SPECIFICATION FOR ELECTRICAL AND ELECTRONICS WORK BENCHES

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1.1 Basic Indicative Diagram

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An integrated workbench consisting of instrument panel and working table should suitable for students to learn and perform various experiments of electronics and electrical related subjects. Instruments should internally electrically connected and should be fitted in the panel such that only front panel and necessary interfaces are easily accessible to use. Structure of workbench should be made up of 1.5 mm thick CRC powder coated pipes with top made up of good quality 19 mm thick plywood and covered with 1.8 mm off white colour mica. The bench working area should be covered by 2 mm thick antistatic mat which help students to controls static discharge as static cause interference or damage to students, equipment and circuitry. There should be demonstration / training at consignee end on how to use Workbench and utilization of this bench for various applications.

1.3 Structure and design of Workbench should follow the below specifications:

1.3.1 The basic structure should be made of 38 X 38 X 1.5 mm CRC powder coated pipes for sturdiness.

1.3.2 The overall dimensions of Workbench should be not less than Width = 1200 mm; Depth = 750 mm; Height = 1150 mm

1.3.3 MS drawers 03 numbers:
Width = 275 mm; Depth = 375 mm; Height = 100 mm and Thickness = 1.2mm with handle & separate lock on each drawer should be provided

1.3.4 For the panel section, raised back height of 1200mm from floor with matching height support from the side at a depth 500mm for instrument housing with a MS Panel strip below it for housing Electrical Sockets and Switches for external use.

1.3.5 Two Pole MCB (32A – Havells / Siemens) to be provided for safety of Workbench

1.3.6 There should be provision to mount main / mother training and development platform on front panel along with the instruments for easy performing the experiments which should provide visibility for the students working in a group.

1.3.7 Workbench should work on Mains Supply - 240 V AC, 50 Hz

1.4 **Technical specifications of instruments and facility to be installed on the Workbench should be as under:**

1.4.1 50 MHz Four Channel Digital Storage Oscilloscope

1.4.2 10 MHz Function Generator with Counter (DDS Technology)

1.4.3 Dual DC Programmable Power Supply, 2 X 30 V, 2 A

1.4.4 Temperature controlled Soldering and De soldering station with soldering iron and de soldering gun

1.4.5 Multimeter cum LCR Meter

1.4.6 Transformer

1.4.7 Induction Coil

1.4.8 Rheostat and Dimmer

1.4.9 Various Meter assembly – Analog voltmeter, ammeter, wattmeter, multifunction meter, energy meter, power factory meter, frequency meter and flux meter

1.4.10 A set of training platform with experimental boards to cover experiments mentioned

1.5 **50 MHz Digital Storage Oscilloscope:**

50 MHz, 4 analog Channel Digital Storage Oscilloscope should have 1 GSa / s sampling and minimum 12 Mpts Memory Depth, Vertical range 1 mV / div -10V / div, Horizontal range 5ns / div to 50 s / div, PC interface USB Host and Device, LAN, Aux Output (Trig Output / passfail), it should also have automatic measurements and Frequency counter, advance and multi triggering like edge, slope, pulse, video, pattern facilities, 7 inches WVGA TFT Display.

1.6 **10 MHz Function Generator with Frequency Counter (DDS Technology):**

Direct Digital Synthesis based waveform generation technique, 3.5 Inch TFT True Color LCD, 10 MHz Sine, 4 MHz Square and 350 Khz Pulse, Ramp, Triangle and Arbitrary waveforms 5 MHz, Noise, and DC waveforms, More than 25 Arbitrary waveforms, 10 Bits, 100 MSa/s, 4 K points arbitrary waves, AM, FM and FSK modulation types, Sweep and Burst / ASK operation, 10 mVpp to 20 Vpp amplitude range, graphical interface for user to create and generate custom waveforms, display of many parameters on same screen, time mark generation, 50 MHz External Frequency Counter, serial interface.

1.7 **30 V - 2 A Dual output DC Programmable Power Supply:**

Dual DC 0-30 V, 0-2 A Power Supply with color LCD for Voltage and Current, Step increment for Voltage - Keypad, Cursor and Encoder for setting, Constant Voltage and Constant Current Source, Resolution Voltage 100 mV, Current 10 mA, Load and Line Regulation with standard parameter, indication of Over load, over voltage, over current and short circuit by beeper, Front panel control through state of art technology using microcontroller.

