certified, 0-300V – 1 No. (ii) Digital DC Ammeter Micro-controller based, NABL Certified, 0-10A – 1 No. (iii) LCD Display for measure the torque, weight in kg and diameter of the pulley – 1 No. (iv) DP MCB suitable for DC operation 220V – 01 No. (v) 2 Point DC Starter 2.5 kW, suitable for above motor – 01 No. (vi) Insulated banana Jack terminals (BS-10) (vii) Patch chords. Instruction manual	

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Machine-II Lab

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartust
1	MAKE CONNECTION OF DOL STARTER/STAR-DELTA STARTER/AUTO TRANSFORMER STARTER/ROTOR RESISTANCE STARTER FOR APPROPRIATE THREE PHASE INDUCTION MOTOR	QUARTER CUT SECTION : 3 PHASE INDUCTION MOTOR Cut Out model of 3 Phase Squirrel Cage Induction Motor, consisting of quarter cut section, including shaft of the enclosed cover to show the constructional details of the Motor. The Motor is fitted on an appropriate size of M.S. channel frame. Silicon Steel laminations are used for STATOR and ROTOR Core and S.E. copper wire for Stator winding and Aluminum BAR for ROTOR winding, having provision of showing Rotor caging and Ring and Stator winding and Insulation. The Model is a working one and all parts are marked. Type : Squirrel Cage Phase : Three Capacity : 2.5kW R.P.M. : 1460 to be displayed on Panel Board using Proximity Sensor fitted on shaft Volts : 415 Starting : Star/Delta, DOL Insulation : Class 'B' Enclosure : foot mounted Connections : All the six terminals of stator winding are brought over to a engraved bakelite sheet, fixed to C.I. terminal box, fitted on top of Motor. **Machines should be from ISO Certified Company.** **Base Plate** Motor will be mounted on fabricated base plate of MS channel base. *QUARTER CUT SECTION : 3 PHASE SLIPRING MOTOR* Cut Model of three phase Slipring Induction Motor, consisting of Quarter cut section of the enclosed cover to show the constructional details of the wound Rotor and Stator, Sliprings. Silicon Steel Lamination are used for Stator and Armature Core (Wound Rotor) assembly. S.E. Copper wire is used for winding of Stator and Rotor. All the connections of Stator and wound Rotor are brought out on the Bakelite plate. Provision has been made to show the details of Stator, wound Rotor, Slipring and Scissors holder with Carbons and windings. All parts properly marked and the Model is a working one. Type : Phase Wound Phase : Three Capacity : 2.5 kW R.P.M. : 1460 to be displayed on Panel Board using Proximity Sensor fitted on shaft Volts : 415 Starting : Rheostatic Insulation : Class 'B'	01

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		Connections : All the terminals of stator & rotor windings are brought over to a engraved bakelite sheet, fixed to C.I. terminal box, fitted on top of Motor. **<u>Base Plate</u>** Motor will be mounted on fabricated base plate of MS channel base. **<u>Control Board</u> :- Rust free powder coated control board made up of high grade Fibre moulded body (FRP) of minimum thickness 4 mm for better safety and in compliance with IS3021/IEC60335-1, tested from NABL accredited Lab. Shock proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab. The Enclosure is open from front side for fitting of Engraved diagram Bakelite plate. Back side door is with hinges & lock for open the door from back side suitable for table mounting.** The Control panel should be provided to fit the instruments mentioned below of Size L - 1220mm x H- 610mm x D - 230mm. The control panel should be mounted on M.S. Angle frame of size 35mm x 35mm x 4mm of height 760 mm with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm plyboard with sunmica fitted top of size 1220mm x 305mm. (i) Digital AC Voltmeter Micro-controller based, NABL Certified, 0-500V – 1 No. (ii) Digital AC Ammeter Micro-controller based, NABL Certified, 0-10 A – 1 No. (iii) Digital RPM Meter with Proximity Sensor – 01 No. (iv) TPN MCB 10 Amp – 01 No. (v) Indicating Lamps LED type 16 mm dia – 3 Nos. (vi) DOL Starter – 01 No. (vii) Star/Delta Starter Fully Automatic – 01 No. (viii) Auto Transformer Starter – 01 No. (ix) Rotor Resistance Starter with Interlocking protection arrangement for motor to start gradually only when resistance is fully introduced in rotor cirucit at the time of starting – 01 No. (x) Insulating Terminals. (xi) Patch chords. *Instruction manual*	
2	Test the Performance of Synchronous Motor at different load condition To see the effect of variation of Excitation and Power Factor (V & Inverted V Curve	**<u>MACHINES REQUIRED</u> :** **<u>SYNCHRONOUS MOTOR WITH MECHANICAL LOADING ARRANGEMENT & DC EXCITOR</u>** <u>SYNCHRONOUS MOTOR</u> Type : Self synchronising Induction Start with built in separate DC Excitor, Screen protected. Horizontal foot mounted. The front and rear end cover should be covered with acrylic sheet with detachable hook	01

