

# BID DOCUMENT

## NATIONAL COMPETITIVE BIDDING

### FOR

SUPPLY, INSTALLATION, COMMISSIONING & MAINTENANCE OF EQUIPMENTS  
FOR  
ELECTRICAL ENGINEERING LABORATORY AT I.K.G.PTU KAPURTHALA  
AND ITS OTHER CONSTITUENT CAMPUSES (PUNJAB)

**Bid No. :** EdCIL/PROC/PTU-2017/LAB-BTECH-ELECTRICAL/ELECTRICAL -PKG1/1

## PART-II- FINANCIAL BID



### EdCIL (India) Limited

*(A Govt. of India Mini Ratna Enterprises)*

'EdCIL House', Plot No. 18A, Sector- 16A

NOIDA – 201301 (UP), INDIA

Tel: 0120 – 2512001-006, FAX: 0120-2515372

Dated: 09.05.2017

This document serially numbered from page number 01 to 52.

**FINANCIAL BID**  
**Instructions to Bidders**

1. Financial Bid shall be submitted with full price details.

Financial Bid shall contain only the prices duly filled in as per the format given in Schedule of Rates provided in the tender document. Price bid should not have any Commercial and/or Technical stipulation in addition to, what is already given in Part I – Technical bid.

Financial Bid Standard Forms (Form-1, Form-2A and /or Form-2B) shall be used for the preparation of the price quote according to the instructions provided.

2. **The Bidder should quote for all the Laboratory items / equipments listed in this document. In case, the Bidder/s does not quote for all the Laboratory items/Equipments, the Bid shall be treated as incomplete and shall be rejected summarily.**
3. The Items / equipments to be supplied / delivered / installed / commissioned at various locations of IKGPTU Campuses is as shown in the enclosed Annexure VI. The rate shall be inclusive of all taxes, octroi, transportation (as per the location), packing, loading and unloading (as designated location), Insurance etc. and nothing shall be paid extra.
4. The bid shall be evaluated on total value of all Laboratory items/Equipments as shown in summary and supply order shall be placed to a bidder as a composite bid.
5. The prices quoted by the bidder shall be fixed for the quantity mentioned for the duration of the contract and shall not be subject to adjustment on any account. Price should be firm for any positive or negative variation in quantities up to 100%.
6. The changes displayed in the corrigendum/addendum to the bid documents, particularly with the financial bid should be attached with the financial bid submission, in the same packet, duly signed and stamped by the authorized signatory of the Bidder firm.

**FINANCIAL BID SUBMISSION FORM**

To:

Chief General Manager (EIS & EPS)  
EdCIL (India) Limited  
EdCIL House, 18 A, Sector-16 A  
NOIDA – 201301 (U.P.), India

Dated: \_\_\_\_/\_\_\_\_/2017

Dear Sir,

We, the undersigned, offer to provide “SUPPLY, INSTALLATION , COMMISSIONING & MAINTENANCE OF LABORATORY EQUIPMENTS” in accordance with your Request for Proposal dated \_\_\_\_/\_\_\_\_/2017.

Our attached Financial Bid is for the amount of \_\_\_\_\_ *[Indicate the corresponding to the amount(s), currency(ies) {Insert amount(s) in words and figures}]*.

Please note that all amounts shall be the same as in Form-1. Our Financial Bid shall be binding upon by us subject to the modifications resulting from Contract negotiations, if any, up to expiration of the validity period of the Proposal.

We remain,

Yours sincerely,

Authorized Signature {In full and initials}:

Name and Title of Signatory:

In the capacity of:

Address:

E-mail:

**FORM-1****SUMMARY OF FINANCIAL BID**

S. No.	Description	Amount (exclusive of Tax) (Rs.)	Tax (Rs.)	Amount (Inclusive of Tax) (Rs.)
A.	ELECTRICAL ENGINEERING LABORATORY EQUIPMENTS (Form-2A and/or Form-2B)			
B.	Comprehensive Annual Maintenance (Annexure-IV)			
	<b>Total (Rs.)</b>			
Total Price Bid (exclusive of taxes) (in Words)				
(Rupees.....)				
Total Price of Bid (Inclusive of taxes) (In Words)				
(Rupees.....)				
Signature of bidder		.....		
Name & Address		..... ..... .....		
Note :	Date		.....	
i)	<b><i>Discount or any other offers affecting the package price must be mentioned here only. Discount or any other offers affecting the package price mentioned at any other place of the bid will not be considered.</i></b>			
ii)	<b><i>In case of discrepancy between unit price and total price, the unit price shall prevail.</i></b>			
iii)	<b><i>Bids shall be evaluated based on total price without taxes.</i></b>			

**FORM-2A**  
**(FINANCIAL BID)**

**PRICE SCHEDULED FOR GOODS TO BE IMPORTED FROM ABROAD**

ANNEXURE – I

Date: .....

Name of the Department:

Name of the Laboratory:

(A) **Price Schedule: (Format used for imported items)**

S.No.	Currency	Description and Specification of the Item	Qty. in Units	Unit Price	Agency Commission (If applicable)	Discount	Ex-works price	Packing + Handling + DOC + Inland Freight	FOB price	Insurance + Freight	CIF Price	Total Price
			(a)	(b)	(c)	(d)	(e)=(b+c-d)	(f)	(g)=(e+f)	(h)	(i) = (g+h)	(j) = (i*a)
	INR			(i)In Figures: (ii)In words:								

Total Price of Bid (In Words) .....

Signature of bidder .....

Name &amp; Address .....

Date .....

**Note:**

- The above financial template should be strictly followed. Any deviation from the above template (in terms of description and specification of the item) may debar the bidder at sole discretion of EdCIL.*
- Discount or any other offers affecting the package price must be mentioned here only. Discount or any other offers affecting the package price mentioned at any other place of the bid will not be considered.*
- In case of discrepancy between unit price and total price, the unit price shall prevail.*
- Bids shall be evaluated based on total price including all charges as CIF Price.*

## FORM-2B

## ANNEXURE-II

**PRICE SCHEDULED FOR INDIGENOUS GOODS****Price Schedule: (Format used for indigenous items).**

S.No.	Description and Specification of the Item	Qty. in Units	Unit Price in Rs.	Excise Duty %	CST/ VAT %	Insurance other duties and taxes if any,	Packing and Inland Transportat ion	CIF Price	Total Price in Rs. (Excluding Taxes)	Total Price in Rs. (Including Taxes)
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)=(b*a)	(i) = (g *a)
			(i)In Figures: (ii)In words:							
<b>Total Price of Bid (In Words)</b> .....										
<b>Signature of bidder</b>						.....				
<b>Name &amp; Address</b>						.....				
<b>Date</b>						.....				
<b>Note:</b> <ol style="list-style-type: none"> <li><i>The above financial template should be strictly followed. Any deviation from the above template (in terms of description and specification of the item) may debar the bidder at sole discretion of EdCIL.</i></li> <li><i>Discount or any other offers affecting the package price must be mentioned here only. Discount or any other offers affecting the package price mentioned at any other place of the bid will not be considered.</i></li> <li><i>In case of discrepancy between unit price and total price, the unit price shall prevail.</i></li> <li><i>Bids shall be evaluated based on total price including all charges as CIF Price.</i></li> </ol>										

### ANNEXURE – III

#### COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT PRICES SCHEDULE

S. No.	Item Description	2 <sup>nd</sup> Yr.	3 <sup>rd</sup> Yr.	Total Comprehensive Annual Maintenance Contract for 2 years(2 <sup>nd</sup> year & 3 <sup>rd</sup> year) after warranty period of 1 year from the date of successful installation. (E= C+D)
A	B	C	D	E
1.	Equipment: Make: Model: Qty.: (Mention Total quantity from Annexure-VI)			
<b>SUB-TOTAL(Rs.)</b> (Carry forwarded to Summary)				
Sub-Total Price Bid (exclusive of taxes) (in Words) (Rupees.....)				
Sub-Total Price of Bid (Inclusive of taxes) (In Words) (Rupees.....)				
Signature of bidder			.....	
Name & Address			..... .....	
<b>Note:</b>	<div style="display: flex; justify-content: space-between;"> <div>Date</div> <div>.....</div> </div>			
i)	<i>Discount or any other offers affecting the package price must be mentioned here only. Discount or any other offers affecting the package price mentioned at any other place of the bid will not be considered.</i>			
ii)	<i>In case of discrepancy between unit price and total price, the unit price shall prevail.</i>			
iii)	<i>Bids shall be evaluated based on total price without taxes.</i>			

**Note:**

- The above rates shall be included in computing the total cost of the equipments.
- Agency to use separate sheet for each equipment/Item/package.