1.8 **Soldering / De soldering Station:**

60 W Microcontroller based Temperature Controlled Soldering and De soldering Station with Set / Read of temperature with separate display for soldering and disordering, Menu keys to set temperature, Digital calibration to avoid analog components tolerances, Burn proof silicon cable with thermal resistance up to 600° C, Blower with 12V DC SMD Iron, de soldering pump diaphragm type, Input voltage for soldering and de soldering 170 to 270 V, temperature range for soldering 180 to 270°C and for de soldering 180° to 480°C. SMD Iron to solder and de solder SMD components.

1.9 **Digital Multimeter cum LCR Meter:**

Large 1999 Counts LCD Display 3 ½ Digital Multimeter with LCR Tests AC / DC Voltage and Current, Resistance, auto ranging Frequency and Capacitance, Transistor (hFE) Check, duty cycle, Diode and Continuity measurement Data Hold and Display Back Light Safety DC voltage range 200 mV to 1000 V, DC current Range 20 mA to 10 A, AC Voltage 200 mV to 750 V, AC Current 20 mA to 10 A, Resistance 200 Ohm to 2000 M Ohm, Frequency 2 KHz - 15 MHz, Capacitance 2 nF to 200 microF, Inductance 2 mH to 20 H, Diode Test 1.0 mA $\pm$ 0.6 mA 3 Vmax, Duty Cycle Range 10% to 90%

1.10 **1KVA Single Phase Transformer**

1.10.1 Rating: 1KVA
1.10.2 Primary Voltage: 0-125V, 0-125V
1.10.3 Secondary Voltage: 0-125V, 0-125V with multi taping arrangement
1.10.4 Flexibility to configure step-up, step-down and Isolation Transformer.
1.10.5 Load Test and correspondingly determine the Efficiency and Voltage Regulation in a Single Phase Transformer
1.10.6 Study of Transformer
- 1.10.6.1 Study of Transformation Ratio in a Single Phase Transformer
- 1.10.6.2 Study of Polarity Test in a Single Phase Transformer
- 1.10.6.3 Study of Open Circuit Test in a Single Phase Transformer
- 1.10.6.4 Study of Short Circuit Test in a Single Phase Transformer

1.11 **Inductor Coil:**

3 Nos to Study Power Factor through inductive coil 0.8 mH, 500 mA, Input 240 v AC

1.12 **Dimmer stat and Rheostat**:

Single phase close type 10 A Dimmer stat with output range is 0-270 V AC and operating range is 240 V AC**,** Sliding type 220 Ohm, 2.8 A Rheostat with insulated wire copper carbon brush sliding contacts

1.13 **Various Meter Assembly:**

1.13.1 Digital Panel Meter:
- 1.13.1.1 Should be Microcontroller based, reliable and accurate designed with 3.5 Digit Seven Segment Display in following ranges:
- 1.13.1.2 AC Voltmeter - Voltage (02 Nos): 0 –500V
- 1.13.1.3 DC Voltmeter - Voltage (02 Nos): 0 – 300V
- 1.13.1.4 AC Ammeter - Current (02 Nos): 0 – 10A
- 1.13.1.5 DC Ammeter - Current (02 Nos): 0 – 10A

1.14 **Analog Meters (1 each):**
Analog voltmeter DC (0-10 V), (0-1 V) and Analog Ammeter (0 -1 A), (0-500 mA)

1.15 **Single Phase Wattmeter:**
Microcontroller based Accurate and Reliable design, 4 - Digit Seven Segment Display Input voltage 0-250 V AC, Input Current: 0 – 5A AC, Watt : 10-1500 W

1.16 **Single Phase Multifunction Meter:**
Single phase multifunction meter to measure seven different parameters like Voltage : 10 – 240 Vrms, Current : 0.2 – 5 Arms, Active Power : 10-1200 Watt, Apparent Power : 10-1200 VA, Reactive Power: 10-1200 VAR, Frequency 45-55 Hz, Power Factor 0.50L – 0.50C with display on seven segment.