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		clamp type for showing the internal parts of machine to student.	
	Capacity	: 2.5 kW	
	RPM	: 1500 to be displayed on Panel Board using Proximity Sensor fitted on shaft	
	Volts	: 415	
	Insulation	: Class 'B'	
	Connections	: All connections brought over to a terminal box fixed to top of motor.	
	Excitation	: Shunt type	
	Starter	: D.O.L. Starting	
	Mechanical Loading	: Loading of the Motor shall be made through Pronney brake arrangement, consisting of a C.I. drum pulley, suitable for water cooling, **Calibrated Digital Linear Sensor with LCD Display for torque, weight in kg and diameter of the pulley**, canvas belt with hooks, C.P. wheels with threaded studs for tightening the belt, frame. The pronney brake loading arrangement should be flexibly coupled (through Love-Joy coupling) to shaft of the motor so that motor is easily detachable from the mechanical loading arrangement as and when required.	
	DC EXCITOR		
	Type	: DC excitor screen protected horizontal foot mounted.	
	Capacity	: 0.5 KW	
	Cooling	: Fan cooled	
	RPM	: 1500	
	Volts	: 230 V. DC	
	Insulation	: Class 'B'	
	Connections	: Shunt All terminals of armature & field coil brought over to a terminal box fitted on top of Motor.	
	Machines should be from ISO Certified Company.		

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Coupling & Mounting :

Motor and Excitor are coupled with Elastomeric coupling with Base arrangement & coupling guard on a common M.S. base. Coupling guard also provided.

Control Board :- **Rust free powder coated control board made up of high grade Fibre moulded body (FRP) of minimum thickness 4 mm for better safety and in compliance with IS3021/IEC60335-1, tested from NABL accredited Lab. Shock proof banana jack terminal (BS-10), BS10 safety terminals are in compliance with IS302-1/IEC60335-1, tested from NABL accredited Lab. The Enclosure is open from front side for fitting of Engraved diagram Bakelite plate. Back side door is with hinges & lock for open the door from back side suitable for table mounting.**

The Control panel should be provided to fit the instruments mentioned below of Size L - 1220mm x H- 610mm x D - 230mm. The control panel should be mounted on M.S. Angle frame of size 35mm x 35mm x 4mm of height 760 mm with provision for grouting on floor through fasteners. The frame should have extended platform with hinges made of 19mm plyboard with sunmica fitted top of size 1220mm x 305mm.

FOR SYNCHRONOUS MOTOR

(i) Digital AC Voltmeter Micro-controller based, NABL Certified, 0-500V – 1 No.
(ii) Digital AC Ammeter Micro-controller based, NABL Certified, 0-10A – 1 No.
(iii) Digital RPM Meter with Proximity Sensor – 01 No.
(iv) Digital Multifunction Meter with graphical LCD display NABL Certified – 01 No.
(v) Indicating Lamps LED type 16 mm dia – 3 Nos.
(vi) LCD Display for measure the torque, weight in kg and diameter of the pulley – 1 No.
(vii) D.O.L Starter – 01 No.
(viii) Excitation Switch
(ix) Insulating Terminals.
(x) Patch chords.