## ANNEXURE-IV

### DETAILED TECHNICAL SPECIFICATIONS:

#### ELECTRICAL ENGINEERING LABORATORY EQUIPMENTS

#### (A). MICROCONTROLLER & PLC LABORATORY:

##### 1. 8051 Microcontroller Kit with LCD display

S. No.	Technical Specification
I.	8051 with 16 X 2 LCD Display or better.
II.	SMPS 5V/1.5 A, +12V, -12V
III.	101 Keys PC AT/PS2 Keyboard
IV.	RS232 Serial interface with Cable & PC up/down loading Software & Cross assembler on CD
V.	RS232 port to USB connector
VI.	CPU @ 20 MHz or better
VII.	32K EPROM
VIII.	16K/8K scratch pad RAM
IX.	48 I/O Lines using 8255
X.	3 Timer Counters using 8253
XI.	RTC Interface
XII.	Assembler and Disassembler
XIII.	All address and data lines brought out on 50 Pin FRC connector

##### 2. PLC TRAINER KIT:

S. No.	Technical Specifications
I.	No of digital Input : 12
II.	No of digital Output : 8
III.	Program Size(Words) :1024

IV.	Expansion Module : Expandable
V.	Toggle Switches : 3 or More
VI.	Latch Switches : 3 or More
VII.	IR Switches : 2 or More
VIII.	LED Display : 7 or More
IX.	Boolean execution speed : 0.33 $\mu$ s/sequential instruction in Avg. or better
X.	Interfacing : RS232/ RS485
XI.	Interface Modules : Traffic control Module, Elevator Module, Conveyor Belt Module, Bottle Filling Module or more
XII.	(With Appropriate configuration of reputed Computer & Software with supporting Operating System, Computer should be of HP/DELL/LENOVO)
	• Processor: i5 – 6 <sup>th</sup> Generation
	• RAM: 4GB
	• Hard-disk: 500GB

## (B). POWER ELECTRONICS & DRIVES LABORATORY

### 1. POWER ELECTRONICS TRAINER:

S. No.	Technical Specifications
I.	<b>Complete Setup For performing below experiments:-</b> <ol style="list-style-type: none"> <li>1. Single Phase SCR convertor.</li> <li>2. UJT characteristics &amp; trigger circuit.</li> <li>3. Series inverter circuit.</li> <li>4. Single-phase cyclo- converter.</li> <li>5. McMurray Half/Full- bridge inverter.</li> </ol>
II.	Mother Board:
	Should have Built in power supply
	DC supply : +/- 12V, 500mA,
	Unregulated Power supply 17V / 750mA,
	Regulated 13.5V/3A O/P must be provided as 12V Battery charging supply. In absence of battery, Same may be used as simulated battery source to run experiments on inverters etc.

	Isolated DC supply +12V/ 300mA with isolated common.
	AC supply: 230V AC line voltage must be made available on two banana 4mm sockets.
	Panel consisting of: Must have Two pulse transformers of 1:1:1 are provided for isolation & supplying firing pulses along with required DC Power supply.
III.	R-L-C Load Panel:
	Must have Provision of R-L-C Loads.
	On Board Power Devices: SCR, IGBT, MOSFET, UJT, DIAC, TRIAC, PUT
	On Board Firing Circuit for Power Devices.
IV.	Daughter Boards:
	1. Single Phase SCR convertor.
	2. UJT characteristics & trigger circuit.
	3. Series inverter circuit.
	4. Single-phase cyclo- converter.
	5. McMurray Half/Full- bridge inverter.

## 2. Single phase full-wave and fully controlled bridge rectifier Kit:

S. No.	Technical Specifications
I.	Instrumentation Power supply cum Multi- channel DPM Panel:
	<ul style="list-style-type: none"> <li>+/-12 V, 500 mA (b) +5V, 300mA</li> <li>Unregulated 17V dc/750 mA</li> <li>Line synchronizing signal.</li> <li>Multi channel DPM for digital display of speed, etc.</li> </ul>
II.	SCR Actuator (variable DC) cum sensor signal conditioning Panel :
	<ul style="list-style-type: none"> <li>Full bridge SCR based 0V-195V / 12 Amp cosine firing with Linear characteristics.</li> <li>Supports signal conditioning circuit for speed to give output 0-2.5Vdc (FS).</li> <li>2 Nos. of these supplies required for DC Armature &amp; DC motor field.</li> </ul>
III.	DC voltmeter and DC ammeter panel :
	<ul style="list-style-type: none"> <li>DC voltmeter (0-300V) or better</li> </ul>

	<ul style="list-style-type: none"> <li>• DC Ammeter (0-5A) or better with polarity protection diode</li> <li>• Field failure relay to control Armature supply.</li> </ul>
IV.	DC Integrated Motor:- 180V/300W/1500RPM or better with series shunt and compound windings, Chasis mounted table top with spring balance loading arrangement [10kg or better] and Electronic Tacho: 1V/1000RPM. Electrical Tacho: 10V/1000RPM.

### 3. Microcontroller based firing control Kit :

S. No.	Technical Specifications
I.	Training system should built in AC/DC Power Supply & On board firing circuit based on Microcontroller 8051.
II.	Output waveform should be observed on Test points.
III.	Should have LCD display.
IV.	Sockets to make different connections with appropriate interface.
V.	SCR assembly, pulse transformer and load should be onboard.

### 4. Three phase fully controlled bridge converter Kit:

S. No.	Technical Specifications
I.	Input 3 phase DOL Starter panel <ul style="list-style-type: none"> <li>• 4 Pole MCB of 415V/4A.</li> <li>• DOL 9A contactor with 230V/50Hz/11VA COIL.</li> <li>• Bimetallic thermal O/L relay with range 1.4A-2.3A.</li> </ul>
II.	DC voltmeter and DC ammeter panel <ul style="list-style-type: none"> <li>• DC voltmeter (0-600V) or better</li> <li>• DC Ammeter (0-5A) or better with polarity protection diode</li> </ul>
III.	Lamp Load <ul style="list-style-type: none"> <li>• 230V/15/40/60/100W X3 bulbs with individual ON/OFF using 6A toggle switch.</li> </ul>
IV.	Inductive (L) Load

	<ul style="list-style-type: none"> <li>Inductive load=0.75W/3H/300mA X3Nos.</li> </ul>
V.	3 Ph. Bidirectional power cum Energy meter panel
	<ul style="list-style-type: none"> <li>Bidirectional Multifunction</li> </ul>
	<ul style="list-style-type: none"> <li>3 Phase <math>\frac{3}{4}</math> wire, 415V CT Input 5A</li> </ul>
	<ul style="list-style-type: none"> <li>LCD/LED display, Aux. supply 230V, 45-65 Hz, 5W</li> </ul>
	<ul style="list-style-type: none"> <li>V, I, Hz, Pf, KVA, KW, KWh</li> </ul>
VI.	6 SCR Firing/Synchronizing Panel
	<ul style="list-style-type: none"> <li>Cosine firing scheme to facilitate linear control for better Harmonic ripple control.</li> </ul>
	<ul style="list-style-type: none"> <li>Cyclo converter frequency generator 25Hz/12.5Hz</li> </ul>
VII.	6 SCR/Diode Power Module
	<ul style="list-style-type: none"> <li>Consist of 6 SCR [Anode to body type] with PIV rating 1200V/25A.</li> </ul>
	<ul style="list-style-type: none"> <li>6 Diode with PIV rating of 1200V/16Amp</li> </ul>
	<ul style="list-style-type: none"> <li>6 No. of uncommitted Snubbers for protection of thyristors consisting of capacitor 0.1uF/1000V &amp; 100E/5W ceramic resistors.</li> </ul>
VIII.	DC Shunt Motor:
	1 HP, 1500RPM with spring balance loading arrangement. Armature = 440V DC, Field = 200V DC

## (C). ELECTRICAL MEASUREMENT LABORATORY

### 1. Kelvin's, Anderson's & Schering Bridge Kit:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- 1. Measurement of resistance using Kelvin's Bridge 2. Anderson's Bridge. 3. Schering Bridge.
II.	DC/AC Bridge circuit Experiment Panel
III.	Standalone panel with built in Power supply with Ammeter.
IV.	Provided with capacitors, resistor decades with multiplying range
V.	AC Bridge of test frequency of 1KHz.

## 2. Magnetic hysteresis loop tracer :

S. No.	Technical Specifications
I.	The set-up should accept the samples of thin wires of different diameters. The demagnetization effects, different diameters of samples and eddy currents (due to the conducting property of the material) have been taken into account within the design or graphically.
II.	Should able to see the B-H Loop, $dJ/dt$ Loop & $d^2J/dt^2$ Loop
III.	The following magnetic parameters should be measured by the set-up:
	• Coercivity
	• Retentivity
	• Saturation magnetization
	• Various magnetic phase identification
	• Hysteresis loss
IV.	The equipment should be complete in all respect, including a set of samples (wires of Nickel, and different grades of iron etc.)