1.17 **Digital Energy Meter:**
Microcontroller based Accurate & Reliable design, CT is used as current transducer for better accuracy, 4-Digit High brightness Seven Segment Display.

1.18 **Power Factor Meter:**
Microcontroller based Accurate & Reliable design, 4-Digit High brightness Seven Segment Display, Frequency Accuracy 45 - 55 Hz.

1.19 **Frequency Meter:**
Accurate & reliable direct reading design, 4 Digit High brightness seven segment display, directly reads mains line frequency between 45 to 55 Hz.

1.20 **Flux Meter:**
Type: Digital 4 digit seven segment display; range: 0.1 to 10 Kilo Gauss; sensor probe with a protective cover; Mains operated.

1.21 **A set of training platform with experiment boards to cover experiments mentioned:**
The training platform should have functional blocks indicated on mimic, on board DC and AC power supplies, Function Generator 1Hz to 100KHz in 06 decades Sine / Square / Triangle waveforms and variable amplitude upto 5V, on board 16 bit data switches and 16 bit LED display, on board Speaker, and Potentiometers, BCD to Seven segment display and pulsar switch (push to on). The training platform must have on board 2 channel of voltage measurement v1, v2 (0-15v), 2 channel of current measurement I1, I2 (0-100 ma), both channel reading must be display on 16X2 LCD.
All experiment boards / modules and should have internally mounted active and passive components, test points, facility to measure signal and waveform at various stages in the circuit, block diagram of the circuit should be printed on mimic, should have an option to work with build in or external power supplies given with other instruments and with main training platform / workbench. The main training platform should have minimum size of 300mm X250mm and the experiment modules / boards should have minimum size of 125mm X 170mm.The complete solutions should comprise with following experimental boards:

1.21.1 Verification of Kirchhoff's Current Law and Voltage Law

1.21.2 Study of V-I characteristics of Silicon Diode, Zener Diode, Light Emitting Diode (LED)

1.21.3 CB, CE, CC configuration of PNP / NPN Transistor and to evaluate Input resistance, Output resistance and Current gain

1.21.4 Study the characteristics of MOSFET, JFET, UJT, DIAC, TRIAC, SCR, IGBT, PUT
1.21.5 SCR triggering circuits, triggering techniques of SCR, Triggering of SCR using UJT, using IC 555 and using IC 74121, application of SCR as a lamp flasher, SCR Alarm Circuit
1.21.6 Study of Half-Wave Rectifier, Full-wave Center-tapped Rectifier, Full-wave Bridge Rectifier
1.21.7 Study of Zener Diode as a Voltage Regulator, with line & load regulation, Transistor Series Voltage Regulator, Transistor Shunt Voltage Regulator,
1.21.8 Study of Clipper (Positive / Negative, Series / Shunt) and Clamper Circuits
1.21.9 Study of design and functioning of Hartley Oscillator, Colpitt Oscillator, Wein Bridge Oscillator, Voltage Controlled Oscillator, Phase shift Oscillator
1.21.10 To study the IC 555 as a MoNostable (One-Shot) Multivibrator, Astable (Free-Running) Multivibrator, Bistable Multivibrator
1.21.11 Study of Series & Parallel R-L-C Resonance
1.21.12 Study of single stage and multi stage RC–Coupled amplifier
1.21.13 Study of Logic gates AND, OR, NOT, NAND, NOR, XOR, XNOR and to verify its truth table
1.21.14 Design of Logic gates using Universal gates NAND / NOR.
1.21.15 Methods of generating EX - OR function, Application of Ex-OR gate; Parity Generator
1.21.16 To verify De-Morgan's theorem
1.21.17 Study of Binary Half Adder, Full Adder, Half Subtractor
1.21.18 Study of S-R Flip-Flop, J-K Flip-Flop, D Flip-Flop, T Flip-Flop and to verify its Transition table
1.21.19 Study of 4-to-1 Line Multiplexer and 1-to-4 Line De-Multiplexer

1.22 **Standard Accessories:**

1.22.1 Operating manual of complete workbench installed in PC
1.22.2 4 no. 1 X 10 Switchable probe 50 MHz (with 10X), USB to Host cable, power cord
1.22.3 BNC to BNC cable 01 no, BNC to test probe 01 No, DMM cord one set, 2mm to 2mm patch cords 10 Nos, connecting patch cords, antistatic mat, soldering / de soldering stand, wrist band, power cord.