FOR DC EXCITOR

(i) Digital DC Voltmeter Micro-controller based, NABL Certified, 0-300V – 1 No.
(ii) Digital DC Ammeter Micro-controller based, NABL Certified, 0-2A – 1 No.
(iii) Field control separately excited unit suitable for above alternator (Static type) – 01 No.
(iv) Indicating Lamps LED type 16 mm dia – 1 No.
(v) Insulating Terminals.
(vi) Patch chords.
(vii) Instruction manual.

ADDITIONAL ACCESSORIES COMPULSORY ITEMS (EXTERNALLY CONNECTED) REQUIRE TO CONDUCT EXPERIMENT

Tubular Rheostat 1.1 Amp, 800Ω – 1 No

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Electrical and Electronics MEASUREMENT Lab

Sl. No	Name of Experiment	Specification of Apparatus/Equipment	Required Qty of Appartus/ Equipment
1.	**Maxwell's Bridge Trainer Kit**	**Maxwell's Bridge Trainer Kit** **Salient Features** • Aesthetically designed injection molded electronic desk carrying useful experiment resources Variable Power supplies / Status / Pulsar / Function Generator, DPMs etc. while the central slot will carry replaceable experiment panel secured in an ABS molded plastic sturdy enclosure, & has colorful screw less overlay showing circuit & its connection tag numbers for easy connectivity. • Connection through Sturdy 4mm Banana Sockets & Patch Cords. •Set of Users Guide provided with each Unit. **Specifications** •**Built in Power Supply :** DC Supply :5V / 1A. & ± 12V, 1A. 0 to 15V DC (Variable), 100 mA (Isolated), 0 to 30V DC (Variable), 100 mA (Isolated High Volt DC 15V to 110V, 100Ma, AC Supply : 12-0-12V AC,150 mA. Short circuit Protected. •**Built in Function Generator –** O/p Waveform : Sine, Triangle & TTL O/Ps Output Frequency : 1 Hz to 1MHz in 6 ranges, with amplitude & frequency control pots. O/P Voltage 20Vp-p max. (Sin/TRG), Modulation I/P:AM : - I/P voltage + 5V (100% modulation) O/P - For 0V (min), + 5V (max.) - 5V (Phase reversal of O/P) FM : I/P voltage ± 400mV (+ 50% modulation) •**Clock Generator :** 10 MHz TTL clock. •Data Switches (10 No.) & bi-colour LED status indicators 10X2 Nos, for High / Low indication. •**Pulser switches** (2 Nos.) with four debounced outputs - 2No. •BNC to 2 channel banana adapter - 2No. •Logic probe to detect High/Low level pulses upto 1MHz, with bi-colour LEDs to indicate status. •2 / 4 digit 7 segment display with BCD to 7 segment decoder. •Onboard DPMs provided with mode/range selection. (A) DC volt : 2V/200V - 1No. (B) DC current : 2mA/200mA - 1No. (C) DC Volts/Current : 20V/200mA - 1No. •**Onboard moving iron meters provided for** (A) AC Current : 1 AMP - 1No. (B) AC Voltage : 15V - 1No.	01

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		•Onboard speaker : 8 Ohms, 0.5 Watt (1No.) •Onboard POTS : 1K - 1No. 1M - 1No. •Operating Voltage: 220/240Vac switch settable ±10%, 50Hz/60VA. **DC/AC Bridge circuits Expt. Panel** : Wheatstone's Bridge, Kelvin's Bridge, Maxwell's Bridge, Hay's Bridge, DC Sauty's Bridge, Owen's Bridge, Anderson's Bridge, Shearing Bridge, Wien bridge. Provided with 2 capacitor decades [100pF to 100uF]. 1 resistor decade [10E to 100mohm], 1 tapped wire wound 10 taps (0.01 ohm) 10k, 10T pot, 1000 ohm pot, fixed resistors of 10 & 4.7 ohm, Earphone & its socket. **Inclusive of 1 year of onsite warranty and trainer should be safety aesthetically designed injection molded desk not wooden box (anti Green), not metallic box (Corrosive and shock possibility for the students).**	

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