## 3. Wein Bridge Oscillator using Op-Amp:

S. No.	Technical Specifications
I.	Built in +12V / 350mA DC Power Supply,
II.	Op-Amp (741) Wein Bridge Oscillator,
III.	Assembled in appropriate Box (Good quality) with proper Socket for test points & to see the waveforms.
	Set of Patch Chords & Experimental Manual.

## 4. TO MEASURE Q OF AN INDUCTION COIL AND VERIFY ITS VALUE USING PRECISION LCR -Q METER:

S. No.	Technical Specifications	
I.	Test Frequency	20Hz to 100 kHz (+/- 5% variation) or better.
II.	Basic Accuracy	+/-1%
III.	Test Speed	68 ms or better

IV.	Test Signal Levels	5 mV to 1.2 V (+/-1 % variation ) or better
V.	Display Ranges	Resistance (R): 0.00001 Ohms to 99999 kohms Capacitance (C): 0.00001 pf to 99999 $\mu$ f Inductance (L): 0.00001 mH to 99999 H Quality Factor (Q): 0.0001 to 9999 Dissipation Factor (D): 0.0001 to 9999
VI.	Equivalent Circuit	Parallel or series, selectable
VII.	Memory	80 or better memory blocks total
VIII.	Averaging	1 to 250 times or better
IX.	Test Speed	Slow, Medium, Fast
X.	Display Modes	Value, Delta, Delta %
XI.	Display	Dot matrix, back lighted LCD
XII.	Power Source	100 V to 240 V, 50/60 Hz
XIII.	Accessories	Power Cord, Instruction Manual, S-232/USB Interface, Includes Leads

#### (D). INSTRUMENT & MEASURING DEVICE LABORATORY:

##### 1. Potentiometer as an Error Detector :

S. No.	Technical Specifications
I.	High quality servo-potentiometers of 360° shaft rotation.
II.	To study the performance of a potentiometer type D.C. position error detector.
III.	Built-in signal and power sources
IV.	3½ digit DVM for measurements
V.	220V $\pm$ 10%, 50Hz mains operation
VI.	Should be with 30 MHz CRO for AC waveform studies
VII.	360° Mechanical, 355° Electrical span
VIII.	DC and AC operation
IX.	3½ Digital Panel Meter for all measurements

## 2. Measurement of Insulation Resistance by Megger :

S. No.	Technical Specifications
I.	Insulation testing up to 300 V and <100 G ohm
II.	Pass fail alarm
III.	Dual digital display

## 3. Measurement of Earth resistance by Earth Tester:

S. No.	Technical Specifications
I.	LCD display
II.	Measuring Resistance Range up to 2500 Ohm at < 1000 Hz or better.
III.	Long Battery life.
IV.	Operating temperature: 0 to 50 C
V.	Range +/-20mm, Resolution = 0.01 mm calibration bench with 20 mm micrometer

## 4. TEMPERATURE SENSING TRANSDUCERS:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- <ol style="list-style-type: none"> <li>Study of the characteristics of resistance temperature detection (RTD)</li> <li>Study of the characteristics of a Thermistor.</li> <li>Study of the characteristics of a Thermocouple.</li> </ol>
II.	Temperature Sensing Transducers with PT100, thermocouple J&K, thermister, Bimetalic relay, IC sensor in standalone mode. Built in heat bar / mini oven driven by Power amplifier of sufficient wattage.
III.	Temp. Selection upto 95 degree C in 5 degree ranges with ON / OFF Closed loop control.
IV.	Temperature sensors: Thermocouple J with room temperature calibration pot, Thermocouple K with room temperature calibration pot, Thermister (100K), PT100, IC sensor (AD 590), bimetallic switch.

### 5. Measurement of power factor and frequency of single phase and Three phase load Trainer:

S. No.	Technical Specifications
I.	Panel (table top) system, carrying various high voltages to minimize shock possibility
	Input 3 phase DOL Starter panel
	4 pole MCB of 415 V/2A.
	DOL 9A Contactor with 230V / 50 Hz / 11VA COIL.
	Bimetallic thermal O/L relay with range 1.4A - 2.3A.
II.	Integrated AC (1 phase) measurement panel
	Consist of 2 nos of Digital meters for V, I, PF (0.2 lag unity 0.2 lead), Hz.
III.	Integrated AC (3/1 phase) measurement panel
	Digital meter for measurement of 3Ø & 1Ø parameters.
	Voltage line to line & line to neutral.
	Current for all 3Ø up to 5A.
	Power factor, frequency, watts, VAR, VA and energy in Kwhr.
IV.	Potential Transformer [PT] Panel :
	Consists of 2 nos. of PTs (230V and 24V secondary or better), 200VA with both primary & secondary terminated at shrouded 4mm sockets.
	Null detection & balancing components
V.	Current Transformer [CT] Panel
	Consists of 2 nos. of CTs (5A and 1A secondary or better) with both primary & secondary terminated at shrouded 4mm sockets.
	Null detection & balancing components
VI.	Load panel: Resistive, Capacitive & Inductive Load Panel of wide range.

### 6. Tachometer:

S. No.	Technical Specifications
I.	Contact & Non - Contact type
II.	Measuring range: 0.001Hz to 30 Hz

III.	LCD display
IV.	Supply: 220V; 50 Hz
V.	Accuracy: 1%

## (E). CONTROL SYSTEM LABORATORY:

### 1. Potentiometer as an Error Detector :

S. No.	Technical Specifications
I.	AC/DC operations
II.	AC excitation at 800Hz approx
III.	3.5 digits DVM for carrying measurements
IV.	Separate test-points to observe waveforms (Sine, Triangular & Square) after each block
V.	Phase reversal of error in AC operation
VI.	Closed loop position control system
VII.	No. of Potentiometer : 2 nos.
VIII.	Type of Potentiometer : High quality 360° Shaft rotation 1° resolution Servo Potentiometer.
IX.	No. of DC geared motor : 1 no
X.	Motor Specification : DC 12 volt operated, 30 RPM
XI.	No. of gear set for shaft coupling: 1 no.
XII.	Gear ratio : 1:1
XIII.	Inbuilt Carrier Frequency : 200 – 800 Hz
XIV.	Potentiometer Excitation : +12 volts
XV.	Digital panel meter (DVM) : +20 & -20 volts display range
XVI.	Power Supply : 110-220 V,+ 10% 50 / 60 Hz

## 2. Synchro Transmitter & Receiver Trainer:

S. No.	Technical Specifications
I.	Calibrated dials for reference and output position
II.	Transformer Rating : 0V – 230V AC, +/-10%, 1 – 2 amp.
III.	Switch for transmitter and Receiver rotor supply
IV.	Synchro Transmitter and Receiver rotor terminals onboard : 35-115 VAC
V.	Synchro Transmitter and Receiver stator terminals onboard :30-90VAC
VI.	AC Voltmeter (0-350V) to measure stator and rotor voltages
VII.	Sensitive, linear, stable and accurate

## 3. Speed-Torque characteristics of an AC & DC Servo Motor Trainer:

S. No.	Technical Specifications
I.	Instrumentation Power supply cum Multichannel DPM panel:
	Multi channel DPM for digital display of parameters.
II.	IGBT/MOSFET power & sensing panel :
	<ul style="list-style-type: none"> <li>IGBT with isolated TTL compatible isolated driver circuit &amp; individual heat sink 4 nos.</li> </ul>
	<ul style="list-style-type: none"> <li>Current/voltage measurement DC.</li> </ul>
III.	DC Voltmeter & Ammeter panel :
	Voltmeter (300V-0-300V) & Ammeter (2A-0-2A)
IV.	Lamp load:
	230V /15/40/60/100W X 3 bulbs with individual ON/OFF using toggle switch.
	20E / 200W rheostat mounted on horizontal profile of rack
	AC & DC Servo Motors with process Setup.