1.23 **Space Requirement for Installation:**

1.23.1	Overall Length:	1200 mm
1.23.2	Overall Width:	750 mm
1.23.3	Overall Height:	1150 mm
1.23.4	Net Weight:	200 Kg (Approx.)

1.24 **Electric Supply Specification:** 240V AC 50 HZ

2 Electronics Work Bench

2.1 Basic Indicative Diagram

2.2 Basic Item Specification:

An integrated workbench consisting of instrument panel and working table should suitable for students to learn and perform various experiments of electronics and electrical related subjects. Instruments should internally electrically connected and should be fitted in the panel such that only front panel and necessary interfaces are easily accessible to use. Structure of workbench should be made up of 1.5 mm thick CRC powder coated pipes with top made up of good quality 19 mm thick plywood and covered with 1.8 mm off white colour mica. The bench working area should be covered by 2 mm thick antistatic mat which help students to controls static discharge as static cause interference or damage to students, equipment and circuitry. There should be demonstration / training at consignee end on how to use Workbench and utilization of this bench for various applications.

2.3 **Structure and design of Workbench should follow the below specifications:**

2.3.1 The basic structure should be made of 38 X 38 X 1.5 mm CRC powder coated pipes for sturdiness.

2.3.2 The overall dimensions of Workbench should be not less than Width = 1200 mm; Depth = 750 mm; Height = 1150 mm

2.3.3 MS drawers 03 numbers:
Width = 275 mm; Depth = 375 mm; Height = 100 mm and Thickness = 1.2mm with handle & separate lock on each drawer should be provided

2.3.4 For the panel section, raised back height of 1200 mm from floor with matching height support from the side at a depth 500 mm for instrument housing with a MS Panel strip below it for housing Electrical Sockets and Switches for external use.

2.3.5 Two Pole MCB (32A – Havells / Siemens) to be provided for safety of Workbench

2.3.6 Display of computer should be fitted in front panel for easy viewing and separate tray to keep keyboard and mouse.

2.3.7 Workbench should work on Mains Supply – 240 V AC, 50 Hz

2.4 **Technical specifications of instruments and facility to be installed on the Workbench should be as under:**

2.4.1 50 MHz Four Channel Digital Storage Oscilloscope

2.4.2 10 MHz Function Generator with Counter (DDS Technology)

2.4.3 Dual DC Programmable Power Supply, 2X30 V, 2 A

2.4.4 Multimeter cum LCR Meter

2.4.5 Temperature controlled Soldering and De Soldering station with soldering iron and de soldering gun

2.4.6 Dimmerstat and Rheostat

2.4.7 A set of training platform with experimental boards on Analog, Digital and Power Electronics

2.4.8 Analog Voltmeter and Ammeter

2.4.9 Single unit PC loaded with Electronic circuit design and simulation software.

2.5 **50 MHz Digital Storage Oscilloscope:**

50 MHz 4 analog Channel Digital Storage Oscilloscope should have 1GSa / s sampling and minimum 12 Mpts Memory Depth, Vertical range 1 mV / div -10 V / div, Horizontal range 5ns / div to 50 s / div, PC interface USB Host and Device, LAN, Aux Output (Trig Output / passfail), it should also have automatic measurements and Frequency counter, advance and multi triggering like edge, slope, pulse, video, pattern facilities, 7 Inches WVGA TFT Display.

2.6 **10 MHz Function Generator with Frequency Counter (DDS Technology):**

Direct Digital Synthesis based waveform generation technique, 3.5 Inch TFT True Color LCD, 10 MHz Sine, 4 MHz Square and 350 Khz Pulse, Ramp, Triangle and Arbitrary waveforms 5 MHz, Noise, and DC waveforms, More than 25 Arbitrary waveforms, 10bits, 100MSa/s, 4K points arbitrary waves, AM, FM and FSK modulation types, Sweep and Burst / ASK operation, 10mVpp to 20Vpp amplitude range.