#### 4. Speed control of an A.C. Servo Motor using a closed loop and an open loop system:

S. No.	Technical Specifications
I.	The Trainer should have feature of carrying various high voltage & minimize shock possibility.
II.	Instrumentation Power supply with DPM panel :
	<ul style="list-style-type: none"> <li>• +/-12 V, 500 mA (b) +5V, 300mA</li> </ul>
	<ul style="list-style-type: none"> <li>• Unregulated DC supply</li> </ul>
	<ul style="list-style-type: none"> <li>• Line synchronizing signal.</li> </ul>
III.	SCR Actuator/ Drive based (variable DC) :
	<ul style="list-style-type: none"> <li>• Full bridge SCR based 0V-195V / 12 Amp with linear characteristics.</li> </ul>
	<ul style="list-style-type: none"> <li>• Supports signal conditioning circuit for speed to give output 0-2.5Vdc (FS). This supply is required for DC Armature.</li> </ul>
	<ul style="list-style-type: none"> <li>• IGBT/MOSFET based Panel for variable PWM controlled power for armature supply.</li> </ul>
IV.	DC voltmeter and DC ammeter panel
	<ul style="list-style-type: none"> <li>• DC voltmeter (0-300V)</li> </ul>
	<ul style="list-style-type: none"> <li>• DC Ammeter 0-2A) with polarity protection diode</li> </ul>
	<ul style="list-style-type: none"> <li>• Field failure relay to control Armature supply.</li> </ul>
V.	A.C. servo Motor with process setup.

#### 5. Strain Gauge Transducers Trainer:

S. No.	Technical Specifications
I.	Piezo resistive transducer for strain measurement Micrometer 0-10/20mm (Accuracy 0.01mm) for strain generation
II.	Strain gauges in half & full Wheatstone bridge arrangement.
III.	Zero & span adjustment for calibration with instrumentation Amplifier.

IV.	Experiments on Gauge factor determination, $\mu$ Strain indicator, Displacement measurement using Strain gauges & cantilever.
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### 6. Lead-Lag compensator Trainer:

S. No.	Technical Specifications
I.	Simulated uncompensated system having adjustable damping peak percent overshoot $M_p$ variable from 20% to 50% and steady state error variable from 50% to 0.5%.
II.	Compensation network implementation through built-in variable gain amplifier. Gain is adjustable from 1 to 11.
III.	Built-in function generator (square & sine wave generators) for transient and frequency response studies. Frequency adjustable from 25Hz – 800Hz (approx.)
IV.	220V + 10% 50 Hz mains operation.
V.	A detailed instruction manual to be supplied.
VI.	Sockets & Patch cords: Terminal sockets should be provided on panel. Interconnections between the panels and components are made via stackable test leads.

## (F). ELECTRICAL MACHINE–I LABORATORY:

### 1. TRANSFORMER TRAINER:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- <ul style="list-style-type: none"> <li>1. Panel for load test on a single phase Transformer.</li> <li>2. Panel for Open circuit and short circuit tests on a single phase transformer and hence find equivalent Circuit, voltage regulation and efficiency.</li> <li>3. Panel for parallel operation of two single phase Transformers.</li> <li>4. Panel for studying the various connections of three Phase transformer.</li> </ul>
II.	The Trainer should have features to minimize shock possibility.
III.	The Trainer should be mounted on a light weight sturdy aluminum panel system
IV.	Should have Patch cord & socket arrangement for high voltage circuits
V.	Single phase Transformer specifications:

	<ul style="list-style-type: none"> <li>• Rating: 1KVA</li> <li>• Primary: 230VAC/4 - 5A, 50Hz or better</li> <li>• Secondary: 100 - 125VAC / 5- 10 Amp or better</li> </ul>
VI.	Three phase Transformer specifications:
	<ul style="list-style-type: none"> <li>• Rating: 1KVA</li> <li>• Primary: 3 Nos isolated primaries 0 - 415V/2.5 - 5Amp, 50Hz or better</li> <li>• Secondary: 3 Nos Isolated winding groups 100 -230V/ 4 – 10 Amp or better</li> </ul>
VII.	Digital meter (LED/LCD) should be fitted for display of voltage & current in appropriate nos.
VIII.	Load: Appropriate rating of resistive load should be supply.
IX.	List of panels :-
	i. Input 3 phase DOL starter panel
	ii. 3 Phase Bidirectional power cum Energy meter panel
	iii. Integrated (1 Phase) measurement panel
	iv. FWD/REV, Star-Delta starter panel
	v. 1 ph. AC Input Panel
	vi. AC voltmeter panel
	vii. AC Ammeter panel
	viii. Lamp Load Panel

## 2. Cut section model of DC Motor:

S. No.	Technical Specifications
I.	To study the constructional details of direct current (D.C.) machine and to draw sketches of different Components.
II.	Cut section model of DC Motor (2HP)
III.	Cut section model should be fitted with terminals, So it can be used as a motor.

### 3. DC MOTOR COUPLED TO DC MOTOR TRAINER:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- 1. Panel to measure armature and field resistance Of direct current (D.C.) shunt generator and to obtain its Open circuit characteristics. 2. Panel to obtain load characteristics of direct Current (D.C.) series/shunt generator. 3. Panel to perform Swinburne's test (no load test) to determine losses of direct current (D.C.) shunt Motor.
II.	The Trainer should make of good/standard material to minimise shock possibility.
III.	DC Power supply with DPM panel: 0V-200V /5 – 10 A with linear characteristics.
IV.	DC voltmeter, DC ammeter & wattmeter fitted on panel with digital display (LED/LCD)
V.	Resistor Load: Appropriate rating of resistive load should be supply.
VI.	Machine specifications: DC Machine rating: 1 HP with 1500rpm & should be come with belt pully arrangement for loading.
VII.	Should have Digital tachometer .

## (G). POWER SYSTEM LABORATORY:

### 1. TRANSMISSION LINE TRAINER:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- 1. Panel for the study of performance of a transmission Line. Also compute its ABCD parameters. 2. Panel for the study of the different types of faults on Transmission line demonstration panel/model
II.	The Trainer should be mounted on a light weight sturdy aluminum panel system
III.	Should have Patch cord & socket arrangement for high voltage circuits
IV.	Should have Digital Display
V.	It should have the following panels of appropriate rating:

1. Input 3 phase DOL Starter panel
2.FWD-OFF-REV, Switch Panel
3. Phase Bidirectional Power cum Energy meter panel
4. VAR Compensation panel (dual panel)
5. Transmission line Panel -:
<ul style="list-style-type: none"> <li>• Simulated model for transmission line using R,L,C</li> <li>• Simulated line for Pi and T model for medium/long length transmission</li> </ul>
6. RLC load panel with appropriate rating & min of 6 Taps.
7. 3 phase dimmer/variator panel

## 2. Study Characteristics of Over current and Earth Fault Relay Protection:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- Study Characteristics of Over current and Earth Fault Relay Protection.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	The Trainer should be mounted on a light weight sturdy aluminum panel system
IV.	Should have Patch cord & socket arrangement for high voltage circuits
V.	Should have Digital Display
VI.	It should have the following panels of appropriate rating:
	<ul style="list-style-type: none"> <li>• 1 phase AC Input supply panel</li> <li>• Variable voltage &amp; current injector panel</li> <li>• Over current &amp; elapsed time measurement panel</li> <li>• Over Current Relay Panel</li> <li>• Protection relay type (Numerical) : Should consist of numerical type IDMT over current relay,</li> </ul>

### 3. HRC FUSE AND MCB CHARACTERISTICS TRAINER:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:-
	1. Panel for the study the operating characteristics of Fuse. (HRC or open type)
	2. Panel for the study of characteristics of bimetal mini Circuit breakers.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	Inbuilt current injecting facility
IV.	Inbuilt digital display (LED/LCD)
V.	Control Power Supply & 1 Phase AC Distribution Panel
VI.	Fuse & MCB Panel:
	• Fuse – 2-6 Amp
	• MCB – 2-6 Amp
VII.	Consist of 1 phase dimmer 230VAC/50 Hz /1A.
VIII.	Short circuit transformer with primary 230VAC/1A
IX.	Appropriate functional blocks should be provided on panel board.

### 4. Directional Over current Protection Relay Trainer:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- Study of over current static relay.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	Should have Digital Display
IV.	Single phase AC Input supply panel Should consist of :
	• 1ph. MCBs.
	• Bulb Load/resistive load
V.	Variable voltage & current injector panel Should consist of:
	• 1 phase dimmer 230VAC/1A

	<ul style="list-style-type: none"> <li>Short circuit transformer with primary 230VAC/1A.</li> </ul>
VI.	Inbuilt digital display (LED/LCD)
VII.	Over Current Relay & Protection relay.

### 5. Under Voltage and Over Voltage relay Trainer:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- Study of the performance of under voltage & over voltage relay.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	Should have Digital Display
IV.	Input 3 phase DOL Starter panel
V.	Digital meter for AC parameters measurement. Determination of over voltage, under voltage, single phasing & reverse phasing / Displays OV, UV, SP, RP on digital display.
VI.	3-phase Dimmer panel: Table top 3 $\Phi$ phase dimmer panel should be provided with rating of 415VAC/
VII.	Phase sequence indicator should be provided.
VIII.	Under voltage relay & over voltage relay should be of standard make.

### 6. Distance Relay Characteristics Trainer:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- Study of the characteristics of distance relay.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	Should have Digital Display
IV.	Input 3 phase DOL Starter panel
V.	Single phase AC Input supply panel Should consist of : <ul style="list-style-type: none"> <li>1ph. MCBs</li> <li>Bulb Load/resistive load.</li> </ul>
VI.	3 Phase Bidirectional Energy meter panel Should consist of:

	<ul style="list-style-type: none"> <li>• Bidirectional Multifunction</li> <li>• 3 phase 3/4 wire, 415VAC, CT Input 5A</li> <li>• LCD/LED display.</li> <li>• V, I, Hz, Pf, KVA, KW, KWH.</li> </ul>
VII.	Distance Relay Panel
	All connection of relay should brought out on this panel & should consist of
	<ul style="list-style-type: none"> <li>• 2 NO Trip contacts, 1 NC Trip contacts, 1 NO Auto reclose contact.</li> <li>• Aux. Supply 230VAC.</li> </ul>
VIII.	CT panel should be on board.
IX.	Star/Star Step Down Transformer Panel should be on board.
X.	FWD-OFF-REV, Switch Panel
	Should consist of FWD/REV, 3 pole 3 way switch with center OFF, 6A/440V.
XI.	Protection relay type (Numerical) should be on board

## 7. Breakdown strength of transformer oil system:

S. No.	Technical Specifications
I.	Complete Setup For performing below experiments:- Study of Breakdown strength of transformer oil system.
II.	The Trainer should make of good/standard material to minimise shock possibility
III.	Should have Digital Display
IV.	Range : 0 — 60 KV Oil Test Kit
V.	Power Supply : 220V AC, 50Hz, Single Phase
VI.	Voltage Range : 0- 60 KV AC
VII.	Indication : Analog / Digital Voltmeter
VIII.	Transformer: 30 KV, 2 No. Epoxy molded transformer
IX.	Bushing : Epoxy molded bushings
X.	Rate of rise of Voltage (for Motorized): 1.2—2KV/Sec.
XI.	Resolution: 1KV

XII.	Accuracy: +/- 1%
XIII.	Safety Features:-
	<ul style="list-style-type: none"><li>• Zero Start Facility</li></ul>
	<ul style="list-style-type: none"><li>• Over Voltage Protection</li></ul>
	<ul style="list-style-type: none"><li>• Door Lock Safety</li></ul>
	<ul style="list-style-type: none"><li>• Auto cut-off at breakdown.</li></ul>

## TECHNICAL COMPLIANCE REPORT:

### (A). MICROCONTROLLER & PLC LABORATORY:

#### 1. 8051 Microcontroller Kit with LCD display

S. No.	Technical Specification	Numerical values or other specification	Whether comply Yes/No
I.	8051 with 16 X 2 LCD Display or better.		
II.	SMPS 5V/1.5 A, +12V, -12V		
III.	101 Keys PC AT/PS2 Keyboard		
IV.	RS232 Serial interface with Cable & PC up/down loading Software & Cross assembler on CD		
V.	RS232 port to USB connector		
VI.	CPU @ 20 MHz or better		
VII.	32K EPROM		
VIII.	16K/8K scratch pad RAM		
IX.	48 I/O Lines using 8255		
X.	3 Timer Counters using 8253		
XI.	RTC Interface		
XII.	Assembler and Disassembler		
XIII.	All address and data lines brought out on 50 Pin FRC connector		

#### 2. PLC TRAINER KIT:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	No of digital Input : 12		
II.	No of digital Output : 8		
III.	Program Size(Words) :1024		
IV.	Expansion Module : Expandable		

V.	Toggle Switches : 3 or More		
VI.	Latch Switches : 3 or More		
VII.	IR Switches : 2 or More		
VIII.	LED Display : 7 or More		
IX.	Boolean execution speed : 0.33 $\mu$ s/sequential instruction in Avg. or better		
X.	Interfacing : RS232/ RS485		
XI.	Interface Modules : Traffic control Module, Elevator Module, Conveyor Belt Module, Bottle Filling Module or more		
XII.	(With Appropriate configuration of reputed Computer & Software with supporting Operating System, Computer should be of HP/DELL/LENOVO)		
	• Processor: i5 – 6 <sup>th</sup> Generation		
	• RAM: 4GB		
	• Hard-disk: 500GB		

## (B). POWER ELECTRONICS & DRIVES LABORATORY

### 1. POWER ELECTRONICS TRAINER:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	<b>Complete Setup For performing below experiments:-</b> <ol style="list-style-type: none"> <li>1. Single Phase SCR convertor.</li> <li>2. UJT characteristics &amp; trigger circuit.</li> <li>3. Series inverter circuit.</li> <li>4. Single-phase cyclo- converter.</li> <li>5. McMurray Half/Full- bridge inverter.</li> </ol>		
II.	Mother Board:		
	Should have Built in power supply		
	DC supply : +/- 12V, 500mA,		

	Unregulated Power supply 17V / 750mA,		
	Regulated 13.5V/3A O/P must be provided as 12V Battery charging supply. In absence of battery, Same may be used as simulated battery source to run experiments on inverters etc.		
	Isolated DC supply +12V/ 300mA with isolated common.		
	AC supply: 230V AC line voltage must be made available on two banana 4mm sockets.		
	Panel consisting of: Must have Two pulse transformers of 1:1:1 are provided for isolation & supplying firing pulses along with required DC Power supply.		
III.	R-L-C Load Panel:		
	Must have Provision of R-L-C Loads.		
	On Board Power Devices: SCR, IGBT, MOSFET, UJT, DIAC, TRIAC, PUT		
	On Board Firing Circuit for Power Devices.		
IV.	Daughter Boards:		
	• Single Phase SCR convertor.		
	• UJT characteristics & trigger circuit.		
	• Series inverter circuit.		
	• Single-phase cyclo- converter.		
	• McMurray Half/Full- bridge inverter.		

## 2. Single phase full-wave and fully controlled bridge rectifier Kit:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Instrumentation Power supply cum Multi-channel DPM Panel:		
	• +/-12 V, 500 mA (b) +5V, 300mA		
	• Unregulated 17V dc/750 mA		
	• Line synchronizing signal.		
	• Multi channel DPM for digital display		

	of speed, etc.		
II.	SCR Actuator (variable DC) cum sensor signal conditioning Panel :		
	<ul style="list-style-type: none"> <li>Full bridge SCR based 0V-195V / 12 Amp cosine firing with Linear characteristics.</li> </ul>		
	<ul style="list-style-type: none"> <li>Supports signal conditioning circuit for speed to give output 0-2.5Vdc (FS).</li> </ul>		
	<ul style="list-style-type: none"> <li>2 Nos. of these supplies required for DC Armature &amp; DC motor field.</li> </ul>		
III.	DC voltmeter and DC ammeter panel :		
	<ul style="list-style-type: none"> <li>DC voltmeter (0-300V) or better</li> </ul>		
	<ul style="list-style-type: none"> <li>DC Ammeter (0-5A) or better with polarity protection diode</li> </ul>		
	<ul style="list-style-type: none"> <li>Field failure relay to control Armature supply.</li> </ul>		
IV.	DC Integrated Motor:-		
	180V/300W/1500RPM or better with series shunt and compound windings, Chasis mounted table top with spring balance loading arrangement [10kg or better] and Electronic Tacho: 1V/1000RPM. Electrical Tacho: 10V/1000RPM.		

### 3. Microcontroller based firing control Kit :

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Training system should built in AC/DC Power Supply & On board firing circuit based on Microcontroller 8051.		
II.	Output waveform should be observed on Test points.		
III.	Should have LCD display.		
IV.	Sockets to make different connections with appropriate interface.		
V.	SCR assembly, pulse transformer and load should be onboard.		