2.7 **30V - 2A Dual output DC Programmable Power Supply:**

Dual DC 0-30 V, 0-2A Power Supply with color LCD for Voltage and Current, Step increment for Voltage - Keypad, Cursor and Encoder for setting, Constant Voltage and Constant Current Source, Resolution Voltage 100 mV, Current 10mA, Load and Line Regulation with standard parameter, indication of Over load, over voltage, over current and short circuit by beeper, Front panel control through state of art technology using microcontroller.

2.8 **Digital Multimeter cum LCR Meter:**

Large 1999 Counts LCD Display 3 ½ Digital Multimeter with LCR Tests AC / DC Voltage and Current, Resistance, auto ranging Frequency and Capacitance, Transistor (hFE) Check, Duty Cycle, Diode and Continuity measurement Data Hold and Display Back Light Safety DC Voltage Range 200 mV to 1000 V, DC Current Range 20 mA to 10 A, AC Voltage 200 mV to 750 V, AC current 20 mA to 10 A, Resistance 200 ohm to 2000 M ohm, Frequency 2KHz -15MHz, Capacitance 2nF to 200 microF, Inductance 2mH to 20H, Diode Test 1.0mA +_ 0.6 mA 3 Vmax, Duty Cycle Range 10% to 90%

2.9 **Soldering / De soldering Station:**

60W Microcontroller based Temperature Controlled Soldering and De soldering Station with Set / Read of temperature with separate display for soldering and disordering, Menu keys to set temperature, Digital calibration to avoid analog components tolerances, Burn proof silicon cable with thermal resistance up to 600°C, Blower with 12V DC SMD Iron, de soldering pump diaphragm type, Input voltage for soldering and de soldering 170 to 270 V, temperature range for soldering 180° to 270°C and for de soldering 180° to 480°C. SMD Iron to solder and de solder SMD components.

2.10 **Dimmerstat and Rheostat:**

Single phase close type 5A Dimmerstat with output range is 0-270 V AC and operating range is 240V AC.

Sliding type 300 Ohm, 0.8 A Rheostat with insulated wire copper carbon brush sliding contacts. Sliding type 220 Ohm, 2.8 A Rheostat with insulated wire copper carbon brush sliding contacts. Sliding type 110 Ohm, 5A Rheostat with insulated wire copper carbon brush sliding contacts

2.11 **A set of training platform with experiment boards on Analog, Digital and Power Electronics:**

The training platform should have functional blocks indicated on mimic, on board DC and AC Power Supplies, Function Generator 1 Hz to 100KHz in 06 Decades Sine / Square / Triangle Waveforms and Variable Amplitude upto 5V, on board 16 Bit Data switches and 16 Bit LED display, on board Speaker, and Potentiometers, BCD to Seven segment display and pulsar switch (push to on). The training platform must have on board 2 channel of voltage measurement V1, V2 (0-15 V), 2 channel of current measurement I1, I2 (0-100 ma), both channel reading must be display on 16X2 LCD.