#### 4. Three phase fully controlled bridge converter Kit:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Input 3 phase DOL Starter panel		
	<ul style="list-style-type: none"> <li>4 Pole MCB of 415V/4A.</li> </ul>		
	<ul style="list-style-type: none"> <li>DOL 9A contactor with 230V/50Hz/11VA COIL.</li> </ul>		
	<ul style="list-style-type: none"> <li>Bimetallic thermal O/L relay with range 1.4A-2.3A.</li> </ul>		
II.	DC voltmeter and DC ammeter panel		
	<ul style="list-style-type: none"> <li>DC voltmeter (0-600V) or better</li> </ul>		
	<ul style="list-style-type: none"> <li>DC Ammeter (0-5A) or better with polarity protection diode</li> </ul>		
III.	Lamp Load		
	<ul style="list-style-type: none"> <li>230V/15/40/60/100W X3 bulbs with individual ON/OFF using 6A toggle switch.</li> </ul>		
IV.	Inductive (L) Load		
	<ul style="list-style-type: none"> <li>Inductive load=0.75W/3H/300mAX3Nos.</li> </ul>		
V.	3 Ph. Bidirectional power cum Energy meter panel		
	<ul style="list-style-type: none"> <li>Bidirectional Multifunction</li> </ul>		
	<ul style="list-style-type: none"> <li>3 Phase <math>\frac{3}{4}</math> wire, 415V CT Input 5A</li> </ul>		
	<ul style="list-style-type: none"> <li>LCD/LED display, Aux. supply 230V, 45-65 Hz, 5W</li> </ul>		
	<ul style="list-style-type: none"> <li>V, I, Hz, Pf, KVA, KW, KWh</li> </ul>		
VI.	6 SCR Firing/Synchronizing Panel		
	<ul style="list-style-type: none"> <li>Cosine firing scheme to facilitate linear control for better Harmonic ripple control.</li> </ul>		
	<ul style="list-style-type: none"> <li>Cyclo converter frequency generator 25Hz/12.5Hz</li> </ul>		
VII.	6 SCR/Diode Power Module		

	<ul style="list-style-type: none"> <li>Consist of 6 SCR [Anode to body type] with PIV rating 1200V/25A.</li> </ul>		
	<ul style="list-style-type: none"> <li>6 Diode with PIV rating of 1200V/16Amp</li> </ul>		
	<ul style="list-style-type: none"> <li>6 No. of uncommitted Snubbers for protection of thyristors consisting of capacitor 0.1uF/1000V &amp; 100E/5W ceramic resistors.</li> </ul>		
VIII.	DC Shunt Motor:		
	1 HP, 1500RPM with spring balance loading arrangement. Armature = 440V DC, Field = 200V DC		

### (C). ELECTRICAL MEASUREMENT LABORATORY

#### 1. Kelvin's, Anderson's & Schering Bridge Kit:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- 1. Measurement of resistance using Kelvin's Bridge 2. Anderson's Bridge. 3. Schering Bridge.		
II.	DC/AC Bridge circuit Experiment Panel		
III.	Standalone panel with built in Power supply with Ammeter.		
IV.	Provided with capacitors, resistor decades with multiplying range		
V.	AC Bridge of test frequency of 1KHz.		

#### 2. Magnetic hysteresis loop tracer :

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	The set-up should accept the samples of thin wires of different diameters. The demagnetization effects, different diameters of samples and eddy currents (due to the		

	conducting property of the material) have been taken into account within the design or graphically.		
II.	Should able to see the B-H Loop, dJ/dt Loop & d <sup>2</sup> J/dt <sup>2</sup> Loop		
III.	The following magnetic parameters should be measured by the set-up:		
	• Coercivity		
	• Retentivity		
	• Saturation magnetization		
	• Various magnetic phase identification		
	• Hysteresis loss		
IV.	The equipment should be complete in all respect, including a set of samples (wires of Nickel, and different grades of iron etc.)		

### 3. Wein Bridge Oscillator using Op-Amp:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Built in +12V / 350mA DC Power Supply,		
II.	Op-Amp (741) Wein Bridge Oscillator,		
III.	Assembled in appropriate Box (Good quality) with proper Socket for test points & to see the waveforms.		
	Set of Patch Chords & Experimental Manual.		

### 4. TO MEASURE Q OF AN INDUCTION COIL AND VERIFY ITS VALUE USING PRECISION LCR -Q METER:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Test Frequency	20Hz to 100 kHz (+/- 5% variation) or better.	
II.	Basic Accuracy	+1%	
III.	Test Speed	68 ms or better	

IV.	Test Signal Levels	5 mV to 1.2 V (+/-1 % variation ) or better		
V.	Display Ranges	Resistance (R): 0.00001 Ohms to 99999 kohms Capacitance (C): 0.00001 pf to 99999 $\mu$ f Inductance (L): 0.00001 mH to 99999 H Quality Factor (Q): 0.0001 to 9999 Dissipation Factor (D): 0.0001 to 9999		
VI.	Equivalent Circuit	Parallel or series, selectable		
VII.	Memory	80 or better memory blocks total		
VIII.	Averaging	1 to 250 times or better		
IX.	Test Speed	Slow, Medium, Fast		
X.	Display Modes	Value, Delta, Delta %		
XI.	Display	Dot matrix, back lighted LCD		
XII.	Power Source	100 V to 240 V, 50/60 Hz		
XIII.	Accessories	Power Cord, Instruction Manual, S-232/USB Interface, Includes Leads		

#### (D). INSTRUMENT & MEASURING DEVICE LABORATORY:

##### 1. Potentiometer as an Error Detector :

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	High quality servo-potentiometers of 360° shaft rotation.		
II.	To study the performance of a potentiometer type D.C. position error detector.		
III.	Built-in signal and power sources		
IV.	3½ digit DVM for measurements		
V.	220V $\pm$ 10%, 50Hz mains operation		

VI.	Should be with 30 MHz CRO for AC waveform studies		
VII.	360° Mechanical, 355° Electrical span		
VIII.	DC and AC operation		
IX.	3½ Digital Panel Meter for all measurements		

## 2. Measurement of Insulation Resistance by Megger :

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Insulation testing up to 300 V and <100 G ohm		
II.	Pass fail alarm		
III.	Dual digital display		

## 3. Measurement of Earth resistance by Earth Tester:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	LCD display		
II.	Measuring Resistance Range up to 2500 Ohm at < 1000 Hz or better.		
III.	Long Battery life.		
IV.	Operating temperature: 0 to 50 C		
V.	Range +/-20mm, Resolution = 0.01 mm calibration bench with 20 mm micrometer		

## 4. TEMPERATURE SENSING TRANSDUCERS:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:-		
	<ul style="list-style-type: none"> <li>Study of the characteristics of resistance temperature detection (RTD)</li> </ul>		
	<ul style="list-style-type: none"> <li>Study of the characteristics of a Thermistor.</li> </ul>		

	<ul style="list-style-type: none"> <li>Study of the characteristics of a Thermocouple.</li> </ul>		
II.	Temperature Sensing Transducers with PT100, thermocouple J&K, thermister, Bimetallic relay, IC sensor in standalone mode. Built in heat bar / mini oven driven by Power amplifier of sufficient wattage.		
III.	Temp. Selection upto 95 degree C in 5 degree ranges with ON / OFF Closed loop control.		
IV.	Temperature sensors: Thermocouple J with room temperature calibration pot, Thermocouple K with room temperature calibration pot, Thermister (100K), PT100, IC sensor (AD 590), bimetallic switch.		

#### 5. Measurement of power factor and frequency of single phase and Three phase load Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Panel (table top) system, carrying various high voltages to minimize shock possibility		
	Input 3 phase DOL Starter panel		
	4 pole MCB of 415 V/2A.		
	DOL 9A Contactor with 230V / 50 Hz / 11VA COIL.		
	Bimetallic thermal O/L relay with range 1.4A - 2.3A.		
II.	Integrated AC (1 phase) measurement panel		
	Consist of 2 nos of Digital meters for V, I, PF (0.2 lag unity 0.2 lead), Hz.		
III.	Integrated AC (3/1 phase) measurement panel		
	Digital meter for measurement of 3Ø & 1Ø parameters.		
	Voltage line to line & line to neutral.		
	Current for all 3Ø up to 5A.		
	Power factor, frequency, watts, VAR, VA and energy in Kwhr.		

IV.	Potential Transformer [PT] Panel :		
	Consists of 2 nos. of PTs (230V and 24V secondary or better), 200VA with both primary & secondary terminated at shrouded 4mm sockets.		
	Null detection & balancing components		
V.	Current Transformer [CT] Panel		
	Consists of 2 nos. of CTs (5A and 1A secondary or better) with both primary & secondary terminated at shrouded 4mm sockets.		
	Null detection & balancing components		
VI.	Load panel: Resistive, Capacitive & Inductive Load Panel of wide range.		