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2.11.5 SCR triggering circuits, triggering techniques of SCR, Triggering of SCR using UJT, using IC 555 and using IC 74121, application of SCR as a lamp flasher, SCR Alarm Circuit
2.11.6 Study of Half-wave Rectifier, Full-wave Center-tapped Rectifier, Full-wave Bridge Rectifier with Capacitor filter.
2.11.7 Study of Zener Diode as a Voltage Regulator with line & load regulation, Transistor Series Voltage Regulator, Transistor Shunt Voltage Regulator, 78xx, 79xx and Using IC 723 Regulator
2.11.8 Study of Clipper (Positive / Negative, Series / Shunt) and Clamper Circuits
2.11.9 Study of Active Low Pass Filter, High pass filter, Band Pass filter, Band Reject filter and to evaluate, Pass band gain and plot frequency response
2.11.10 Study of design and functioning of Hartley Oscillator, Colpitt Oscillator, Wein Bridge Oscillator, Voltage Controlled Oscillator, Phase shift Oscillator
2.11.11 To study the IC 555 as a Monostable (One-Shot) Multivibrator, Astable (Free-Running) Multivibrator, Bistable Multivibrator
2.11.12 Study of Series & Parallel R-L-C Resonance
2.11.13 Study of single stage and multi stage RC–Coupled amplifier, Darlington pair RC–Coupled Amplifier, Class B Amplifier, Transformer Coupled Amplifier,
2.11.14 Study of Operational Amplifier as Inverting Amplifier, Non - inverting Amplifier, Buffer, Comparator, Zero crossing detector, Schmitt Trigger, Adder, Subtractor, Square Wave Generator, Differentiator, Integrator, Logarithmic Amplifier, Voltage Controlled Current Source, Current Controlled Voltage Source, V to I and I to V converter
2.11.15 Study of Logic gates AND, OR, NOT, NAND, NOR, XOR, XNOR and to verify its truth table
2.11.16 Design of Logic gates using Universal gates NAND / NOR.
2.11.17 Methods of generating EX - OR function, Application of Ex-OR gate; Parity Generator
2.11.18 Binary to Gray, Gray to Binary conversion, and BCD to Excess-3
2.11.19 To verify De-Morgan's theorem
2.11.20 Study of Binary Half Adder, Full Adder, Half Subtractor
2.11.21 Study of S-R Flip-Flop, J-K Flip-Flop, D Flip-Flop, T Flip-Flop and to verify its Transition table
2.11.22 Study of 4-to-1 Line Multiplexer and 1-to-4 Line De-Multiplexer
2.11.23 Study of 4-bit synchronous binary up Counter, 4-bit asynchronous binary up / down Counter and a modulo-N programable Counter (IC 74LS190)

2.11.24 Study of shift registers (SISO, SIPO, PISO, PIPO)
2.11.25 BCD to 7 segment Decoder Using IC 74LS47
2.11.26 Study of different Optical Transducers, Photoconductive Cell, Photovoltaic Cell, Phototransistor, PIN Photodiode its signal conditioning circuitry and transducer controlled switching

2.12 **Analog meters (1 each):**
Analog voltmeter DC (0-10 V), (0-1V) and Analog Ammeter (0 -1 A), (0-500 mA)

2.13 **Single unit PC loaded with Electronic circuit simulation software:**
2.13.1 The All-in-One PC should come with following configuration and loaded with single user licensed Content and programs: 24" Full HD with Intel Core i3, 4GB DDR, 1TB 7200RPM hard disk, wired keyboard and mouse, 720P HD camera, 1DVDRW, with Windows10 single user License Copy.
2.13.2 Electronic circuit simulation software with 1 user license:
2.13.2.1 Circuit Design and Simulation Software with PCB Design with Gerber and G Code Generation
2.13.2.2 3D View of PCB
2.13.2.3 Breadboard View
2.13.2.4 Fault Creation and Simulation
2.13.2.5 Program to understand design, analysis, simulation and PCB layout of analog, digital, MCU and mixed electronic circuits.
2.13.2.6 It should have library consisting of sufficient types of components, measuring instruments and virtual instruments. Analyze SMPS, RF, Communication, power electronics and optoelectronic circuits.
2.13.2.7 3D view of selected components on the schematic diagram with run time simulation, visualization of PCB design with enclosures in 3D.
2.13.2.8 The software should support the symbolic analysis.

2.14 **Standard Accessories:**
2.14.1 Operating manual of complete workbench installed in PC
2.14.2 4 no 1 X 10 Switchable probe 50MHz (with 10X), USB to Host cable, power cord
2.14.3 BNC to BNC cable 01 no, BNC to test probe 01 No, DMM cord one set, 2mm to 2mm patch cords 10 Nos, connecting patch cords, antistatic mat, soldering / de soldering stand, wrist band, power cord.

2.15 **Space Requirement for Installation:**

2.15.1	Overall Length:	1200 mm
2.15.2	Overall Width in mm	750 mm
2.15.3	Overall Height in mm	1150 mm
2.15.4	Net Weight – Kg	200 Kg (Approx.)

2.16 **Electric Supply Specification:** 240V AC 50 HZ