#### 6. Tachometer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Contact & Non - Contact type		
II.	Measuring range: 0.001Hz to 30 Hz		
III.	LCD display		
IV.	Supply: 220V; 50 Hz		
V.	Accuracy: 1%		

### (E). CONTROL SYSTEM LABORATORY:

#### 1. Potentiometer as an Error Detector :

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	AC/DC operations		
II.	AC excitation at 800Hz approx		
III.	3.5 digits DVM for carrying measurements		
IV.	Separate test-points to observe waveforms (Sine, Triangular & Square) after each block		

V.	Phase reversal of error in AC operation		
VI.	Closed loop position control system		
VII.	No. of Potentiometer :2 nos.		
VIII.	Type of Potentiometer :High quality 360° Shaft rotation 1° resolution Servo Potentiometer.		
IX.	No. of DC geared motor :1 no		
X.	Motor Specification :DC 12 volt operated, 30 RPM		
XI.	No. of gear set for shaft coupling:1 no.		
XII.	Gear ratio :1:1		
XIII.	Inbuilt Carrier Frequency :200 – 800 Hz		
XIV.	Potentiometer Excitation :+12 volts		
XV.	Digital panel meter (DVM) :+20 & -20 volts display range		
XVI.	Power Supply :110-220 V,+ 10% 50 / 60 Hz		

## 2. Synchro Transmitter & Receiver Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Calibrated dials for reference and output position		
II.	Transformer Rating : 0V – 230V AC, +/- 10%, 1 – 2 amp.		
III.	Switch for transmitter and Receiver rotor supply		
IV.	Synchro Transmitter and Receiver rotor terminals onboard : 35-115 VAC		

V.	Synchro Transmitter and Receiver stator terminals onboard :30-90VAC		
VI.	AC Voltmeter (0-350V) to measure stator and rotor voltages		
VII.	Sensitive, linear, stable and accurate		

### 3. Speed-Torque characteristics of an AC & DC Servo Motor Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Instrumentation Power supply cum Multichannel DPM panel:		
	Multi channel DPM for digital display of parameters.		
II.	IGBT/MOSFET power & sensing panel :		
	<ul style="list-style-type: none"> <li>IGBT with isolated TTL compatible isolated driver circuit &amp; individual heat sink 4 nos.</li> </ul>		
	<ul style="list-style-type: none"> <li>Current/voltage measurement DC.</li> </ul>		
III.	DC Voltmeter & Ammeter panel :		
	Voltmeter (300V-0-300V) & Ammeter (2A-0-2A)		
IV.	Lamp load:		
	230V /15/40/60/100W X 3 bulbs with individual ON/OFF using toggle switch.		
	20E / 200W rheostat mounted on horizontal profile of rack		
	AC & DC Servo Motors with process Setup.		

### 4. Speed control of an A.C. Servo Motor using a closed loop and an open loop system:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	The Trainer should have feature of carrying various high voltage & minimize shock possibility.		
II.	Instrumentation Power supply with DPM		

	panel :		
	<ul style="list-style-type: none"> <li>+/-12 V, 500 mA (b) +5V, 300mA</li> </ul>		
	<ul style="list-style-type: none"> <li>Unregulated DC supply</li> </ul>		
	<ul style="list-style-type: none"> <li>Line synchronizing signal.</li> </ul>		
	<ul style="list-style-type: none"> <li>DPM for digital display of speed, etc.</li> </ul>		
III.	SCR Actuator/ Drive based (variable DC) :		
	<ul style="list-style-type: none"> <li>Full bridge SCR based 0V-195V / 12 Amp with linear characteristics.</li> </ul>		
	<ul style="list-style-type: none"> <li>Supports signal conditioning circuit for speed to give output 0-2.5Vdc (FS). This supply is required for DC Armature.</li> </ul>		
	<ul style="list-style-type: none"> <li>IGBT/MOSFET based Panel for variable PWM controlled power for armature supply.</li> </ul>		
IV.	DC voltmeter and DC ammeter panel		
	<ul style="list-style-type: none"> <li>DC voltmeter (0-300V)</li> </ul>		
	<ul style="list-style-type: none"> <li>DC Ammeter 0-2A) with polarity protection diode</li> </ul>		
	<ul style="list-style-type: none"> <li>Field failure relay to control Armature supply.</li> </ul>		
V.	A.C. servo Motor with process setup.		

### 5. Strain Gauge Transducers Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Piezo resistive transducer for strain measurement Micrometer 0-10/20mm (Accuracy 0.01mm) for strain generation		
II.	Strain gauges in half & full Wheatstone		

	bridge arrangement.		
III.	Zero & span adjustment for calibration with instrumentation Amplifier.		
IV.	Experiments on Gauge factor determination, $\mu$ Strain indicator, Displacement measurement using Strain gauges & cantilever.		

## 6. Lead-Lag compensator Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Simulated uncompensated system having adjustable damping peak percent overshoot $M_p$ variable from 20% to 50% and steady state error variable from 50% to 0.5%.		
II.	Compensation network implementation through built-in variable gain amplifier. Gain is adjustable from 1 to 11.		
III.	Built-in function generator (square & sine wave generators) for transient and frequency response studies. Frequency adjustable from 25Hz – 800Hz (approx.)		
IV.	220V + 10% 50 Hz mains operation.		
V.	A detailed instruction manual to be supplied.		
VI.	Sockets & Patch cords: Terminal sockets should be provided on panel. Interconnections between the panels and components are made via stackable test leads.		

## (F). ELECTRICAL MACHINE–I LABORATORY:

### 1. TRANSFORMER TRAINER:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:-		
	1. Panel for load test on a single phase		

	Transformer.		
	2. Panel for Open circuit and short circuit tests on a single phase transformer and hence find equivalent Circuit, voltage regulation and efficiency.		
	3. Panel for parallel operation of two single phase Transformers.		
	4. Panel for studying the various connections of three Phase transformer.		
II.	The Trainer should have features to minimize shock possibility.		
III.	The Trainer should be mounted on a light weight sturdy aluminum panel system		
IV.	Should have Patch cord & socket arrangement for high voltage circuits		
V.	Single phase Transformer specifications:		
	• Rating: 1KVA		
	• Primary: 230VAC/4 - 5A, 50Hz or better		
	• Secondary: 100 - 125VAC / 5- 10 Amp or better		
VI.	Three phase Transformer specifications:		
	• Rating: 1KVA		
	• Primary: 3 Nos isolated primaries 0 - 415V/2.5 - 5Amp, 50Hz or better		
	• Secondary: 3 Nos Isolated winding groups 100 -230V/ 4 – 10 Amp or better		
VII.	Digital meter (LED/LCD) should be fitted for display of voltage & current in appropriate nos.		
VIII.	Load: Appropriate rating of resistive load should be supply.		
IX.	List of panels :-		
	I. Input 3 phase DOL starter panel		
	II. 3 Phase Bidirectional power cum		

	Energy meter panel		
III.	Integrated (1 Phase) measurement panel		
IV.	FWD/REV, Star-Delta starter panel		
V.	1 ph. AC Input Panel		
VI.	AC voltmeter panel		
VII.	AC Ammeter panel		
VIII.	Lamp Load Panel		

## 2. Cut section model of DC Motor:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	To study the constructional details of direct current (D.C.) machine and to draw sketches of different Components.		
II.	Cut section model of DC Motor (2HP)		
III.	Cut section model should be fitted with terminals, So it can be used as a motor.		

## 3. DC MOTOR COUPLED TO DC MOTOR TRAINER:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:-		
	1. Panel to measure armature and field resistance Of direct current (D.C.) shunt generator and to obtain its Open circuit characteristics.		
	2. Panel to obtain load characteristics of direct Current (D.C.) series/shunt generator.		
	3. Panel to perform Swinburne's test (no load test) to determine losses of direct current		

	(D.C.) shunt Motor.		
II.	The Trainer should make of good/standard material to minimise shock possibility.		
III.	DC Power supply with DPM panel: 0V-200V /5 – 10 A with linear characteristics.		
IV.	DC voltmeter, DC ammeter & wattmeter fitted on panel with digital display (LED/LCD)		
V.	Resistor Load: Appropriate rating of resistive load should be supply.		
VI.	Machine specifications: DC Machine rating: 1 HP with 1500rpm & should be come with belt pully arrangement for loading.		
VII.	Should have Digital tachometer.		

## (G). POWER SYSTEM LABORATORY:

### 1. TRANSMISSION LINE TRAINER:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:-		
	1. Panel for the study of performance of a transmission Line. Also compute its ABCD parameters.		
	2. Panel for the study of the different types of faults on Transmission line demonstration panel/model		
II.	The Trainer should make of good/standard material to minimise shock possibility		
III.	The Trainer should be mounted on a light weight sturdy aluminum panel system		
	Should have Patch cord & socket arrangement for high voltage circuits		
	Should have Digital Display		
IV.	It should have the following panels of appropriate rating:		
	1. Input 3 phase DOL Starter panel		
	2.FWD-OFF-REV, Switch Panel		
	3. Phase Bidirectional Power cum Energy meter panel		

	4. VAR Compensation panel (dual panel)		
	5. Transmission line Panel :-		
	<ul style="list-style-type: none"> <li>Simulated model for transmission line using R,L,C</li> </ul>		
	<ul style="list-style-type: none"> <li>Simulated line for Pi and T model for medium/long length transmission</li> </ul>		
	6. RLC load panel with appropriate rating & min of 6 Taps.		
	7. 3 phase dimmer/variatic panel		

## 2. Study Characteristics of Over current and Earth Fault Relay Protection:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- Study Characteristics of Over current and Earth Fault Relay Protection.		
II.	The Trainer should make of good/standard material to minimise shock possibility		
III.	The Trainer should be mounted on a light weight sturdy aluminum panel system		
IV.	Should have Patch cord & socket arrangement for high voltage circuits		
V.	Should have Digital Display		
VI.	It should have the following panels of appropriate rating:		
	<ul style="list-style-type: none"> <li>1 phase AC Input supply panel</li> </ul>		
	<ul style="list-style-type: none"> <li>Variable voltage &amp; current injector panel</li> </ul>		
	<ul style="list-style-type: none"> <li>Over current &amp; elapsed time measurement panel</li> </ul>		
	<ul style="list-style-type: none"> <li>Over Current Relay Panel</li> </ul>		
	<ul style="list-style-type: none"> <li>Protection relay type (Numerical) : Should consist of numerical type IDMT over current relay,</li> </ul>		

### 3. HRC FUSE AND MCB CHARACTERISTICS TRAINER:

S. No.	Technical Specifications		
I.	Complete Setup For performing below experiments:-		
	1. Panel for the study the operating characteristics of Fuse. (HRC or open type)		
	2. Panel for the study of characteristics of bimetal mini Circuit breakers.		
II.	The Trainer should make of good/standard material to minimise shock possibility		
III.	Inbuilt current injecting facility		
IV.	Inbuilt digital display (LED/LCD)		
V.	Control Power Supply & 1 Phase AC Distribution Panel		
VI.	Fuse & MCB Panel:		
	• Fuse – 2-6 Amp		
	• MCB – 2-6 Amp		
VII.	Consist of 1 phase dimmer 230VAC/50 Hz /1A.		
VIII.	Short circuit transformer with primary 230VAC/1A		
IX.	Appropriate functional blocks should be provided on panel board.		

### 4. Directional over current Protection Relay Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- Study of over current static relay.		
II.	The Trainer should make of good/standard material to minimize shock possibility		

III.	Should have digital display.		
IV.	Single phase AC Input supply panel Should consist of :		
	• 1ph. MCBs.		
	• Bulb Load/resistive load		
V.	Variable voltage & current injector panel Should consist of:		
	• 1 phase dimmer 230VAC/1A		
	• Short circuit transformer with primary 230VAC/1A.		
VI.	Inbuilt digital display (LED/LCD)		
VII.	Over Current Relay & Protection relay.		

#### 5. Under Voltage and Over Voltage relay Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- Study of the performance of under voltage & over voltage relay.		
II.	The Trainer should make of good/standard material to minimize shock possibility		
III.	Should have digital display.		
IV.	Input 3 phase DOL Starter panel		
V.	Digital meter for AC parameters measurement. Determination of over voltage, under voltage, single phasing & reverse phasing / Displays OV, UV, SP, RP on digital display.		
VI.	3-phase Dimmer panel: Table top 3 $\Phi$ phase dimmer panel should be provided with rating of 415VAC/		
VII.	Phase sequence indicator should be provided.		
VIII.	Under voltage relay & over voltage relay should be of standard make.		

## 6. Distance Relay Characteristics Trainer:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- Study of the characteristics of distance relay.		
II.	The Trainer should make of good/standard material to minimize shock possibility		
III.	Should have digital display.		
IV.	Input 3 phase DOL Starter panel		
V.	Single phase AC Input supply panel Should consist of :		
	• 1ph. MCBs		
	• Bulb Load/resistive load.		
VI.	3 Phase Bidirectional Energy meter panel Should consist of:		
	• Bidirectional Multifunction		
	• 3 phase 3/4 wire, 415VAC, CT Input 5A		
	• LCD/LED display.		
	• V, I, Hz, Pf, KVA, KW, KWH.		
VII.	Distance Relay Panel		
	All connection of relay should brought out on this panel & should consist of		
	• 2 NO Trip contacts, 1 NC Trip contacts, 1 NO Auto reclose contact.		
	• Aux. Supply 230VAC.		
VIII.	CT panel should be on board.		
IX.	Star/Star Step Down Transformer Panel should be on board.		
X.	FWD-OFF-REV, Switch Panel		
	Should consist of FWD/REV, 3 pole 3 way switch with center OFF, 6A/440V.		
XI.	Protection relay type (Numerical) should be on board		

### 7. Breakdown strength of transformer oil system:

S. No.	Technical Specifications	Numerical values or other specification	Whether comply Yes/No
I.	Complete Setup For performing below experiments:- Study of Breakdown strength of transformer oil system.		
II.	The Trainer should make of good/standard material to minimize shock possibility		
III.	Should have digital display.		
IV.	Range : 0 — 60 KV Oil Test Kit		
V.	Power Supply : 220V AC, 5 0Hz, Single Phase		
VI.	Voltage Range : 0- 60 KV AC		
VII.	Indication : Analog / Digital Voltmeter		
VIII.	Transformer: 30 KV, 2 No. Epoxy molded transformer		
IX.	Bushing : Epoxy molded bushings		
X.	Rate of rise of Voltage (for Motorized): 1.2—2KV/Sec.		
XI.	Resolution: 1KV		
XII.	Accuracy: +/- 1%		
XIII.	Safety Features:-		
	• Zero Start Facility		
	• Over Voltage Protection		
	• Door Lock Safety		
	• Auto cut-off at breakdown.		

**ANEXURE-VI**
**DETAILS OF EQUIPMENTS TO BE SUPPLIED AT VARIOUS IKGPTU CAMPUSES:**

S. NO	NAME OF THE EQUIPMENT	BATALA	TOTAL QUANTITY
<b>A.</b>	<b>MICROCONTROLLER &amp; PLC LABORATORY:</b>		
1.	8051 Microcontroller Kit with LCD display	3	3
2.	PLC TRAINER KIT	1	1
<b>B.</b>	<b>POWER ELECTRONICS &amp; DRIVES LABORATORY</b>		
1.	POWER ELECTRONICS TRAINER	3	3
2.	Single phase full-wave and fully controlled bridge rectifier Kit	2	2
3.	Microcontroller based firing control Kit	1	1
4.	Three phase fully controlled bridge converter Kit	2	2
<b>C.</b>	<b>ELECTRICAL MEASUREMENT LABORATORY</b>		
1.	Kelvin's, Anderson's & Schering Bridge Kit	2	2
2.	Magnetic hysteresis loop tracer	2	2
3.	Wein Bridge Oscillator using Op-Amp	2	2
4.	TO MEASURE Q OF AN INDUCTION COIL AND VERIFY ITS VALUE USING PRESICION LCR -Q METER	1	1
<b>D.</b>	<b>INSTRUMENT &amp; MEASURING DEVICE LABORATORY</b>		
1.	Potentiometer as an Error Detector	2	2
2.	Measurement of Insulation Resistance by Megger	2	2
3.	Measurement of Earth resistance by Earth Tester	2	2
4.	TEMPERATURE SENSING TRANSDUCERS	2	2
5.	Measurement of power factor and frequency of single phase and Three phase load Trainer	2	2

6.	Tachometer	2	2
<b>E.</b>	<b>CONTROL SYSTEM LABORATORY</b>		
1.	Potentiometer as an Error Detector	2	2
2.	Synchro Transmitter & Receiver Trainer	1	1
3.	Speed-Torque characteristics of an AC & DC Servo Motor Trainer	1	1
4.	Speed control of an A.C. Servo Motor using a closed loop and an open loop system	1	1
5.	Strain Gauge Transducers Trainer	2	2
6.	Lead-Lag compensator Trainer	1	1
<b>F.</b>	<b>ELECTRICAL MACHINE-I LABORATORY</b>		
1.	TRANSFORMER TRAINER	2	2
2.	Cut section model of DC Motor	1	1
3.	DC MOTOR COUPLED TO DC MOTOR TRAINER	2	2
<b>G.</b>	<b>POWER SYSTEM LABORATORY</b>		
1.	TRANSMISSION LINE TRAINER	1	1
2.	Study Characteristics of Over current and Earth Fault Relay Protection	1	1
3.	HRC FUSE AND MCB CHARACTERISTICS TRAINER	1	1
4.	Directional Over current Protection Relay Trainer	1	1
5.	Under Voltage and Over Voltage relay Trainer	1	1
6.	Distance Relay Characteristics Trainer	1	1
7.	Breakdown strength of transformer oil system	1	1